Background: Poor awareness remains a substantial limitation to harnessing the benefits of umbilical cord blood (UCB) in sub-Saharan Africa. The aim of this study was to determine the level of awareness and factors influencing intention to donate cord blood to blood bank among antenatal clinic attendees at a tertiary hospital in Nigeria. Methods: We conducted a questionnaire-based cross-sectional study of 400 women attending the antenatal clinic of a tertiary hospital in Lagos, Nigeria, between February and June 2018. The data were analyzed using Stata version 13; comparisons were conducted with Chi-square, Student’s t-test, and Mann–Whitney U-test. Univariable and multivariable binary logistic regression was conducted with “willingness to donate” as the outcome variable. Results: Majority (n = 287/331 [86.2%, 95% confidence interval [CI]: 76.4–84.9]) of the participants had some knowledge of UCB, almost half intended future donation of UCB (n = 161/333, [48.3%, 95% CI: 42.9–53.6]). Based on our findings, factors such as religion (P = 0.001), education (P = 0.03), information from health-care provider (P < 0.001) appear to influence awareness, and the decision to donate UCB. Conclusion: Although the awareness of the clinical uses of UCB is very limited in Nigeria, the intent to participate in UCB donation is high. Factors such as religion, education, and prior information about UCB donation by health-care providers have been identified in this study to have an influence on the decision to donate UCB.

Keywords: Bone marrow transplantation, hemopoetic stem cell, umbilical cord blood

Résumé

Contexte: La faible sensibilisation demeure une limitation substantielle à l’exploitation des avantages du sang de cordon ombilical (UCB) en Afrique subsaharienne. Le but de cette étude était de déterminer le niveau de sensibilisation et les facteurs influençant l’intention de donner du sang de cordon à une banque de sang parmi les participants à une clinique prénatale dans un hôpital tertiaire au Nigéria. Méthodes: Nous avons mené une étude transversale basée sur un questionnaire auprès de 400 femmes fréquentant la clinique prénatale d’un hôpital tertiaire à Lagos, au Nigeria, entre février et juin 2018. Les données ont été analysées à l’aide de Stata version 13; des comparaisons ont été effectuées avec le chi carré, le test t de Student et le test U de Mann-Whitney. Binaire univariable et multivariable une régression logistique a été effectuée avec la «volonté de donner» comme variable de résultat. Résultats: Majorité (n = 287/331 [86.2%, confiance à 95% intervalle [IC]: 76.4–84.9]) des participants avaient une certaine connaissance de l’UCB, près de la moitié des dons futurs prévus de l’UCB (n = 161/333, [48.3%, IC à 95%: 42.9-53.6]). Des facteurs tels que la religion (P = 0.001), l’éducation (P = 0.03), les informations fournies par le prestataire de soins de santé (P <0.001) ont influence la sensibilisation et la décision de faire un don d’UCB. Conclusion: Bien que la connaissance des utilisations cliniques de l’UCB soit très limitée au Nigéria, la l’intention de participer au don UCB est élevée. Facteurs tels que la religion, l’éducation...
INTRODUCTION
Enthusiasm for umbilical cord blood (UCB) has grown as an important source of hematopoietic stem cells for the treatment of blood and genetic disorders.[1-9]

UCB has been shown to have ten times the amount of hematopoietic stem cells compared to bone marrow.[10] Not only is it faster and easier to find a tissue match through cord blood but also the risk of the recipient’s body rejecting the donation is less than traditional bone marrow transplants.[11]

However, most African countries (including Nigeria) have low UCB banking facility.[12-14] Thus, approximately 50% of patients who need an unrelated blood stem cell transplant are unable to find a timely suitable match due to poor UCB banking facilities.[15,16]

This study aimed to determine the level of awareness and the factors influencing donation of UCB among pregnant women to assist the design and implementation of appropriate national policies for UCB banking in Nigeria.

