

# THE VALUE OF BLOOD IN SUB-SAHARAN AFRICA

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## INTRODUCTION

- Blood transfusion is an essential component of the health care system of every country<sup>1-77</sup>. Patients who require blood transfusion services as part of the clinical management of their condition have the right to expect that enough safe blood will be available to meet their needs<sup>29</sup>.
- Millions of lives are saved each year through blood transfusions. In 2013, the most recent year for which global data are available, approximately 100 million blood units were donated worldwide<sup>87</sup>, 5.6 million of those were collected in Africa (5.6%). An estimated million (4.3%) of those units were donated in sub-Saharan Africa (SSA), which has approximately 12% of the global population. In SSA, the access to enough safe blood is not guaranteed. Previous research demonstrated that African countries in general struggle to match blood supply to blood demand<sup>29,47</sup>. Examples of such countries include Kenya<sup>1-24</sup>, Ghana<sup>25-40</sup> and Ivory Coast<sup>41-47</sup>.
- Though there is a good understanding on the relationship between blood supply and morbidity and mortality within a country, studies that directly measure the impact of increased blood supply on healthcare performance are not publicly available within Kenya, Ghana and Ivory Coast. More specifically, very few studies in this region have looked at predictors of survival of patients requiring acute massive transfusion (e.g. due to maternal bleeding) or chronic transfusion (e.g. due to chronic anemia)<sup>12-13</sup>.

## OBJECTIVES

This research intended to map the causes and consequences of the shortage in blood and blood components in SSA and specifically in Kenya, Ghana and Ivory Coast. Moreover, this research intended to summarize the impact of shortage of blood on general mortality, socio-economic outcomes, morbidity and maternal mortality in specific.

## METHODOLOGY

A comprehensive literature search was performed using PubMed. The following search terms were applied separately and in combination with the countries of investigation (Kenya, Ivory Coast and Ghana): blood, availability, supply, demand, donation, transfusion, shortage, maternal, hemorrhage, bleeding, pregnancy, collection. In total this search yielded 695 publications. 321 of those publications related to Kenya, 310 to Ghana and 64 related to Ivory Coast. After initial screening of the abstracts, 46 (Kenya: 23, Ghana: 15, Ivory Coast: 8) publications were retained that directly discuss the impact of blood availability on the health outcomes for patients<sup>1-47</sup>. As few publications on these topics were identified, clinical experts from the selected countries were included as an additional source of information.

## RESULTS

### Absolute shortage of blood units

The World Health Organization(WHO) estimates that resource-limited countries will begin to meet clinical demand if at least 10 whole blood units per 1,000 inhabitants are collected annually. Neither Ghana, Ivory Coast or Kenya achieve the 10 collections per 1000 inhabitants threshold (see table 1: Blood collections per 1000 inhabitants)<sup>47,48</sup>.

Country	2008	2013
Ghana	6,0	6,0
Ivory Coast	6,0	6,0
Kenya	3,5	3,5

### Failure of an entire blood supply chain

Our literature review<sup>1-47,50,54,55,57,59</sup> suggests that within SSA and specifically within the 3 countries of investigation (Kenya, Ghana and Ivory Coast) a substantial gap exists between the need for blood and the availability of blood. This gap results in the delay of initiating life-saving transfusions or not providing required transfusions at all<sup>51,11,12</sup>.

Gaps between the demand and supply of blood are available across the entire blood supply chain and include:

- Lack of transparency on the availability of blood versus demand<sup>41,51,60</sup>
- Shortage of (repeat) (non-remunerated) blood donors<sup>5,9,26,28,31,41,44,47,51,55</sup>
- High level of blood contamination with transfusion transmissible infection (TTIs)<sup>3,6-10,19,41-43,45,47,49,51,54-56,66</sup>
- Shortages of specific blood types<sup>8,41,47,55</sup>
- Cultural counter-arguments for the collection and transfusion of blood<sup>41,58,45</sup>
- Missing healthcare infrastructure (blood collection centres, storage, collection devices and disposables, blood testing and trained staff) at the point of blood collections as well as missing healthcare infrastructure at the point where blood is transfused<sup>17,20,25,28,41,51</sup>
- Educational difficulties on the collection, distribution and application of blood<sup>41,45,47</sup>
- Large differences between rural and urban healthcare infrastructure<sup>25,41,55</sup>
- Missing local blood transfusion guidelines and non-adherence to international recommendations<sup>12,41,45,51,59</sup>
- Misuse of the scarce available units of blood, up to 47% of blood transfusion may be provided to patients that are not in the highest need for blood transfusion<sup>3,5,12,41,53,59,60</sup>
- Insufficient funds dedicated for organizing a sufficient blood supply chain<sup>31,41,42,55</sup>

## RESULTS

### Very high burden of TTIs

The importance of blood safety in public health was recognized long ago<sup>41,45</sup>. Local governments and authorities in Kenya, Ghana and Ivory Coast did take initiatives within the last decades to improve the availability of safe blood. Simultaneously international governmental and non-governmental organizations have largely supported this effort as well. However, the output of these efforts has been negligible<sup>2,45,48,60</sup>.

