

Table 3: Association between maternal characteristics and anemia in pregnancy

Variable	Sub-groups	Anemia in pregnancy (%)		P	OR (CI 95%)	Adj. OR (CI 95%)
		Yes	No			
Parity*	Para 0	31 (35.2)	57 (64.8)	0.04	1.9 (1.01-3.62)	-
	Para ≥5	23 (22.1)	81 (77.9)	0.85	1.2 (0.22-6.21)	-
	Para 1-4	2 (25.0)	6 (75.0)	-	-	-
Gestational age (weeks)	<28	27 (32.9)	55 (67.1)	0.19	1.5 (0.81-2.81)	1.7 (0.92-3.28)**
	≥28	29 (24.6)	89 (75.4)	-	-	-
Educational status	≥Secondary	17 (32.7)	35 (67.3)	0.38	1.4 (0.68-2.69)	-
	Tertiary	39 (26.4)	109 (73.6)	-	-	-
Age groups (years)	<30	30 (33.0)	61 (67.0)	0.15	1.5 (0.84-2.92)	-
	≥30	26 (23.9)	83 (76.1)	-	-	-
Weight (kg)	≥90	8 (29.6)	19 (70.4)	0.84	1.1 (0.45-2.67)	-
	<90	48 (27.7)	125 (72.3)	-	-	-

*Multinomial logistic regression, **Adjusted for effect of 1st trimester. CI: Confidence interval, OR: Odds ratio**Table 4: Participants' arm preferences and reasons**

Reason	Arm preference (%)		Total
	Right arm	Left arm	
No reason	26 (40.0)	39 (60.0)	65
Avoid effect of after pains	6 (20.7)	23 (79.3)	29
Easy blood vessel access	4 (36.4)	7 (63.6)	11
Total	36 (34.3)	69 (65.7)	105

Discussion

The average HCT in this study is within the normal range for the pregnant population,^[3,6] and this also holds for participants recruited in the second trimester—the period when hemodilution of pregnancy is most marked.^[1] This encouraging finding may be related to the high social class of the majority of the participants as suggested by their higher educational status. Nevertheless, the average HCT in this study is lower than 37.1% reported from a faith-based specialist hospital in the study area.^[27] The marked disparity is unexpected and difficult to explain, however, measurement bias cannot be ruled out from the earlier study which showed that the average HCT of its pregnant population was higher than that of nonpregnant control – an unusual finding because of the hemodilution associated with pregnancy that is responsible for a lower cut-off for anemia in pregnancy when compared to nonpregnant population.^[1,2] On the other hand, the average HCT in this study is expectedly higher than 29.6% observed from rural communities in Enugu,^[31] which may support the explanation above as regards women's social status and HCT. Furthermore, the average HCT found in this study is higher than 30.2%, and 33.0% reported from Lagos,^[32] and Ibadan,^[33] respectively. Furthermore, it is not surprising that the HCT observed in the second trimester was significantly lower than that in the third trimester because of the marked hemodilution that characterize this period of pregnancy.

This study showed an anemia prevalence of 28% which is almost a half of the figure reported in 2007 from the same center.^[14] Baring any effect of sampling error, this study

finding may reflect an improvement in maternal health care over the period preceding the current study and suggests a downward category shift in the public health burden of anemia in pregnancy.^[6] It should be noted that participants in the previous study were recruited at booking and, therefore, were not on hematinics;^[14] and following that study, antenatal education for pregnant women at the study center was reviewed and emphasis was placed on the importance of good nutrition and adherence to hematinics administered during pregnancy. It is possible that this intervention had contributed to the observed reduction in anemia prevalence. Furthermore, the anemia prevalence in this study is far lower than findings of recent studies from urban (64.1%),^[13] and rural (69.3%)^[31] areas of Enugu state, Nigeria. Nutritional anemia especially iron deficiency is the most common cause of anemia, and it is related to socioeconomic status.^[6] Since the study population for these studies varied, it is likely that low socioeconomic status might have contributed to the observed disparity in anemia prevalence. A multi-center survey is, therefore, necessary to determine the actual epidemiology of the disorder in the state. We also suggest that the periodic HIV sentinel survey of Nigeria be expanded to include HCT or Hb concentration estimation so as to get a more precise prevalence of anemia in Nigeria and its constituent states. Furthermore, this study finding deviated markedly from WHO reports which showed that about one-half of pregnant women in Africa were anemic.^[6] It is also lower than reports of several other studies from developing countries.^[7,8,10-12,34]