METHODS
We conducted a cross-sectional study among pregnant women attending the antenatal clinics at the Lagos University Teaching Hospital (LUTH), Lagos, Nigeria between February and June 2018.[17] All the pregnant women who participated in this study gave written informed consent and the study was approved by the Health and Research Ethical Committee of LUTH (ADM/DCST/ HREC/APP/1932). This study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. Sociodemographic, donation history, and medical history data were collected from the study participants using a interviewer administered questionnaire.

Data collection
Phase 1
An initial pilot study involving 20 women was conducted in LUTH using a survey tool developed based on the similar published studies[17,19] to assess the knowledge and perception of cord blood donation during November 2017.

Phase 2
An adjusted questionnaire was subsequently used to collect de-identified sociodemographic data and other information related to the study objectives such as intention to donate UCB and acceptance of the third party use of donated UCB.

Operational definition
Questions regarding knowledge of risk factors, uses, and collection methods of umbilical cord blood were scored and pulled together, and the median score was computed to determine the overall knowledge of respondents.

Knowledgeable (High knowledge): Respondents scored above the median score of knowledge assessing questions.

Minimal knowledge: respondents scored the median score of knowledge assessing questions.

Not knowledgeable (No knowledge): Respondents scored below the median score of knowledge assessing questions.

Questions regarding awareness of the clinical uses of umbilical cord blood were also scored and pulled together and the median score was computed to determine the overall level of awareness of respondents.

Aware: Those respondents who scored above the median score of awareness assessing questions.

Not aware: Those respondents who scored below the median score of awareness attitude assessing questions.

Statistical analysis
The data were analyzed using Stata version 13 (StataCorp., TX, USA). Normally distributed continuous variables were presented as mean (± standard deviation), while non-normally distributed continuous variables were presented as median (inter-quartile range). Categorical variables were presented as frequency and percentages. Comparison between categorical, continuous (normally distributed and non-normally distributed), and sociobiological variables among women who were aware and those who were not aware of the clinical benefit of cord blood was conducted using Pearson’s Chi–square test, Student’s t-test, and Mann–Whitney U-test, respectively. The self-reported knowledge of the participants was dichotomized into poor knowledge (no knowledge or just heard about it) and moderate-to-excellent knowledge (some knowledge,
confident knowledge, and previously donated). The variable “willing to donate if cord bank is available in Nigeria” was also dichotomized into “willing to donate” (those who answered “strongly agree” or “agree”) and “not willing to donate” (those who answered “neutral” “strongly disagree” or “disagree”). Similarly, comparisons were conducted using Chi-square test, Student’s t-test, and Mann–Whitney U-test. Univariable and multivariable binary logistic regression was conducted with “willingness to donate” as the outcome variable. The model was built using the backward elimination technique and the literature search. Statistically significant value was set at \( P < 0.05 \).

**Results**

Three hundred and thirty-three questionnaires were returned out of 400 questionnaires distributed to participants (response rate of 83.3%). The mean age and median parity of the participants were 30.8 (±4.7) years and 2 (0–3), respectively. The majority of the women had tertiary education (\( n = 276/333, 83.0\% \)) and more than half were of the Christian faith [Table 1].

The majority (\( n = 287/333 \) (86.2\%, 95\% confidence interval [CI]: 76.4–84.9) of the participants had minimal to no knowledge of cord blood banking [Figure 1] and of those participants that had minimal knowledge of CB banking; majority got the information through the Internet \( n = 27 (41.5\%) \) or their health-care provider 26 (38.8%). Nearly half of the respondents \( n = 142 (43.2\%) \) indicated that they would like to receive additional information on how UCB is collected. There was a statistically significant relationship between the respondents’ knowledge of cord blood banking, their religious belief \( (P = 0.007) \), and prior information from health care provider \( (P < 0.005) \). Instructively, the respondents’ educational attainment \( (P = 0.503) \) and age \( (P = 0.474) \) did not impact on their knowledge base of cord blood banking [Table 2].

