Enhancing the Medical Selection Process of Blood Donors: Examining the Correlation between Body Mass Index and Hemoglobin Levels

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Abstract

Medical selection of blood donors is the first link in the transfusion safety chain. It enables us to identify any factors which might temporarily or permanently render a person unfit to donate blood. Indeed, blood donation safety is a crucial issue worldwide. In response to this situation, the World Health Organization (WHO) has taken initiatives. Côte d'Ivoire has joined them; however, shortcomings persist, particularly in the medical selection of blood donors. This study was carried out to determine the existence of a correlation between BMI and hemoglobin levels in blood donors at the Yamoussoukro Regional Blood Transfusion Centre. This analytical study took place at the Yamoussoukro Regional Blood Transfusion Center (CTS). It was carried out from March 15 to June 15, 2021. Old and new blood donors from the 2020 fixed blood drive at the said site were recruited according to inclusion and exclusion criteria. Data were extracted from the PROGESA database of the Centre National de Transfusion Sanguine de Côte d'Ivoire (CNTSCI). The 525 blood donors in the study were divided into 475 males (90%) and 50 females (10%). There was no correlation between BMI and hemoglobin. On the other hand, an assessment of nutritional status revealed that 316 blood donors (60%) were in good nutritional condition, 29 were underweight (5.5%) and 39 were obese (7.4%), including 13 (2%) who were severely obese. Apart from the lack of correlation between BMI and hemoglobin levels, this study highlights the need to introduce nutritional assessment into the medical selection criteria for blood donors in Côte d'Ivoire.

Keywords

Blood Donation, Medical Screening, Body Mass Index, Nutritional Assessment, Hemoglobin, Yamoussoukro, Ivory Coast

1. Introduction

The process of medically screening blood donors represents the initial measure in ensuring the safety of transfusions. This process is essential for identifying factors that could temporarily or permanently disqualify an individual from donating blood [1].

The global significance of ensuring safe blood donations cannot be overstated [2].

In light of this challenge, several measures have been introduced: for instance, the World Health Organization (WHO) issued guidelines in 1975 [3] and again in 1984 [4] aimed at enhancing transfusion services by formulating and executing national blood transfusion policies to optimize safety.

In alignment with these objectives, Côte d'Ivoire, through its National Blood Transfusion Center (NBTC), has developed a regulatory framework comprising two legislative texts that regulate blood transfusion practices: Decree No. 91-653 dated October 9, 1991, which established and organized the NBTC, and Law No. 93-672 dated August 9, 1993, concerning therapeutic substances of human origin [5] [6].

Remarkable progress has been noted; according to the World Health Organization (WHO) report, in many developed countries, including those within the European Union, there is a legal mandate to report adverse and serious reactions and events to the regulatory authorities [7]. In contrast, in Africa, only 17 out of 43 countries have reported having a national hemovigilance system [7]. Despite the observed advancements, substantial work remains to be carried out regarding the medical screening of blood donors. Côte d'Ivoire is also addressing these issues. Research conducted by the Francophone Africa transfusion research group, along with a 2008 WHO report on African regions, has highlighted deficiencies in the medical screening of healthy donors [8]. Additionally, Côte d'Ivoire established a hemovigilance service in 2009 [6]; however, it was not until 2018 that the implementation of the traceability and reporting of Adverse Transfusion Effects (ATE) was completed [6].

The lack of revised medical selection criteria is the reason behind the choice of nutritional assessment, which is not one of the selection criteria for blood donors in Côte d'Ivoire [5]. Another reason is the number of obese, sometimes severe, or underweight subjects among blood donation candidates deemed suitable at blood drives.

Furthermore, a review of the literature, particularly findings from the study by Jaffuel *et al.*, has indicated that maintaining a normal nutritional status is crucial

for recovery from severe illnesses [9].

Considering the impact of nutrition on blood quality, this study, in addition to assessing the scale of the problem, will determine the existence of a correlation between BMI and hemoglobin levels among blood donors at the Yamoussoukro Regional Blood Transfusion Center, with a view to reinforcing blood donor safety.

2. Materials and Methods

2.1. Study Design and Population

The selection of the Regional Blood Transfusion Center in Yamoussoukro as the study site was deliberate, as this setting exhibited cases of underweight and obesity, including instances of morbid obesity, among individuals deemed eligible for blood donation.

