Book Chapter

Evaluation of Body Mass Index, Hematocrit, Erythrocyte Sedimentation Rate and Total Protein in Voluntary and Commercial Blood Donors in Nigeria: Advocating for Simultaneous Screening for Nutritional Status

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Abstract

Aims: The provision of blood for transfusion largely depends on the availability of blood donors. Hence donor protection as well as patient's protection is necessary in achieving good quality blood and blood products for the benefit of the patient. Methods: A cross- sectional, descriptive and analytical study was conducted to compare the hematocrit, erythrocyte sedimentation rate (ESR), serum protein and body mass index (BMI) in

voluntary (99) and commercial (95) blood donors aged between 18–36 years using simple, cost effective and efficient techniques. Data were analyzed using Pearson correlation and Student T-test. Results: The commercial and voluntary blood donors differed significantly ($p < 0.05$) in ESR, total protein, hematocrit and BMI. The majority, 13 (13.7%) of the commercial donors were underweight while the voluntary blood donors had more 14(14.1%) of overweight blood donors.

There were significant correlations between the hematocrit and the BMI among the voluntary blood donors ($r = 0.287$, $p<0.05$) and commercial blood donors ($r = 0.371$, $p<0.05$) respectively. The total protein differed significantly between the commercial and voluntary donors, but there was no significant correlation with BMI ($r = 0.000$ and 0.053 respectively, $p>0.05$). Conclusion: Voluntary donors are better choice for good quality blood donation than commercial donors in respect of the PCV and BMI. Blood donors should be protected against the adverse effect of blood donation by assessing both the hematologic and nutritional status and by behavioral change communications.

Keywords

Blood Donors; Hematologic Profile; Nutritional Status, Safety

Introduction

The provision of blood for transfusion largely depends on the availability of blood donors; hence donor protection as well as recipient's protection is necessary in achieving good quality blood and blood products for the benefit of the patient. It has been observed that large amounts of financial funding are expended annually on the safety of recipients, but very little attention is given to the state of wellbeing of blood donors [1]. This is worrisome especially in developing and poor nations where malnutrition is common and majority of the blood donors are remunerated (paid) with attendant hematologic, nutritional and socio-economic implications.

Despite the guideline on national blood transfusion service in Nigeria [2], aimed at ensuring safety, adequacy, accessible and

efficiency of blood supply in an efficient, cost effective co-ordinate manner, where protection of both the donor and recipient is paramount and the WHO recommendation on voluntary and non-remunerated blood donation [3], most blood used in Nigeria are sourced from undernourished commercial (paid) blood donors [4]. No doubt the recommended standards may be compromised.

Under-nutrition is one of the major health challenges in developing countries [5]. The basic causes of under- nutrition and infections in developing countries are poverty, poor hygiene conditions and little access or no to preventive healthcare [6–7]. Hence, assessment of the nutritional status of a population has attracted the attention of not only the nutritionists, medical experts and other biological scientists, but also economists and other social scientists with a view to understanding the health and socio-economic status of the population [8– 12]. More so cultural values and practices play a role. Commercial (paid) blood donors are poor and uneducated young men that rely on the remunerations for their day- to-day sustenance and existence thereby compromising their health and safety [4].

Screening criterion based on the assessment of hemoglobin and/or hematocrit for the eligibility of blood donations may not be able to exclude blood donors with underlying health problems. Some of the commercial blood donors indulge in negative health practices such as consumption of alcohol, clay [4] and other substances believing that would help them pass the screening tests. Malnutrition is common in developing and poor nations [5] and blood donation also has some negative effects. There is need therefore, to also assess the nutritional status of blood donors alongside the hemoglobin concentration/ or hematocrit to ensure the safety of blood donors as well as the provision of good quality blood and blood products.

