



Prevalence of under-five years of age mortality by infectious diseases in West African region

Yusupha Sanyang

University of the Gambia, Gambia



ARTICLE INFO

Keywords:

Infant
Mortality
Infectious disease
Children
Under-five
West Africa

ABSTRACT

Background: The under-five mortality is one of the indicators of the progress and improvement of the health system of a country. With the passage of the Millennium Development Goals and now four years into the sustainable development goal the countries within West Africa still are faced with the high burden of under-five mortality especially from infectious diseases.

Objective: The objective of this review is to highlight the prevalence of under-five mortality in West Africa.

Data sources: This is a grey literature review of under-five deaths in West Africa. Searches for relevant literatures was made on pub Med, Google Scholar and Scopus. Searches was also done in institute for Health Metrics and Evaluation (IHME) and World Health Organization Data Bases. Relevant publications and reports available at WHO and UNICEF websites were also used. A total of ten articles were included in this review and the rest are publications from UNICEF AND WHO. The keywords used during the search include under-five mortality, infectious diseases, and West Africa. The year of publication of the reports and data included in this review ranges from 2015 to 2017.

Results: There is still high burden of under-five mortality in the West African region and the major contributing factor is the infectious diseases including Pneumonia Sepsis tetanus Diarrhoea Malaria AIDS measles meningitis. While others are still lingering, it was only Niger and Senegal that had achieved the millennium development goal target of reducing under-five mortality to two-thirds from m1990-2015. However, Cape Verde has now achieved the SDG target 3.2 with an under-five mortality of 17/1000 live births.

Conclusion: The countries in this region needs to work hard to reduce this burden. This requires huge investment especially the financial and human resource development.

1. Introduction

The region of West Africa comprises fifteen countries that stretches from Senegal in the northeast, to the Gulf of Guinea, the Lake Chad and the highlands bordering Cameroon to the west. The average population of the region in 2011 was 316 million with Nigeria forming the largest proportion of 160 million and capo Verde the lowest with 0.5 million. The under-five proportion of the population range from 10.3% to 19.9% with Nigeria having the largest under-five population of 27.2 million, forming 52.2% of the total in the sub-region (Umar and Osinusi, 2014).

All the countries in the region are classified under “lower income” and “middle lower income” group. The world bank classified lower income countries as those with a Gross National Income (GNI) per capita of less than \$1,025 or less in 2015, lower middle income countries are defined as those with GNI per capita between \$1025 and \$4035 respectively (World Bank, 2016). The reduction of Under-five mortality rate is a target for millennium development goal four (MDG 4), which

aimed to reduces under-five mortality by one third from 1990 to 2015. However with the conclusion of the MDG in 2015 few countries 57 out of 195 were able to meet the target (Golding et al., 2017). With the passage of the MDG the focus has now shifted to the Sustainable development goals (SDG 3). The focus of the goal is to end preventable deaths in New-born and children under-five years of age and requires all countries to reduce under-five mortality to at least 25 deaths/1000 live birth by 2030. There remains enormous concern in meeting this target as the child survival remain a major concern. The number under-five deaths recorded in 2017 stands at 5.4 million and 2.5 million of those children died in the first month of life (UN-IGME-Child-Mortality-Report-2018.pdf, 2019). The current under-five mortality rate in sub-Saharan Africa is 76/1000 live birth with decline of 58% from 1990 to 2017 (UN-IGME-Child-Mortality-Report-2018.pdf, 2019). The Africa health region generally experience a decline in neonatal mortality to 38% from 41 in 2000 to 28 in 2015 and the under-five mortality rate decline from 153 in 2000 to 81 in 2015 (Atlas, 2019). Most of these

E-mail address: ysanyang@utg.edu.gm.