Not only is there a shortage of blood in the countries under investigation, but the safety of available blood cannot be guaranteed. Donated blood is frequently contaminated with HIV, hepatitis B (HBV), hepatitis C (HCV), syphilis, malaria and other TTIs. These TTIs make the organization and facilitation of a stable blood supply chain even more complex<sup>3,6-8,10,19,41-43,45,47-49,51,54-56,66</sup>.

Across the investigated countries the following published TTI prevalence were found (see table 2: TTI incidence); though large variations were found per country, region, blood collection service and hospital type<sup>3,5-8,19,28,30,32,43</sup>.

	Min	Average	Max	(n = references)
<b>Total TTI infected blood units</b>	9,4%	21,2%	50%	8
HIV	1,2%	7,5%	20%	14
HBV	3,5%	5%	7,5%	5
HCV	3,2%	5,14%	6,1%	3
Syphilis	1%	3%	4,7%	4
Malaria	0,6%	25,3%	5%	2

### Mortality and Morbidity

These shortages in terms of blood supply in Kenya, Ghana and Ivory Coast directly contribute to the overall mortality and morbidity figures<sup>10,11</sup>. Anemic patients (often children and pregnant women) that are not transfused blood or experience a delay to meet their transfusion needs may have a mortality risk that could be over twice as high versus their peers that receive blood transfusion appropriately<sup>11,47</sup>.

### Economic impact

As discussed above, multiple conditions require the transfusion of blood. In the countries of investigation there are between 342 and 600 maternal mortality cases per 100 000 births<sup>89</sup>. Our research demonstrated that bleeding and shortage of blood accounts for minimally 10% of maternal mortality rates<sup>15,22,27,33,34,36,38,40,49,57,58,62,66-69</sup>. Taking into account the births per year in the countries of investigation<sup>79,80,82</sup>, an age at delivery<sup>90</sup> between 20-27 and the local life expectancy rates<sup>79,81,83</sup>, it is possible to estimate the life years lost due to untreated bleeding. The value of a life year lost is estimated by means of the human working capital method, taking into account the yearly wages and a 48-64% employment rate of females<sup>91</sup>. Doing so, the total minimal yearly value forgone due to severe bleeding and the shortage of blood to overcome this condition, is 7.3 million USD (see table 2: Economic Impact of Blood Shortage).

	Kenya	Ghana	Ivory Coast	Total
<b>Total births per year</b>	1 534 900 <sup>(79)</sup>	836 005 <sup>(80)</sup>	944 778 <sup>(82)</sup>	3 315 683
<b>Maternal mortality</b>	5 249	2 575	5 829	13 654
<b>Life expectancy</b>	61,1 <sup>(79)</sup>	63 <sup>(81)</sup>	54 <sup>(83)</sup>	
<b>Median age at delivery</b>	20,3	22,3	27	
<b>Life years lost</b>	40,8	40,7	27	
<b>Total life years lost</b>	214 174	104 798	157 391	
<b>Employment rate females</b>	64%	64%	48%	
<b>Total life years lost due to blood shortage (10%)</b>	21 417	10 480	15 739	
<b>Value of a life year lost per year (USD)</b>	6979 <sup>(84)</sup>	6259 <sup>(85)</sup>	3626 <sup>(86)</sup>	
<b>Total value of life years lost due to blood shortage (USD)</b>	149 471 899	65 593 220	57 069 820	
<b>Total value lost per year (USD)</b>	3 663 527	1 611 627	2 113 697	7 388 851