In Nigeria most other poor and developing countries, the main source of blood for transfusion is paid (commercial) donors [4]. This leads to exploitation of the donors and the negative health implications which made the World Health Assembly in 1995 to urge member nations to promote the development of National Blood Transfusion Services based on voluntary, non-

remunerated donation and to enact effective and appropriate legislation governing the operation of blood services and to take other actions necessary in promoting the health of the blood donors and recipients of blood and blood products [13,14]. In Nigeria, the National Blood Transfusion Services (NBTS) rely on hemoglobin and/or hematocrit assessments as one of the screening criteria for eligibility to donate blood [2]. Since hemoglobin concentrations may be normal even when there is underlying problem(s), such individuals are possibly in danger of negative effects of the donation; iron deficiency anemia, under-nutrition and immunodeficiency state. The negative effects are influenced more by the frequency of donation [1,15] over a one-year period than by the number of lifespan donations [16]. Assessing the nutritional status of donors with simple, cost effective and efficient techniques definitely will help in protecting the donors as well as provision of good quality blood and blood products.

In the assessment of the nutritional status of individuals and communities, anthropometric measurements play a very important role. Departures from normal can often be detected earlier by anthropometry than by clinical examination and anthropometric figures are more objective than clinical assessments [17,18], especially for the individuals that are clearly at high risk of becoming malnourished themselves. In 1992, a task force of the International Dietary Energy Consultative Group of the ACC sub-committee on nutrition suggested that body mass index (BMI) be used to define adult chronic dietary energy deficiency [19]. The BMI or quetelet index has been known since the last century as a measure of body proportion and composition, thinness or undernutrition [20].

The body mass index (BMI) is the most widely used indicator in epidemiological studies [21], associated or not with other anthropometric variables in identification of patients at nutritional risk of obesity [9]. The great advantage of this index is the easy way to measure, the low cost, the good correlation with the fat mass and the association to morbidity and mortality [22]. However, use of anthropometry may be more difficult in adolescents than in other age groups because anthropometric

indices in normally nourished adolescents change with age and sexual development [23].

Packed cell volume (hematocrit) and body mass index estimations are essential factors associated to the etiology of certain disease; cardiovascular disease especially hypertension increased risk for type 2 diabetes mellitus [24] and in the development of non-insulin-dependent diabetes mellitus, independent of age, body mass index (BMI), smoking physical activity, high density lipoprotein (HDL)-cholesterol, and systolic blood pressure [25] and hence a good measure to access health. Screening for PCV and BMI therefore will help not only to exclude anemic donors but also those with other health problems and chronic disease thereby protecting both the blood donor and recipient as well.

The work therefore, used the hematocrit, ESR, serum protein and BMI to assess the eligibility of blood donors to donate blood in a poor and underdeveloped community setting where majority of the donors rely on the remuneration as the major source of income.

Materials and Methods

Subjects and Sampling

This cross-sectional, descriptive and analytical study was conducted at Federal Teaching Hospital, Abakaliki, Nigeria: Blood Transfusion Unit to assay the hematocrit, ESR, serum protein and some anthropometric parameters; weight, height (and used to calculate the BMI) of male blood donors. Written informed consent was obtained from each participant and study protocol was approved by the institutional ethics committee of the hospital. Strict anonymity was observed throughout the study and intervention programmed aimed at educating the blood donors on the safety and health implications of frequent donations was instituted.

One hundred and ninety-four apparently healthy blood donors comprised of 99 voluntary (mean age 23.54±2.9 years.) and 95 commercial (mean age 25.11±2.86 years) who attended Federal Teaching Hospital, Abakaliki; Transfusion Unit from February

to August 2016 for the purpose of blood donation were selected and enrolled to the study, according to the inclusion criteria. The commercial blood donors consisted of remunerated repeat donors (those who have donated blood at three to four times or more in a year for at least two consecutive years), while the voluntary blood donors included non- remunerated, replacement, targeted or relative blood donors (those who have not donated blood more than once or twice in a year). The standard instructions and questionnaire used to screen donors for transfusion transmissible infections and chronic diseases were followed and those with other health problems other than decrease hemoglobin and or hematocrit excluded. All donors were recruited irrespective of whether fit to donate blood based on the hematocrit or due; the interval between last donation. Donors that failed the screening tests on the ground of low hemoglobin or hematocrit without any other health problems were counseled and given hematinics while those with health problem(s) were referred to the physician. General health assessments were done by means of interviews and completion of a comprehensive questionnaire on age, past medical history, medications, frequency of donations per year and reason for phlebotomy.