Only about one-sixth (16.8\%, \( n = 56/333 \)) of the participants were aware that umbilical cord blood can be used to treat some medical conditions and about 4.5\% \( (n = 15/333) \) had a family history of cancer or genetic disorder. The mean age of those who were aware of the clinical use of umbilical cord blood was not statistically different from those who were not aware \( (P = 0.2348) \). Similarly, there was no difference in parity \( (P = 0.376) \) and trimester of recruitment \( (P = 0.218) \) among women who were aware as compared to those who were not aware of the usefulness of umbilical cord blood for treatment of haematological conditions. However religion and educational attainment were associated with possibility of being aware of Umbilical cord use in treating disease conditions [Table 3].

Majority of the respondents \( (n = 217, (65.1\%)) \) believed that their religion would not influence their decision to donate to the cord bank. There was no statistically significant difference in the mean age \( (30.5 \pm 4.6 \text{ vs. } 31.4 \pm 4.9, P = 0.12) \) and median parity \( (2 [0–3] \text{ vs. } 2 [0–3], P = 0.440) \) of those who were willing to donate as compared those who were not willing to donate cord blood to the blood bank. However, there was a statistically significant association between religious belief of the respondents and their intention to donate cord blood \( (P = 0.001) \) [Table 4].

Almost half of the respondents indicated interest in future donation of UCB \( (n = 161/333, 48.3\%, 95\% \text{ CI: } 42.9–53.6) \) [Figure 2]. About 52.5\% \( (n = 175/333) \) of the respondents disagree that donated cord blood should only be for the use of family members [Figure 3], while Christians had about

### Table 1: Obstetric and demographic characteristics of the participants (\( n = 333 \))

| Characteristics                          | \( n \) (%) |
|------------------------------------------|-------------|
| **Age (years), mean±SD**                 | 30.8±4.7    |
| 20-24                                    | 25 (7.5)    |
| 25-29                                    | 109 (32.7)  |
| 30-34                                    | 125 (37.5)  |
| 35-39                                    | 58 (17.5)   |
| 40-44                                    | 15 (4.5)    |
| Missing                                  | 1 (0.3)     |
| **Educational qualification**            |             |
| None/primary                             | 10 (3.0)    |
| Secondary                                | 47 (14.1)   |
| Tertiary                                 | 276 (82.9)  |
| **Religion**                             |             |
| Christianity                             | 233 (70.0)  |
| Islam                                    | 64 (19.2)   |
| Others                                   | 36 (10.8)   |
| **Trimester of pregnancy**               |             |
| 1\text{st}                               | 72 (21.6)   |
| 2\text{nd}                               | 145 (43.5)  |
| 3\text{rd}                               | 108 (32.4)  |
| Missing                                  | 8 (2.4)     |
| **Parity, median (IQR)**                 |             |
| 0 (nulliparous)                          | 2 (0–3)     |
| ≥1 (multiparous)                         | 209 (62.8)  |
| Missing                                  | 27 (8.1)    |

SD=Standard deviation, IQR=Interquartile range

**Figure 2:** Prevalence of intention to donate cord blood among the study population
John-Olabode, et al.: Knowledge and practice of cord blood donation
Annals of African Medicine ¦ V olume 20 ¦ Issue 1 ¦ January-March 2021

...fourfold odds of donating cord blood as compared to women who were non-Christians (odds ratio [OR] = 3.9 95% CI: 1.80–8.44, \( P = 0.001 \)) [Table 5]. Although not reaching statistical significance, women with tertiary education had a fivefold higher likelihood of donating cord blood as compared to women who had primary or no educational qualification (OR = 5.26, 95% CI: 0.83–33.32, \( P = 0.078 \)). In addition, women in their second trimester were twice as likely to have the intention of donating cord blood as compared to women in their first trimester (OR = 2.31, 95% CI: 0.97–5.49, \( P = 0.057 \)) [Table 5]. The woman’s self-reported knowledge base of umbilical cord donation, family history of genetic conditions, and age did not influence their future intention to donate cord blood at delivery (\( P \)-value>0.05).