## REFERENCES

- Kris E.M. et al (1997) Longitudinal evaluation of severely anemic children in Kenya: the effect of transfusion on mortality and hematologic recovery. *AIDS*. Oct;11(12):1487-94. 12. Nabwera H.M. et al (2015) Pediatric blood transfusion practices at a regional referral hospital in Kenya. *Transfusion*. Nov;55(11):2722-2738. 13. Centers for Disease Control and Prevention (CDC) (1995) CDC finds Kenya's blood stocks unsafe. *AIDS Alert*. Aug;5(4):21-4. Zuber J.R. et al (1994) Inequity, blood transfusion practices, HIV and mortality among women of reproductive age in western Kenya. *Trans R Soc Trop Med Hyg*. 1994; Apr;68(1):174-8. 15. Luchini E.M. et al. (1993) Blood transfusion practices and blood-banking services in a Kenyan hospital. *AIDS*. 1993 Jul;7(7):995-9. 16. Onyango G. et al (2018) Seroprevalence and determinants of transfusion-transmissible infections among voluntary blood donors in Kisumu, Kenya. *BMC Public Health*. 2017 Nov 8;18(46):362-366. doi: 10.1007/s10086-017-0609-9. 17. Wambua D. et al (2015) Transfusion Transmissible Infections Among Walk-in Blood Donors at Kisumu Regional Blood Transfusion Centre, Kisumu County, Kenya. 2015. Lab Med. 2017 Nov 8;48(11):362-366. doi: 10.1093/labmed/lbx009. 18. Mami D. et al (2011) Blood donors in Kenya: a comparison of voluntary and family replacement donors based on a population-based survey. *Vol Blood Donor*. 2011 Feb;1(2):212-4. doi: 10.1133/1473-0430(2011)0101212. Epub 2010 Aug 25. 19. Quantification of point, radio and television exposure among previous blood donors in Kenya: an opportunity for encouraging repeat donation in a resource-limited setting? *Vol Sang*. 2010 Oct;9(3):274-7. 110. Guetter C. et al (2010) Giving transaminase cut to reduce surgical bleeding in sub-Saharan Africa: an economic evaluation. *Cost Eff Health Alloc*. 2010 Feb 17;11(1):1-11. Thomas J. et al (2017) Blood Transfusion Delay and Outcome in County Hospitals in Kenya. *Am J Trop Med Hyg*. 2017 Feb;96(2):151-154. doi: 10.4269/ajtmh.16-0735. Epub 2016 Dec 5. 12. Riviere D. S. et al (2015) Improving decision-making for massive transfusions in a resource-poor setting: a preliminary study in Kenya. *PLoS One*. 2015 May 28;10(5):e0127987. doi: 10.1371/journal.pone.0127987. 13. Kiguli S. et al (2015) Anemia and blood transfusion in African children presenting to hospital with severe febrile illness. *BMC Med*. 2015 Feb 23;13:21. doi: 10.1186/s12916-014-0246-7. 114. Saidi H., Mutiso B., and Ojwangi (2014) Mortality after road traffic crashes in a system with limited trauma data capability. *J Trauma Manag Outcomes*. 2014 Feb 13;8(1):4. doi: 10.1186/1752-2897-4-13. Oloro A. A. et al (2013) Determinants of Maternal Mortality among Women of Reproductive Age Attending Kisi General Hospital, Kisi Central District, Kenya (January 2009 - June 2010). *East Afr Med J*. 2013 Aug;90(8):253-61. 116. Androic R. (2010) Changing trends in blood transfusion in children and neonates admitted in Kisi District Hospital, Kenya. *Malawi J Med*. 2010 Oct;10:307-117. Oloro A. A. et al (2010) Progress in Blood Transfusion Services in Kenya from the 1980's to Present. *East Afr Med J*. 2009 Dec;86(12 Suppl):S98-101. 118. Oloro A. A. et al (2007) Changing trends in blood transfusion in Nairobi. *East Afr Med J*. 2007 Sep;84(9 Suppl):S22-31. 119. Moore A. et al (2010) Estimated risk of HIV transmission by blood transfusion in Kenya. *Lancet*. 2010 Aug 25;376(9820):657-60. 120. Nagai P.M. and Saha P.K. (2007) Open sample seroprevalence and blood transfusion in Nairobi. *East Afr Med J*. 2007 Sep;84(9 Suppl):S22-31. 121. Rang R.M., Mwangi J.K., and Brhene E.K. (2017) When a woman is pregnant, her grave is open: health beliefs concerning dietary practices among pregnant Kalerwin women in rural Uasin Gishu County, Kenya. *J Health Popul Nutr*. 