<https://doi.org/10.1016/j.ijans.2019.100175>

Received 1 February 2019; Received in revised form 1 November 2019; Accepted 7 November 2019

Available online 09 November 2019

2214-1391/ © 2019 The Author. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

deaths are from preventable causes such as diarrhoea, malaria and pneumonia ([UN-IGME-Child-Mortality-Report-2018.pdf, 2019](#))

This review intends to find out the deaths caused by infectious diseases among the Under-fives in West African countries as well as to look at the gains in reducing under-five deaths during the MDG era and the progress made towards meeting the sustainable development goal 2030. This is very significant as under-five deaths is a good indicator of the countries socio-economic development. Since there is high mortality among this age group, the main aim will be to find out the percentage of death caused by infectious diseases. This will highlight the magnitude of the problem and bring it to the attention of the policy makers. The review will also highlight the progress made by the West African countries towards the achievement of the millennium development goal four and the sustainable development goals. 1) What are the successes of West African countries in meeting the MDG target of reducing under-five mortality? 2) What are the successes of West African countries in reducing under-five mortality to meet the SDG TARGET? 3) What is the percentage of deaths caused by infectious diseases among under-fives in West Africa?

The objectives of this study:

- To find out whether successes achieved towards meeting the Millennium development Goals target of reducing under-five mortality
- To find out the progress towards Sustainable Development Target of reducing under-five mortality
- To find out the number of deaths caused by infectious diseases by infectious diseases among under-fives in West Africa?

2. Methods

This is a grey literatures review to find out the under-five deaths and the major infectious diseases causing under-five deaths in West Africa.

2.1. Search strategy

Searches for relevant literatures was made on pub Med, Google Scholar and Scopus. Searches was also done in institute for Health Metrics and Evaluation (IHME) and World Health Organization Data Bases. Relevant publications and reports available as well as data at WHO and UNICEF websites were also used. The language used for searching the literature was the English language and it is also presented in the English language.

Sources: the sources of the review are from journal articles, United Nations agency reports, which includes World Health Organisation and UNICEF and the World Bank.

2.2. DATA collection method

The search was done in many online journals and databases to find articles that have relationship with the research questions. The titles and abstract were first checked to find out whether they have a relationship with the topic and finally the full content of the articles were reviewed. Most of the data included in the study were collected form the WHO Global Health Observatory Data and publications. Furthermore, additional data were obtained from some journal articles, Ending Preventable Child and Maternal Deaths Reports and UNICEF, which include the ranking of countries under-five mortality rates.

Inclusion and Exclusion criteria: The focus of the review was the under five deaths from infectious diseases, which are the major killers in the world. These include pneumonia, malaria, HIV/AIDS, Neonatal sepsis, diarrhoeal diseases and meningitis. Therefore, only deaths caused by infectious diseases were included as well as the mortality among children under-five years of age. Any deaths resulting from any other causes were excluded from the data. Articles found not to have the required information relating to the topic were excluded. Articles

with specific reference to under five mortality in West Africa and sub-Saharan Africa were included.

2.3. Sample size

Most of the articles included in this review are UNICEF and WHO publications. Data included are from the WHO data base.

Framework for classification: The data was reviewed and used as the basis of classification. First the countries were classified according to the level of income as low income and middle-income countries. Secondly, they were classified according to high and low under five mortality countries.

Furthermore, classification was done according to countries that are on target to meet the millennium development goals. Finally, the mortality rate of the diseases was used as another form of classification.

3. Results

Many articles were searched and their titles, abstract and contents were reviewed at the end only sixteen articles as well as reports are included in this review. The articles included include cross-sectional studies using verbal autopsy and global burden of disease study, as well as WHO and UNICEF reports as indicated in the flow diagram ([Fig. 1](#)).

3.1. Under-five mortality rate

The under-five mortality rate remains higher in West Africa. Child mortality in west Africa is more than double to those experienced in north and south Africa. ([Gayawan et al., 2016](#)) The death rate was higher among children from 1 to 4 years in West Africa, with Sierra Leone having a mortality rate of 111 per 1000 livebirths. Among the countries in West Africa, Sierra Leone is ranked fifth in the world with a mortality rate of 111/1000 livebirths. Cape Verde is the country with the lowest mortality rate in West Africa with a mortality rate of 17/1000 livebirth and is ranked 80th in the world. Three countries in West Africa have a mortality rate above 100/1000 livebirths. These include, Nigeria (100/1000 livebirths), Mali (106/1000 livebirths), and Sierra Leone (111/1000 livebirths). The rest have a mortality rate of below 100/1000 livebirths in 2015 ([UN-IGME-Child-Mortality-Report-2018.pdf, 2019](#)). It can be seen that Nigeria has recorded a decline from 128 in 2013 according to the findings of ([Morakinyo and Fagbamigbe, 2017](#)). Furthermore, the rate of under-five mortality in these West African countries is below the projected rate of reduction if they are to meet the SDG target of reducing under-five mortality to 25 deaths/1000 live births in 2030. Only Cape Verde has met the SDG target in this region as shown in the table below ([Table 1](#)).