**Discussion**

Nigeria with its large population and the high birth rate\(^{20}\) is uniquely placed to set up the largest cord blood bank to cater for Nigerians and ultimately the rest of Africa. Sadly, despite having the prevalence of sickle cell disease (SCD) as high as 3% in newborns and an increasing incidence of hematological and non-hematological malignancies in pediatric age group\(^{21}\) umbilical cord is still being discarded as biohazard waste in Nigeria and most countries in sub-Saharan Africa. We sought to assess the knowledge and possible intention to donate umbilical cord blood among antenatal clinic attendees at Lagos to heighten awareness and provide the information for design and implementation of a UCB banking facility in the country. In this study, 16.8% of the respondents were aware of the clinical uses of UCB with less than one-fifth of pregnant women admitting to having at least good knowledge of UCB. The poor

---

**Table 2: Association between the sociobiological characteristics and the participants’ knowledge of cord blood banking**

| Characteristics            | Average to good knowledge | Poor or no knowledge | \( P \) |
|----------------------------|----------------------------|----------------------|--------|
| Age mean±SD                |                            |                      |        |
| 20-24                      | 2 (4.3)                    | 23 (8.0)             | 0.474  |
| 25-29                      | 14 (30.4)                  | 95 (33.1)            |        |
| 30-34                      | 21 (45.7)                  | 104 (36.2)           |        |
| 35-39                      | 7 (15.2)                   | 51 (17.8)            |        |
| 40-44                      | 1 (2.2)                    | 14 (4.9)             |        |
| Missing                    | 1 (2.2)                    | 0 (0)                |        |
| Educational qualification  |                            |                      |        |
| None/primary               | 2 (4.3)                    | 8 (2.8)              | 0.503  |
| Secondary                  | 4 (8.7)                    | 43 (15.0)            |        |
| Tertiary                   | 40 (87.0)                  | 236 (82.2)           |        |
| Religion                   |                            |                      |        |
| Christianity               | 34 (74.0)                  | 199 (69.0)           | 0.007  |
| Islam                      | 10 (21.7)                  | 54 (19.0)            |        |
| Others                     | 2 (4.3)                    | 34 (12.0)            |        |
| Trimester of pregnancy     |                            |                      |        |
| First                      | 7 (15.2)                   | 65 (22.6)            | 0.070  |
| Second                     | 18 (39.1)                  | 127 (44.3)           |        |
| Third                      | 21 (45.7)                  | 87 (30.3)            |        |
| Missing                    | 0 (0)                      | 8 (2.8)              |        |
| Parity, median (IQR)       |                            |                      |        |
| 0 (nulliparous)            | 12 (26.1)                  | 85 (29.6)            | 0.988  |
| ≥1 (multiparous)           | 28 (69.9)                  | 181 (63.1)           |        |
| Missing                    | 6 (13.0)                   | 21 (7.3)             |        |
| Information by healthcare provider |              |                      |        |
| Yes                        | 13 (28.3)                  | 17 (5.9)             | <0.005 |
| No                         | 33 (71.7)                  | 270 (94.1)           |        |

IQR=Interquartile range, SD=Standard deviation

Figure 3: Preferences of the study population on the use of donated cord blood
level of awareness and knowledge of UCB among our cohort of Nigerian women, though in agreement with the finding of Nwannadi et al. among women in Northern Nigeria, \[17\] is a far cry from the findings of Bhandari et al. and Jordens et al. that were conducted in the United States of America and Europe, respectively. \[22,23\] This sharp contrast in the level of awareness of UCB can be attributed to the fact that few Haemopoetic stem cell transplant (HSCT) has been performed in Nigeria. Although there is a renewed interest by tertiary hospitals in Nigeria to build the capacity for performing HSCT for SCD, only four successful transplants had been conducted since the first was performed in 2011. \[24\]