2017 Dec; 18(36):153. doi: 10.1186/s10443-017-0130-0. 122. Makhkha A. E. (1991) Medical-social and socio-demographic factors associated with maternal mortality at Kenyatta National Hospital, Nairobi, Kenya. *J Obstet Gynaecol East Cent Africa*. 1991;19(1):6-13. Burke T.F. et al. (2015) Shock progression and survival after use of a condom uterine balloon tamponade package in women with uncontrolled postpartum hemorrhage. *Int J Gynaecol Obstet*. 2017 Oct;191(3):36-38. doi: 10.1002/igo.12215. Epub 2017 Jul 21. 24. Brown H. et al. (2016) The Babt tamponade balloon as an adjunct treatment for refractory postpartum hemorrhage. *Int J Gynaecol Obstet*. 2016 Dec;192(1):276-280. doi: 10.1016/j.ijgo.2016.06.025. Epub 2016 Aug 2. 25. Gebreyes W. et al (2012) Geographical access to care at birth in Ghana: a barrier to safe motherhood. *BMC Public Health*. 2012 Nov 16;12:991-126. Owusu-Ofori S. et al (2010) Fostering repeat donations in Ghana. *Biological*. 2010 Jun;36(1):47-52. doi: 10.1016/j.biolog.2009.10.021. 127. Maternal mortality due to hemorrhage in Ghana. *Int J Gynaecol Obstet*. 1998 Sep;62(1):37-41. 128. Kubli C. et al. (2012) Blood transfusion practice in a rural hospital in Northern Ghana, Ghana. *West Afr J Med*. 2012 Oct;31(10):216-4. 129. Mahomed S. and Kiser B. (2018) Motivational factors for blood donation, potential barriers, and knowledge about blood donation in first-time and repeat blood donors. *BMC Hematol*. 2018 Dec; 20:38-36. 130. Allan J.P. et al. (2013) Deferred donor care in a regional hospital blood centre in Ghana. *Transfusion*. 2009 Apr;49(4):669-75. 131. Allan J.P. et al. (2010) A pool of repeat blood donors can be generated with little expense: the blood centre in sub-Saharan Africa. *Transfusion*. 2008 Apr;48(4):750-41. 132. Owusu-Ofori S. et al. (2013) Transfusion-transmitted malaria in Ghana. *Clin Infect Dis*. 2013 Jun;56(12):1735-41. 133. Fofie C. and Ballo P. (2010) A two-year review of uterine rupture in a regional hospital. *Ghana Med J*. 2010 Sep;44(3):186-192. 134. Gebreyes W. et al. (2006) Maternal and fetal outcome after severe anemia in pregnancy in rural Ghana. *Aids Obstet Gynecol*. 2006;8(5):49-55. 135. Conroy D. and Dwyer P. (1995) Childbirth deaths from anaemia in Accra, Ghana. *West Afr J Med*. 1995 Apr-Jun;14(2):101-8. 136. Owusu-Sarpong A., Baaidin F., Associated Factors and Quality of Care Received among Maternal Deaths at a Regional Hospital in Ghana. *Maternal Death Review Afr J Reprod Health*. 2017 Jun;21(12):49-54. 137. Rang R. et al. (2014) Ovipositor for preventing postpartum haemorrhage (PPH) in non-facility birth settings. *Cochrane Database Syst Rev*. 2014 Apr 14;CD010493. 138. Adusu-Poku Y. et al (2015) Quality of Care: A Review of Maternal Deaths in a Regional Hospital in Ghana. *Afr J Reprod Health*. 2015 Sep;19(3):68-76. 139. Stanton C.K. et al (2013) Effect on postpartum hemorrhage of prophylactic oxytocin (10 IU) by injection by community health officers in Ghana: a community-based, cluster-randomized trial. *PLoS Med*. 2013 Oct;10(10):e1001224. 140. Motherhood can be safer - even where conditions are hard (N96). *Safe Mother*. 1996;11(1):2-141. Tanyi C.T. et al. (2019) Characteristics of blood donors and donated blood in sub-Saharan Francophone Africa. *Transfusion*. 2019 Aug;59(8):1592-9. 142. Hember M. and Jefferson E. (2000) Financing blood transfusion services in sub-Saharan Africa: a role for user fees? *Health Policy Plan*. 2000 Sep;15(3):287-95. 143. Schurr C. et al. (1993) Reducing blood donors at high risk of HIV infection in a west African city. *Bull WHO*. 1993 Dec; 11:307(6):615-19. 144. Kroube D. et al. (2017) Reasons for blood donation refusal in sub-Saharan Africa: experience in Ivory Coast. *Transfusion*. 