The study was of an analytical nature and took place between March 15 and June 15, 2021.

The study population comprised blood donors from the fixed collection, totaling 525 individuals, at the Regional Blood Transfusion Center (CRTS) of Yamoussoukro. These participants were registered in the PROGESA database maintained by the National Blood Transfusion Center of Côte d'Ivoire (CNTSCI) during the year 2020.

The selection of participants was based on the following criteria.

▪ **Inclusion Criteria**

Qualified participants included:

- Any individual who donated blood at least once at the permanent donation center of the Regional Blood Transfusion Center (CRTS) in Yamoussoukro during the year 2020.
- Any individual whose information is documented in the PROGESA database of the National Blood Transfusion Center (CNTSCI) of Côte d'Ivoire.

▪ **Exclusion Criteria**

Excluded were blood donors listed in the PROGESA database of the CNTSCI with missing weight and/or height data.

2.2. Data Collection

Data were retrieved from the PROGESA database of the National Blood Transfusion Center of Côte d'Ivoire (CNTSCI). The collection process involved a questionnaire divided into three sections.

- Sociodemographic characteristics and history of blood donations.
- Anthropometric measurements.
- Biological indicators.

For the evaluation of nutritional status, the body mass index (BMI) was selected based on World Health Organization (WHO) guidelines [1].

The questionnaire employed in the study is the medical consultation form of the National Blood Transfusion Center, upon which the blood donation candidate provided written consent.

2.3. Data Processing and Entry

The variables examined in this study encompassed sociodemographic characteristics (age, gender, residence location), anthropometric measurements (weight, height, body mass index), pre-donation biological data (hemoglobin levels), and the number of donations made by each participant in the study.

For the anthropometric measures, weight was obtained using a Salter mechanical precision personal scale; height was recorded from the blood donor's identity card.

Body mass index (BMI) was determined using the formula: BMI = weight $(kg)/height^2$ (m).

Data processing and analysis were conducted using SPSS version 26. For bivariate analysis, the Pearson chi-square test was employed at a 5% significance level. The chi-square test was chosen due to the qualitative or categorical nature of the variables involved.

Ethical Considerations

The study adhered to the ethical guidelines applicable to research involving human participants, as established in Côte d'Ivoire.

3. Results

3.1. Sociodemographic Characteristics and Blood Donation History

The 525 individuals in our study consisted of 475 (90%) male subjects and 50 (10%) female subjects (Table 1). The average weight of male individuals was 69.9 kg and 70.8 kg for females. The majority of study subjects were over 1.6 meter (m) tall (Table 2). Among the participants, 390 (75%) resided in Yamoussoukro, 70 (13%) in Abidjan, and 65 (12%) in the rest of the country.

Table 1. Distribution of blood donors by age group and gender.

Gender	Age 18 - 24 N (%)	Age 25 - 44 N (%)	Age 45 - 60 N (%)	Total N (%)
Female	5 (1)	33 (6)	12 (2)	50 (10)
Male	24 (5)	352 (67)	99 (19)	475 (90)
TOTAL	29 (6)	385 (73)	111 (21)	525 (100)

Table 2. Distribution of blood donors by size and gender.

Gender	<1.6 m N (%)	≥1.6 m N (%)	TOTAL
Female	13 (2)	37 (7)	50 (10)
Male	6 (1)	469 (89)	475 (90)
TOTAL	19 (4)	506 (6)	525 (100)

3.2. Measurement of Hemoglobin Levels Conducted Prior to Blood Donation

Of the 525 subjects studied, capillary hemoglobin levels were obtained for 283 individuals, representing 54% of the sample (Table 3). Of these, 134 individuals, or 47%, exhibited hemoglobin levels below the standard range. Specifically, 17 women—equating to 3% of the female participants—had normal hemoglobin levels defined as ≥12 g/dl. In contrast, 132 men, comprising 25% of the male group, had normal hemoglobin concentrations of ≥13 g/dl.

Table 3. Distribution of blood donors by hemoglobin level by gender.