Expectedly, we found that there was a significant relationship between respondents’ knowledge of UCB and prior information on the topic from the health-care provider. This result echoes the finding of other studies conducted in India and Canada. \[19,25\] Another striking finding of our study is that majority of the women were interested in learning more about the process of collection of UCB from their health-care provide. This highlights the fact that health-care practitioners delivering prenatal and obstetric care have primary roles in efforts aimed at increasing the awareness of umbilical cord blood donation. Thus, appropriate information campaigns largely championed by maternal and child health-care professionals would significantly contribute to raising the level of awareness and acceptance of CB donation. Recognizing the important role of obstetrics and maternity staff, we recommend that the views of obstetricians and midwives should be incorporated into the designs, planning, and implementations of initiatives to expand current efforts to provide education and guidance regarding the participation in UCB donation.

The majority of the women in this study who had some knowledge about UCB donation identified their primary source of information irrespective of age and educational attainment, as being the Internet rather than their health-care provider. This finding contrasted with the US study by Bhandari et al. that reported the primary source of information on UCB among their cohort of women to be the health-care provider. \[22\] Extrapolating from the experiences of the respondents who were aware of UCB, the utilization of social media platforms and other Internet sources to disseminate information about UCB donation should be further evaluated. This is in line with findings of several researchers that social media platforms are very useful tools for dissemination of health information. \[17,26\]

Expectedly in a deeply religious country like Nigeria, there was a significant relationship between religious belief knowledge and awareness of cord blood donation among our cohort. Furthermore, Christians had about fourfold odds of donating cord blood as compared to non-Christians. This is in agreement with the work of Jordens et al. \[27\] which showed that there was a religious perspective to UCB donation and banking that when optimally harnessed, has the potential to help people of faith to choose whether to donate, store, or discard their child’s umbilical cord blood. Although a substantial proportion of our respondents believed that their religion will not influence their decision to donate UCB in future. Nevertheless, our study suggests that religious leaders in our environment can influence the dissemination of appropriate information on UCB banking.

Thus, public enlightenment campaigns to religious institutions can also assist to improve the awareness of UCB donation in the country.

Overall, there is a positive attitude toward the UCB donation as nearly three-quarters (72.7%) of the women indicated interest in knowing more about UCB and more than half (52.4%) agreed that donated UCB can be used for a third party and not only for family members. Not that the women were receptive to the idea of donating UCB for third-party use but also more than a quarter expressed willingness to donate UCB if a cord blood bank was established in the country. Ironically, there is a positive attitude to cord blood banking despite the participants being poorly informed, uneducated with little or no knowledge of cord blood banking, and lacking knowledge regarding UCB, as this study has shown. We conclude from this study that although the awareness of UCB donation and its potential for treatments and medical applications are very limited in Nigeria, the intent to participate in cord blood donation is high. Factors such as religion, education, and

---

**Table 3: Comparison of sociobiological characteristics by the level of awareness of cord blood-related treatment**

| Characteristics          | Aware, n (%) | Not aware, n (%) | P     |
|--------------------------|--------------|------------------|-------|
| Age, mean±SD             |              |                  |       |
| 20-24                    | 30.1±4.3     | 30.9±4.7         | 0.2348|
| 25-29                    | 5 (8.9)      | 20 (7.2)         | 0.602 |
| 30-34                    | 18 (32.1)    | 91 (32.9)        |       |
| 35-39                    | 24 (42.9)    | 101 (36.5)       |       |
| 40-44                    | 7 (12.5)     | 51 (18.4)        |       |
| Missing                  | 1 (1.8)      | 14 (5.1)         |       |
| Educational qualification|              |                  |       |
| None/primary             | 3 (5.4)      | 7 (2.5)          | 0.029 |
| Secondary                | 2 (3.6)      | 45 (16.3)        |       |
| Tertiary                 | 51 (91.1)    | 225 (81.2)       |       |
| Religion                 |              |                  |       |
| Christianity             | 25 (39.5)    | 208 (75.1)       | 0.001 |
| Islam                    | 12 (10.5)    | 52 (18.8)        |       |
| Others                   | 19 (50.0)    | 17 (6.1)         |       |
| Trimester of pregnancy   |              |                  |       |
| 1st                      | 9 (16.1)     | 63 (22.7)        | 0.218 |
| 2nd                      | 21 (37.5)    | 124 (44.8)       |       |
| 3rd                      | 23 (41.1)    | 85 (30.7)        |       |
| Missing                  | 3 (5.4)      | 5 (1.8)          |       |
| Parity, median (IQR)     |              |                  |       |
| 0 (nulliparous)          | 1 (0-2)      | 2 (0-3)          | 0.2430|
| ≥1 (multiparous)         | 19 (33.9)    | 78 (28.2)        | 0.376 |
| Missing                  | 4 (7.1)      | 23 (8.3)         |       |