3.2. Millennium development targets

Table 2.

3.3. Deaths caused by infectious diseases

West African countries continue to experience high number of deaths from infectious diseases. The infectious diseases with the highest causes of under-five mortality includes, Sepsis, Tetanus, Diarrhoea, Pneumonia, Malaria, AIDS, Measles and Meningitis.

The number of deaths from these key infectious diseases killers in west and central Africa stands at 54% ([Ending Preventable Maternal and Child Deaths, 2016](#)). Malaria, pneumonia and diarrhoea is among the major infectious diseases that kills a large percentage of under-fives in West Africa. They contribute 13%, 17% and 10% respectively to the under-five deaths in west and central Africa. Furthermore, sepsis kills about 6%, AIDS 2%, measles 1% and pertussis, tetanus and meningitis 2% of the under-fives in west Africa ([Ending Preventable Maternal and Child Deaths, 2016](#)). There are some variations in the percentage of

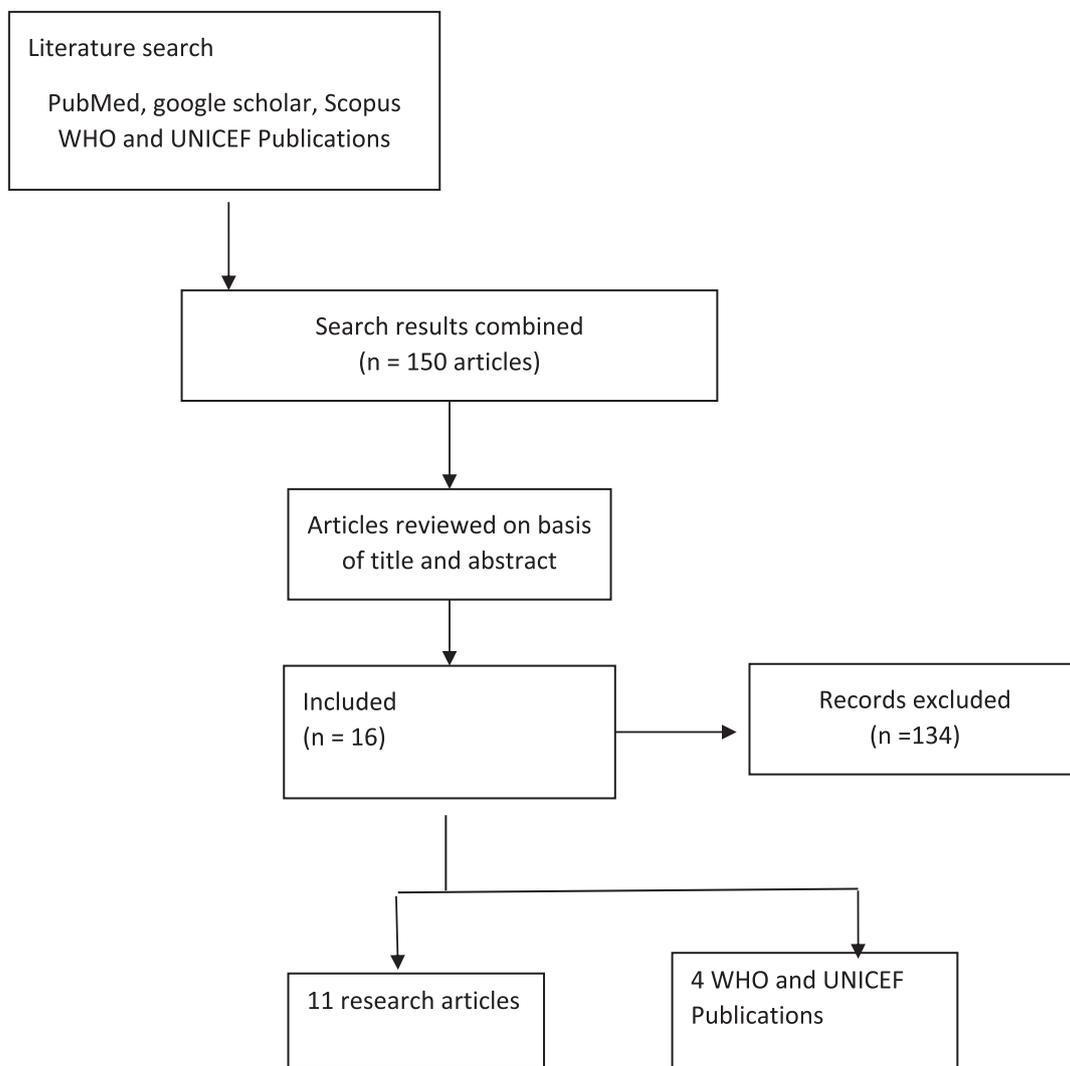


Fig. 1. Prisma flow diagram.

Table 1

Under-five mortality rate and required projected reduction in under-five mortality to meet SDG 3.2.

No	Country	Under-five mortality rate/ 100 live births	Current Annual rate of reduction	Projected rate of reduction to meet the SDG target of 25/1000 live birth by 2030
1.	Benin	98	2.2	9.7
2.	Burkina Faso	81	3.3	8.7
3.	Cape Verde	17	4.7	
4.	Cote d'Ivoire	89	2.0	9.3
5.	Gambia	64	3.6	6.9
6.	Ghana	49	3.5	6.1
7.	Guinea	86	3.7	9.1
8.	Guinea Bissau	84	3.6	9.0
9.	Liberia	75	4.6	7.1
10.	Mali	106	3.2	10.6
11.	Mauritania	79	1.5	8.4
12.	Niger	85	5.0	9.3
13.	Nigeria	100	2.8	10.2
14.	Senegal	45	4.2	4.5
15.	Sierra Leone	111	3.2	10.8
16.	Togo	73	2.6	8.0

SOURCE: WHO Africa Health Observatory (progress on SDG) and level and trends in child mortality UNICEF report 2018 statistical table.