Hemoglobin level				
Gender				
Female	Not done N (%)	<12 g/dl N (%)	≥12 gd/l N (%)	Total N (%)
	29 (58)	4 (8)	17 (34)	50 (100)
Male	Not done N (%)	<13 g/l N (%)	≥13 g/l N (%)	
	213 (45)	130 (27)	132 (28)	475(100)

3.3. Assessment of Nutritional Status Based on BMI (Body Mass Index)

Among the blood donors, 316 individuals, accounting for 60%, exhibited a normal Body Mass Index (BMI) (Table 4). Underweight conditions were identified in 29 individuals, representing 6% of the subjects, while obesity was found in 39 subjects, making up 7.4% of the group. Of these, 13 individuals, or 2%, were classified as having severe obesity.

Table 4. Distribution of respondents by body mass index.

BMI	Count	Percentage (%)	Nutrition status
<18.5	29	6	Underweight
[18.5 - 25[*	316	60	Normal
[25 - 30[	141	27	Overweight
[30 - 35[	26	5	Moderate obesity
IMC ≥ 35	13	2	Severe obesity
Total	525	100	

*BMI normal.

3.4. Relationship between Body Mass Index and Hemoglobin Concentrations in Male and Female Subjects

There is no correlation between BMI and hemoglobin (Table 5).

Table 5. Correlation between BMI and hemoglobin levels in men and women.

BMI	Hemoglobin level male			Hemoglobin level female		
	>13 g/dl	≥13 g/dl	Total	>12 g/dl	≥12 g/dl	Total
<18.5	11	7	18	0	1	1
[18.5 - 25[*	201	108	309	7	10	17
[25 - 30[	81	39	120	14	7	21
[30 - 35[	11	9	20	4	2	6
IMC ≥ 35	4	3	7	4	2	6
Total	308	166	474	29	21	51

H: Pearson Chi-Square = 1.518; P = 0.823 (not significant); F: Pearson Chi-Square = 5.182; P = 0.269 (not significant).

4. Discussion

This study has several limitations: it was conducted at a single transfusion center, which raises concerns regarding the representativeness of its population. Additionally, the presence of missing data adversely affected the quality of the results.

The findings of this study underscore issues related to nutritional status among the subjects, with 6% being underweight and 2% of blood donors experiencing morbid obesity.

The Body Mass Index (BMI) serves as an indicator of nutritional health and associated risks linked to weight problems. These risks may include obesity, which could contribute to the development of diabetes or cardiovascular diseases [10], or, conversely, underweight, which is indicative of undernutrition and may lead to various nutritional disorders, particularly micronutrient deficiencies [11].

According to the World Health Organization, a high Body Mass Index (BMI) is linked with 21% of ischemic heart disease, 23% of stroke cases, 58% of type 2 diabetes occurrences, and 39% of hypertension cases. Additionally, a BMI exceeding 30 correlates with a heightened risk of cancer, joint issues, infertility, and mortality [12].

The aim of this study is to investigate the correlation between BMI and hemoglobin levels among blood donors at the Regional Blood Transfusion Center in Yamoussoukro. Contrary to expectations, our results did not support this correlation, differing from existing literature. Notably, several studies corroborate a correlation, such as the study by Kannan U and Achuthan A, "correlation of hemoglobin concentration with Body Mass Index among medical students," which found that overweight, obesity, and increased waist circumference were inversely related to anemia in urban medical students [13]. Another study by Chakraborty A and Mandal CG reported a strong positive correlation between BMI and hemoglobin levels in their "A cross sectional study of association between hemoglobin levels and the BMI Indices among the adolescents Sunni Muslim population in Lucknow City, India" [14].

The discrepancies observed in our findings may be attributed to limitations in our study, particularly regarding the representativeness of our population sample and the presence of missing data.

Looking ahead, a more detailed study using more robust statistical methods will be carried out to deepen our knowledge of the subject, in order to make the right decisions for better medical selection of blood donors.

5. Conclusions

Donating blood is a generous gesture of solidarity that saves lives. There are selection criteria for blood donors, designed to guarantee their safety.

Admittedly, this study did not reveal any correlation between BMI and hemoglobin among blood donors at the Yamoussoukro Regional Blood Transfusion Center.

However, the fact that underweight and morbidly obese subjects are found among blood donors deemed suitable, reveals shortcomings in medical selection. It would therefore be necessary to make a plea to the relevant authorities to integrate new parameters, in particular nutritional assessment, as a criterion for the medical selection of blood donors.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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