Six milliliters of blood was collected from each participant in EDTA (for hematocrit, ESR) and plain vial (for serum protein). Serum was separated within one hour after centrifugation, labeled appropriately and preserved at -70^{O}C.

Measurements of Variables

Anthropometric parameters (weight, height) of donors were measured using standard protocol. The height (in meter), weight (in kilogram) were used to calculate the body mass index (kg/m^2) using the following formula. BMI= weight (kg)/ (height in meter)^2.

The serum protein was estimated using RANDOX TP reagent kit method. The hematocrit and ESR estimations were done without preservation within 1HOUR using standard methods. Data were analyzed using Pearson correlation and Student T-test, adapted from Statistical Package for Social Sciences (SPSS)

version 22 and Microsoft excel software. Statistical significance was set at $p < 0.05$.

Results

This study is a comparative of adult male blood donors of selected 99 adult voluntary blood donors and 95 adult commercial blood donors. Less than 2% of the donors were females and therefore excluded. The mean ±SD of age, weight, height and BMI of voluntary and commercial blood donors are presented in Table 1 There were significant differences in age, weight and BMI among the two groups ($p<0.05$). In height the mean ± SD of voluntary and commercial blood donors were 1.72±0.15 m and 1.73±0.07 m respectively and there was no significant difference between them ($p>0.05$). In the ESR, the mean±SD of voluntary and commercial blood donors were 6.79±3.80 (mm/hr) and 12.33±8.39 (mm/ hr) respectively and there was a significant difference between them ($p<0.05$). Similar significant differences were seen in the total protein and PCV of the blood donors.

The majority, 13 (13.7%) of the commercial donors were underweight while the voluntary donor had more 14 (14.1%) of overweight blood donors (Table 2). There was a significant correlation between the PCV and the BMI among the voluntary blood donor ($r = 0.287$, $P<0.05$) (Figure 1) and the estimation of PCV from BMI of the voluntary blood donors is shown in the regression equation thus: PCV = 46.728–0.346 (BMI). More so there was significant correlation between the PCV and the BMI among the commercial blood donor ($r = 0.371$, $p<0.05$), and the estimation is shown in the regression equation thus: PCV = 20.966 + 0.371(BMI). The equilibrium BMI for the two groups was 21.98 kg/m^2 the PCV was 41.81%.

The total protein differed significantly (Table 1) between the commercial and voluntary donors, but there were no significant correlation between the total protein and BMI among groups ($r = 0.000$, and $r = 0.053$) respectively.

Table 1: Comparison of the parameters in voluntary and commercial.

Age	23.54±2.9	25.11±2.86	-3.775*	192	0.000
Weight (kg)	67.94±10.03	63.51±8.16	3.369*	192	0.001
Height (m)	1.72±0.15	1.73±0.07	-0.418	192	0.677
BMI (kg/m^2)	22.72±1.82	21.06±2.01	6.025*	192	0.000
ESR(mm/hr)	6.79±3.80	12.33±8.39	-5.962*	192	0.000
Total protein(TP)(g/dl)	85.33±10.39	72.43±10.15	8.745*	192	0.000
PCV	38.86±2.20	36.68±4.05	4.676*	192	0.000

* P<0.05 there is significant difference
Key: ESR = Erythrocyte sedimentation rate
BMI = Body mass index
Tp = Total protein

Table 2: Body mass index group difference among the donors.

Under weight (<18.5)	0(0.0%)	13(13.7%)	13(6.7%)	22.078	2	0.000
Normal weight (18.5–24.9)	85(85.9%)	80(84.2%)	165(85.1%)			
Over weight (25.0–29.9)	14(14.1%)	2(2.1%)	16(8.2%)			
Total	99(100.0%)	95(100%)	194(100.0%)			