deaths caused by infectious diseases in these countries. Nine countries have their under-five deaths caused by infectious disease above 50% with Mali recording the highest under-five deaths due to infectious diseases at 57%. Cape Verde recorded the lowest percentage of under-five deaths among the west African countries, which stands at 26% (Ending Preventable Maternal and Child Deaths, 2016). The under-five deaths caused by pneumonia among the countries ranges from 21% in Niger to 12% in Ghana. Mali recorded the highest under-five deaths caused by Malaria in west Africa with a percentage of 24% while Cape Verde has 0% deaths recorded (Ending Preventable Maternal and Child Deaths, 2016). The highest percentage of death among the under-five caused by diarrhoea was in Niger and Burkina Faso at 11%. Guinea Bissau has the highest percentage of its under-five deaths caused by AIDS at 4%, Gambia and Ivory Coast has 2% under-five deaths caused by AIDS while Mauritania recorded 0%. The rest of the countries recorded 1% of their under-five deaths caused by AIDS (Ending Preventable Maternal and Child Deaths, 2016). The meningitis death was high in Niger in West Africa with 5% under-five deaths caused by the disease. Senegal recorded the highest under-five death due to sepsis with 10% while deaths due to tetanus was generally low in the region only Ivory Coast and Mauritania recorded 1% death caused by the disease. The highest under-five deaths caused by measles was in Burkina Faso and Sierra Leone with 2% of the deaths caused by the disease (Ending Preventable Maternal and Child Deaths, 2016). Looking at findings from other studies. Nigeria has a large number of its under-five

Table 2
Millennium development targets for West African countries 2015.