2012 Jul;52(7 Pt 2):1602-6. 145. Tanyi C.T. et al. (2009) The transfusion center, the blood donor and the given blood in Francophone African countries. *Transfus Clin Biol*. 2009 Nov;16(5):493-41. 146. Berardi L., Richard A., Ojwangi B. and Pagnier M. (1989) Concentration of maternity care in World Bank Forum. 1989;10(3):403-6. 147. Oloro A. A., Nembere B. and Konde S. (2016) Blood collection to cover national need in sub-Saharan Africa: the reality of the Ivory Coast. *Blood Transfus*. 2016 Oct;12(4):624-5. 148. Ubbayankar S. et al. (2018) Trends and Gaps in National Blood Transfusion Services - 34 sub-Saharan African countries, 2014-2016. *MMWR Morb Mortal Wkly Rep*. 2018 Dec 21; 67(50): 1392-1396. 149. Tanyi C.T. et al (2017) Ethical hemorrhage and safe blood for transfusion in sub-Saharan Africa. *Transfusion*. 2017 Oct;57(10):2526-2531. 150. Akara B. (2017) Knowledge, attitudes, and practice towards blood donation among health care providers in hospitals in Bahr Dar, Congo, Ethiopia. *Transfus Apher Sci*. 2017 Jun;56(3):494-498. 151. Anika J.C. and Doucha E.C. Blood transfusion safety, current status and challenges in Nigeria. *Ann Afr J Transfus Sci*. 2017 Jun;11(1):5. doi: 10.4300/ajts.17.01.02. 152. Spiegel D.A. et al. (2017) Retrospective review of Surgical Availability and Readiness in 8 African countries. *BMC Opin*. 2017 Mar; 6(3):1404-666. 153. Oloro A. A., Oloro A. A., Oloro Oloro A. S., and Allan J. P. (2013) Appropriateness of blood product transfusion in the Obstetrics and Gynecology (OG) department of a tertiary hospital in West Africa. *Transfus Med*. 2013 Jun;23(3):150-6. 154. Erhabor O. and Adisa T.C. (2011) From whole blood to component therapy: the economic, supply/demand need for implementation of component therapy in sub-Saharan Africa. *Transfus Clin Biol*. 2011 Dec;18(5):156-166. 155. Allan J.P. (2011) Moving from voluntary non-remunerated donors, who are the best blood donors? *Br J Haematol*. 2011 Sep;145(4):763-9. 156. Zwerdt D. and Sany Y. (1991) National blood requirement, services A11 and hepatitis in Ethiopian blood donors. *Ethiop Med J*. 1991 Oct;29(4):175-83. 157. Bullock C.H. (1981) Analysis of maternal deaths in the Central Region of Malawi. *East Afr Med J*. 1981 Jun;58(12):36-158. 158. Ouyahire G. J. (1980) Environmental factors influencing maternal mortality in Zaria, Nigeria. *J Soc Health*. 1980 Apr;10(2):72-139. 159. Tanyi M. et al. (2017) Obstetric hemorrhage and safe blood for transfusion in Ethiopia: the challenges of bridging the gap. *Transfusion*. 2017 Dec;57(12):2526-2531. 160. Jarman A.J., van Rheenen D.J., Steeghe A. and Duvetel L.J. (2005) Postpartum hemorrhage and transfusion of blood and blood components. *Obstet Gynecol Surv*. 2005 Oct;60(10):166-71. 161. Balk M. et al. (2018) Blood transfusion for primary postpartum hemorrhage: a tertiary care hospital review. *J Obstet Gynecol*. 2018 Nov; 30(10):1600-1607. 162. Bennett M. and Benhamou S. (2016) Management of postpartum hemorrhage. *Version 1.1*. 2016. 15000 Faculty for US-14. Published online 2016 Jun 27. 63. Sawford R. and Mabury H. How to treat postpartum hemorrhage. *Blood*. 2015; 25:2759-2770. 164. Price B.W., Duvetel L.J., van Rheenen D.J., and Jarman A. J. C. (2016) Transfusion triggers in patients with postpartum hemorrhage. First published: 29 January 2016. 165. Royal College of Obstetricians and Gynaecologists (2018) Blood Transfusion in Obstetrics. Retrieved from: [https://www.rcog.org.uk/~/media/rcogmedia/documents/clinical\\_guidance/2018\\_blood\\_transfusion\\_in\\_obstetrics.pdf](https://www.rcog.org.uk/~/media/rcogmedia/documents/clinical_guidance/2018_blood_transfusion_in_obstetrics.pdf) 166. International Federation of Gynecology and Obstetrics (2018) PPH: leading to unnecessary deaths. Retrieved from: <https://www.ifgob.org/en/press-and-publications/news-clips/2018-09-14-pph-leading-to-unnecessary-deaths> 167. Anderson J. and Titcher D. (2007) Prevention and Management of Postpartum Hemorrhage. *Am Fam Physician*. 