\( ^t \)-test, \(^t\)Mann-Whitney U-test. Other P values are for Chi-square test.
IQR=Interquartile range, SD=Standard deviation
provision of evidence-based information about UCB donation by health-care providers, most especially obstetricians, have been identified in this study to have an influence on the decision to donate cord blood. These findings are also encouraging to the stakeholders that are shouldered with the responsibility of establishing a functional UCB banking system in Nigeria. A focused and coordinated awareness campaign can therefore yield an unprecedented interest in UCB donations in the country.

While this study adds to the body of knowledge on the awareness of and willingness to donate cord blood among Nigerian women, we must acknowledge some of the limitations of the study. This study was conducted in an urban setting where there is better access to health-care and health information. Our findings could be overestimating the level of awareness of cord blood donation not yet defined in the general population. A multicenter study will help to define the level of awareness in the general population.

**Conclusion**

Given the significant findings reported in this study, we posit that any government policy or program aimed at promoting cord blood donation for future cord blood transplantation in sub-Saharan Africa should explore options that engage health-care professionals to take charge of accretion of cord blood programs. Obstetricians and other maternal and

| Table 4: Association between sociobiological factors and participants’ willingness to donate cord | Willing to donate, n (%) | Not willing to donate, n (%) | P |
| Characteristics | ^Willing to donate | ^Not willing to donate | |
| Age (mean±SD) | 30.5±4.6 | 31.4±4.9 | 0.1189 |
| 20-24 | 17 (7.4) | 8 (7.8) | 0.393 |
| 25-29 | 83 (36.1) | 26 (25.5) | |
| 30-34 | 87 (37.8) | 38 (37.3) | |
| 35-39 | 33 (14.3) | 25 (24.5) | |
| 40-44 | 10 (4.3) | 5 (4.9) | |
| Missing | 0 (0) | 1 | |
| Educational qualification | | | |
| None/primary | 3 (1.3) | 7 (6.7) | 0.092 |
| Secondary | 30 (13.1) | 17 (16.3) | |
| Tertiary | 196 (85.6) | 80 (76.9) | |
| Religion | | | |
| Christianity | 180 (73.5) | 53 (60.2) | 0.001 |
| Islam | 51 (20.8) | 13 (14.8) | |
| Others | 14 (5.7) | 22 (25) | |
| Trimester of pregnancy | | | |
| First | 48 (20.7) | 24 (23.8) | 0.311 |
| Second | 107 (46.1) | 38 (37.6) | |
| Third | 71 (30.6) | 37 (36.6) | |
| Missing | 6 (2.6) | 2 (2.0) | |
| Parity, median (IQR) | | | |
| 0 (nulliparous) | 46 (28.8) | 51 (29.5) | 0.765 |
| ≥1 (multiparous) | 104 (65.0) | 105 (60.7) | |
| Missing | 10 (6.25) | 17 (9.8) | |