A majority of anemia cases in this study were of the mild variety which conforms with the findings of related studies.^[12,13] Also as in the preceding survey from the center, there was no case of severe anemia,^[14] which suggests that severe form of anemia may be uncommon among registered pregnant women at the hospital.

Contrary to the findings of previous studies,^[12,14] this study identified a relationship between women's parity and likelihood of anemia in pregnancy [Tables 2 and 3]. The odds of anemia in this study was the highest among women in their first ongoing

pregnancy (nullipara) followed by grand multiparous women thus, a nulliparous woman was two times more likely to be anemic when compared to those who were para 1 to para 4. Though this finding may appear unusual, it however, supports the report from Oman which showed that nulliparous women had a higher risk of anemia when compared to women that were para 1–2.^[35] Unfortunately, unlike the Oman study,^[35] our study could not control for the effect of hemodilution phenomenon in the second trimester because of inadequate power for such analysis. The increased prevalence of anemia in nullipara may be related to poor nutrition as a result of nausea and vomiting that are more predominant in the group, while that of grandmultiparas may be associated with depleted iron stores as a result of repeated pregnancies. A recent study at the hospital showed that the average inter-birth interval was suboptimal,^[36] which may support the depleted iron stores theory in grandmultiparous women. Furthermore, women in second trimester of pregnancy were about two times more likely to have anemia when compared to those in third trimester though, the relationship was not significant—a larger sample size would have increased the study's precision. This increased odds of anemia in the second trimester was also found in other studies,^[14,34] and it is related to a significantly reduced average HCT in the second trimester as observed in the present study. On the other hand, maternal age, obesity, and educational status had no significant association with prevalence of anemia in this study. It is observed that the reports from the study area show varying levels of association between suspected maternal predictors and anemia in pregnancy;^[13,14] therefore, a well-designed multi-center study will help determine the real predictors of the condition in our environment.

For varying reasons, over half of the study participants preferred one of either left or right arm for blood sample collection. Furthermore, over 90% of the respondents would want their choice of arm preference sought for and respected during blood collection. This study finding is interesting because it has been observed that most health providers and phlebotomist in our environment decide on the patient's arm to be used for blood sample collection without recourse to her preference. This study findings calls for more patients respect and exposes the need for training and retraining of health staff in the act of blood sample collection. It is hoped that this form of patients' respect would be adopted as a routine practice in all health centers in Nigeria including the study center.

The study was based on one hospital which limits its generalization to the study area. However, a rigorous quality control measures employed during the study ensured its internal validity. Outside the measures noted in the study's methods, others quality control measures employed were availability of written standard operating protocol including eligibility and exclusion criteria as well as study protocol for PCV estimation and data recording, intermittent certification of centrifuge efficiency. The study was further strengthened by the fact that it explored participant's arm

preference for blood sample collection—an important aspect of patients' autonomy that is often violated by caregivers in our environment.

Conclusion

The average HCT among pregnant women at the UNTH, Enugu Nigeria was within normal range, and the prevalence of anemia was lower than the preceding report. The majority of women expressed a preference for either right or left arm for blood collection for clinical investigations and would wish their choices are sought for and respected. It is important that phlebotomist and caregivers enquire about, and respect the arm preference of pregnant women during blood sample collection for any investigation.

Acknowledgments

The study was funded by authors.

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How to cite this article: Dim CC, Ugwu EO, Dim NR, Anyaehie UB. Hematocrit, anemia, and arm preference for blood sample collection: A cross-sectional study of pregnant women in Enugu, South-Eastern, Nigeria. *Ann Med Health Sci Res* 2015;5:36-41.

Source of Support: Nil. **Conflict of Interest:** None declared.