2007 May 15;75(6):875-882. 17. Adoni A. C. (2010) Global Maternal Mortality Rates. Retrieved from: <http://www.who.int/mediacentre/factsheets/fs204/en/> 18. Ramler P.I. et al (2017) Incidence, management and outcome of women requiring massive transfusion after childbirth in the Netherlands: secondary analysis of a nationwide cohort study between 2006 and 2006. *BMC Pregnancy Childbirth*. 2017; 17: 171. 19. Wenzel A. (2016) The prevention and treatment of postpartum haemorrhage: what do we know, and where do we go to next? DOI: 10.1111/1471-0528.13098 retrieved from: <https://doi.org/10.1111/1471-0528.13098> 174. zane B. Ford J.B. et al. (2011) Trends and outcomes of postpartum haemorrhage, 2003-2011. *BMC Pregnancy Childbirth*. 2015; 15: 175. 20. Sheldon H.S. et al (2014) Postpartum haemorrhage management, risks, and maternal outcomes: findings from the World Health Organization Multicountry Survey on Maternal and Newborn Health. First published: 18 March 2014. <https://doi.org/10.1181/s11474-014-0218-176> 21. Bates J., Chappot G., McKee S., van den Broek N. Maternal mortality in sub-Saharan Africa: the contribution of ineffective blood transfusion services. *BMC Res Notes*. 2016; 9:1333-1339. 177. Field S.P., Allan J.P. Transfusion in sub-Saharan Africa: does a Western model fit? *Clin Pathol*. 2007; 10: 1073-1075. doi: 10.1136/bcp.2006.040305. 178. UN San Francisco (2000) Economic Studies and Related Methods - Valuing Human Life: Estimating the Present Value of Lifetime Earnings. 2000. Retrieved from: <http://www.unicef.org/development/040305.pdf> 179. Kenya statistics retrieved from: <http://www.statistics.go.ke/> 180. Koenigstein (2019) Ghana Birth rate. Retrieved from: <https://data.worldbank.org/SH.SRVS.SRVS.CD> 181. The world bank (2019). The expectancy at birth. Retrieved from: <http://data.worldbank.org/SH.SRVS.SRVS.CD> 182. The global economy (2019) Ivory coast birth rate. Retrieved from: [https://www.theglobaleconomy.com/Ivory\\_Coast/Birth\\_rate/](https://www.theglobaleconomy.com/Ivory_Coast/Birth_rate/) 183. World Population review (2019) Ivory coast. Retrieved from: <http://www.worldpopulationreview.com/countries/ivory-coast/> 184. CXC (2019) Kenya Average Wage Statistics CXC. Retrieved from: <http://www.cxc.org/~/media/cxcorg/kenya-average-wage-statistics-2019.pdf> 185. Number (2019) Cost of living in Ghana. Retrieved from: [https://www.numbers.com/cost-of-living/country\\_result.php?country=Ghana](https://www.numbers.com/cost-of-living/country_result.php?country=Ghana) 186. Number (2019) Cost of living in Ivory Coast. Retrieved from: [https://www.numbers.com/cost-of-living/country\\_result.php?country=Cote\\_d'Ivoire](https://www.numbers.com/cost-of-living/country_result.php?country=Cote_d'Ivoire) 187. Global Press Journal (2019) Blood Transfusion in Africa. Retrieved from: <http://www.globalpressjournal.com/press-release/blood-transfusion-in-africa-reveals-unsafe-practices/> 188 WHO 2016. blood report. Retrieved from: [https://apps.who.int/iris/handle/10665/259877?ref=publist\\_ui/15045411\\_cms111](https://apps.who.int/iris/handle/10665/259877?ref=publist_ui/15045411_cms111) 189 The World Bank (2019) Maternal Mortality rates. Retrieved from: <https://data.worldbank.org/indicator/SH.MRVS.SRVS.CD> 190 The world factbook - Mother's smm: age at first birth. Retrieved from: <https://www.cia.gov/library/publications/the-world-factbook/files/docs/1001131.html> 191 The world bank (2019) Labor force participation rate, female. Retrieved from: <https://data.worldbank.org/indicator/SL.TLFC.FE.ZS>