^Willing to donate“ means those that answered “strongly agree” or “agree” to donating to cord bank in Nigeria while, ^^“Not willing to donate” are others that answered “strongly disagree” and “disagree” to the same question. IQR=Interquartile range, SD=Standard deviation

| Table 5: Multiple logistic regression of the predictors of intention to donate cord blood among the participants | Adjusted OR | 95% CI | P |
| Characteristics | | | |
| Knowledge of CBD | | | |
| Poor knowledge | 1.00 | Reference | Reference |
| Moderate to excellent knowledge | 0.56 | 0.21-1.53 | 0.259 |
| Age | | | |
| 20-24 | 1.00 | Reference | Reference |
| 25-29 | 1.03 | 0.30-3.56 | 0.964 |
| 30-34 | 0.82 | 0.24-2.79 | 0.748 |
| 35-39 | 0.44 | 0.12-1.62 | 0.217 |
| 40-44 | 0.31 | 0.04-2.23 | 0.247 |
| Educational qualification | | | |
| None/primary | 1.00 | Reference | Reference |
| Secondary | 2.40 | 0.33-17.41 | 0.386 |
| Tertiary | 5.26 | 0.83-33.32 | 0.078 |
| Religion | | | |
| Others | 1.00 | Reference | Reference |
| Christianity | 3.90 | 1.80-8.44 | 0.001 |
| Islam | 2.59 | 0.84-8.00 | 0.099 |
| Trimester of pregnancy | | | |
| First | 1.00 | Reference | Reference |
| Second | 2.31 | 0.97-5.49 | 0.057 |
| Third | 1.35 | 0.55-3.34 | 0.511 |
| Family history of genetic conditions | | | |
| No | 1.00 | Reference | Reference |
| Yes | 3.55 | 0.71-17.8 | 0.122 |

OR=Odds ratio, CI=Confidence interval, CBD= Cord blood donation
child health-care providers should be encouraged to be the lodestar in championing projects to improve the awareness of cord blood donation and the potential benefits of cord blood transusion.