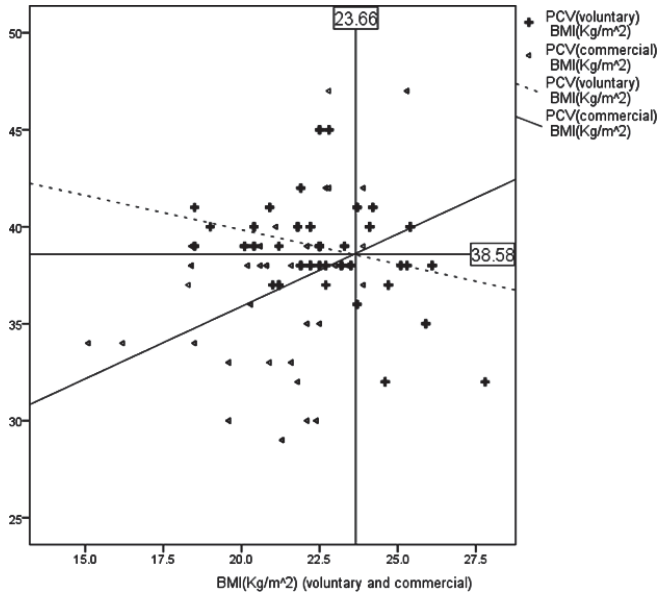

Figure 1: A scatter plot with trend lines and line of equilibrium of BMI and PCV in the voluntary and commercial blood donors
Abbreviations: PCV: Packed cell volume, BMI: Body mass index

Discussion

In this study, the mean BMI for voluntary and commercial blood donors were 22.72±KG/M^2 and 21.06±2.0 kg/m^2 respectively and there was significant difference between them. These figures were within normal when compared with the normal range of 18.50–24.90 kg/m^2 [26]. By the classification of National Institute of Health, NIH [27], in overall; 85.10% were within normal weight, while 13.7% of the commercial and none of the voluntary blood donors respectively were underweight and 2.1% and 14.1% of the commercial and voluntary blood donors respectively were overweight. Frequency of donation, varying nutritional status and patterns of food consumption, life style, eating habits and medical conditions may account for these differences [28].

The respective mean PCV for commercial and voluntary blood donors were 36.68±4.05% and 38.86±2.20%. These fall below the normal range of 40.00–54.00% and 47±3% as

previously reported [29,30] in the same environment and 40–53% in Caucasians [31]. It is likely, anemia due to frequency of donation, effect on serum iron, erythropoietic stress, and related diseases could be contributory in commercial donors as well as effects of endemicity of malaria and other diseases, varying nutritional status and patterns of food consumption in voluntary donors.

The PCV and BMI correlates significantly ($r = 0.287$, and $r = 0.371$, $p<0.05$) in both the voluntary and commercial blood donors respectively. The equilibrium BMI of the two groups was 21.98 kg/m^2 WHILE the PCV was 41.81%. The negative slope of the PCV of voluntary donors explains that the PCV is comparatively higher than that of the commercial donors. The PCV assesses the anemia or hemoglobin concentration of the individual while the BMI assess the nutritional status of the same. The body mass index (BMI) is the most common marker used on diagnoses of the nutritional status. The great advantage of this index is the easy way to measure, the low cost, the good correlation with the fat mass and the association to morbidity and mortality. Measuring both the BMI and PCV would be of value in assessing the fitness and the nutritional status of the donor thereby protecting the donor and would be recipient and ensuring safety as well as provision of good quality blood and blood products. Applications of these principles are cost effective, fast and can be used in economically underdeveloped and developing countries to reduce the number of inappropriate blood transfusion services. Screening for PCV and BMI, therefore, will help not only to exclude anemic donors but also those with other health problems and chronic disease thereby protecting both the blood donor and recipient as well.

Conclusion

Voluntary (unremunerated) blood donors are better choice for blood donation than commercial blood donors in respect of the PCV and BMI. Efforts towards the achievement and implementation of the World Health Organization (WHO) guidelines on unremunerated blood donation should be encouraged. In the developing countries, blood donors should

be protected against the adverse effect of blood donation by assessing both the hematologic and nutritional status. In every health system, blood donors should be regularly educated about the risks and implications of frequent blood donation and choice of food substances to be taking in order to boost their immunity and also to increase the iron store of their body system before blood donation. There is need for advocacy towards appropriate health policies and programs aimed at provision of safe and appropriate blood and blood products through behavioral change communications with the blood donors.

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