Acknowledgment
We are grateful to the participants of this study who were gracious enough to take time out to answer the questionnaires and also the resident doctors in the Department of Obstetrics and Gynaecology, LUTH, for helping to collate the data.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES
1. Gluckman E, Broxmeyer HA, Auerbach AD, Friedman HS, Douglas GW, Devergie A, et al. Hematopoietic reconstitution in a patient with Fanconi’s anaemia by means of umbilical-cord blood from an HLA-identical sibling. N Engl J Med 1989;321:1174-8.
2. Fruchtman SM, Hurlet A, Drucker R, Isola L, Goldman B, Schneider BL, et al. The successful treatment of severe aplastic anaemia with autologous cord blood transplantation. Biol Blood Marrow Transplant 2004;10:741-2.
3. Cutler C, Ballen KK. Improving outcomes in umbilical cord blood transplantation: State of the art. Blood Rev 2012;26:241-6.
4. Rocha V, Cornish J, Sievers EL, Filipovich A, Locatelli F, Peters C, et al. Comparison of outcomes of unrelated bone marrow and umbilical cord blood transplants in children with acute leukemia. Blood 2001;97:2962-71.
5. Locatelli F, Rocha V, Reed W, Bernaudin F, Ertzem M, Grafakos S, et al. Related umbilical cord blood transplantation in patients with thalassemia and sickle cell disease. Blood 2003;101:2137-43.
6. Hall JG, Martin PL, Wood S, Kuztberg J. Unrelated umbilical cord blood transplantation for an infant with B-thalassemia major. J Pediatr Hematol Oncol 2004;26:382-5.
7. Staba S, Escolar M, Poe M, Kim Y, Martin PL, Szaboics P, et al. Cord-blood transplants from unrelated donor in patients with Hurler’s syndrome. N Engl J Med 2004;350:1960-9.
8. Myers LA, Hershfield MS, Neale WT, Escolar M, Kurtzberg J. Purine nucleoside phosphorylase deficiency (PNP-def) presenting with lymphopenia and developmental delay: Successful correction with umbilical cord blood transplantation. J Pediatr 2004;145:710-2.
9. Escolar ML, Poe MD, Provenzale JM, Richards KC, Allison J, Wood S, et al. Transplantation of umbilical-cord blood in babies with infantile Krabbe’s disease. N Engl J Med 2005;352:2069-81.
10. Gunning J. Umbilical cord cell banking--implications for the future. Toxicol Appl Pharmacol 2005;207:538-43.
11. Horwitz EM. Stem cell plasticity: A new image of the bone marrow stem cell. Curr Opin Pediatr 2003;15:32-7.
12. Global Cord Blood Industry Database; 2017-18. Available from: https://www.bioinformant.com/product/global-cord-blood-industry-database/. [Last accessed on 2018 Sep 15].
13. Cord Blood Industry Report; 2015. Available from: http://cordbloodindustryreport.org/. [Last accessed on 2018 Sep 10].
14. Geographical Breakdown of AABB Accredited Cord Blood Banks; 2015. Available from: https://www.bioinformant.com/geographical-breakdown-of-aabb-accredited-cord-blood-banks/. [Last accessed on 2018 Sep 15].
15. Kurtzberg J, Lyerly AD, Sugarman J. Untying the Gordian knot: Policies, practices, and ethical issues related to banking of umbilical cord blood. J Clin Invest 2005;115:2592-7.
16. Federal Ministry of Health. Bone Marrow Registry in Nigeria; 2012. Available from: http://www.bonebarnigeria.org/wp-content/uploads/.../BMRR-cord-blood-bank.pdf [Last accessed on 2018 Jan 20].
17. Nwannadi IA, Aalo OO, Swende T, Elachi AF. Umbilical cord blood donation and banking: Awareness among pregnant women, in Makurdi, Nigeria. IOSR JDMS 2014;13:16-9.
18. Curtis K, Haws M, Jacob T. Knowledge and perceptions of cord blood donation among pregnant women. Weber State Univer Undergrad Res J 2013;7:72-9.
19. Fernandez CV, Gordon K, Van den Hof M, Taweel S, Baylis F. Knowledge and attitudes of pregnant women with regard to collection, testing and banking of cord blood stem cells. CMAJ 2003;168:695-8.
20. The World Bank Data; 2017. Available from: https://data.worldbank.org/indicator/SP.DYN.TFRT.IN?locations=NG. [Last accessed on 2018 Aug 19].
21. Adekile AD, Adeodu OO. Haemoglobinopathies: Textbook of Paediatrics and Child Health in a Tropical Region. 2nd ed. Owerri: African Educational Services; 2007. p. 373-90.
22. Bhandari R, Lindley A, Bhatia D, Bagic A, Mueckl K, Rao R, et al. Awareness of cord blood collection and the impact on banking. Pediatr Blood Cancer 2016;70:e26412.doi:10.1002/pbc.26412.
23. Jordens CF, Kerridge IH, Stewart CL, O’Brien TA, Samuel G, Porter M, et al. Knowledge, beliefs, and decisions of pregnant Australian women concerning donation and storage of umbilical cord blood: A population-based survey. Birth 2014;41:360-6.
24. Bazuyu N, Nwogoh B, Ikponmwen D, Irowa O, Okugbo S, Isa I, et al. First successful allogeneic hematopoietic stem cell transplantation for a sickle cell disease patient in a low resource country (Nigeria): A case report. Ann Transplant 2014;19:210-3.
25. Pandey D, Kaur S, Kamath A. Banking Umbilical Cord Blood (UCB) stem cells: Awareness, attitude and expectations of potential donors from one of the largest potential repository (India). PLoS One 2018;11:e0155782.
26. Katz G, Mills A, Garcia J, Hooper K, McGurckin C, Platz A, et al. Banking cord blood stem cells: Attitude and knowledge of pregnant women in five European countries. Transfusion 2011;51:578-86.
27. Jordens CF, O’Connor MA, Kerridge IH, Stewart C, Cameron A, Keown D, et al. Religious perspectives on umbilical cord blood banking. J Law Med 2012;19:497-511.