Ranking (W/A)	Countries	< 5 Mortality 2015	MDG TARGET FOR 2015 for each country (Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate.)
1	Cape Verde	25	21
2	Senegal	47	47
3	Ghana	62	42
4	Gambia	69	57
5	Liberia	70	85
6	Togo	78	49
7	Mauritania	85	39
8	Burkina Faso	89	67
9	Guinea Bissau	93	76
10	Côte d'Ivoire	93	51
11	Guinea	94	79
12	Niger	96	109
13	Benin	100	60
14	Nigeria	109	71
15	Mali	115	85
16	Sierra Leone	120	88

SOURCE Levels and trend in child mortality 2015 report statistical table. The Millennium Development Goal (MDG) targets a two-thirds reduction in the under-five mortality rate between 1990 and 2015. Only Niger and Senegal have achieved the MDG target of reducing child mortality. The rest of the countries in this region had failed to achieved the MDG target set for them (IGME-report-2015-child-mortality-final_236.pdf, 2016). The results are shown in Table 2.

deaths caused by malaria and pneumonia (Ending Preventable Maternal and Child Deaths, 2016; Global, regional, and national causes of child mortality in 2000, 2016). Findings from a study done in rural Gambia to determine disease specific mortality burden found that malaria, acute respiratory tract infection and diarrhoeal diseases accounted for more than 58% of deaths among children under five years of age (Jasseh et al., 2014). These findings corroborate with a study done in rural Senegal, which also discovered that malaria and diarrhoeal diseases were the major causes of mortality constituting about 30% of the under-five deaths (Etard et al., 2004). Another study attempted to compare malaria deaths among under-five in Gambia and Burkina Faso, found out that malaria specific deaths stands at 10.1 per 1000 live years from 1981 to 1999 and for Burkina Faso the was 36.6 per 100 life years from 1993 to 1999 (Ndugwa et al., 2008). Nigeria alone, which is part of West Africa contributed substantially to the global under-five deaths. It is among the countries with the highest proportion of deaths due to pneumonia, which collectively accounted for 52%, and it is also among the countries where most of the under-five deaths due to diarrhoea 51% of the global total and also among the six sub Saharan countries where 57% of the global under-five malaria death is concentrated (Black et al., 2010). Other infectious diseases such as pertussis, tetanus, and meningitis contribute 4% to the under-five mortality in west and central Africa. Deaths from measles stands at 1%, AIDS 2% and sepsis 6% respectively among the under-fives in west and central Africa (Ending Preventable Maternal and Child Deaths, 2016). Nigeria is also among the five countries, which contributed substantially to global under-five neonatal deaths due to sepsis. Malaria, diarrhoea, meningitis, lower respiratory tract infection and HIV/AIDS were found to be the leading cause of Disability-Adjusted Life Years (DALYs) in West Africa (Reiner et al., 1990). They collectively contribute 0.271million (52%) under-five deaths due to neonatal sepsis. Furthermore, Nigeria is among the five African countries where 0.103 million under-five deaths (51%) due to AIDS occurred (Black et al., 2010) (Table 3).

4. Discussion

Most of the data are from reports published by various agencies such as the United Nations Inter-Agency Group for Child Mortality Estimation, UNICEF reports and some articles. The result from these

reports are also compared to findings in the research articles used to see whether there will be any differences in their findings. The data that was included in the top section of the results on the percentage of deaths caused by infection diseases was from the UNICEF committing to Child Survival: A Promise Renewed Report. At the last part findings from some studies done in some west African countries and global burden of diseases report are included to compare them with the UNICEF report to see whether there will be similarities or differences in their findings. The results were group into three sections, the first section highlight the under-five mortality in west Africa, the second shows the achievement of the MDGs and the third section is the deaths caused by the infectious diseases.

Based on findings all the reports and articles indicated a high level of under-five mortality in west Africa (IGME-report-2015-child-mortality-final_236.pdf, 2016; Ending Preventable Maternal and Child Deaths, 2016). One could link the high rates of under-five mortality in this region to the high level of poverty as all the countries in this region are low or middle low income countries (IGME-report-2015-child-mortality-final_236.pdf, 2016)

Although progress have been made in terms of reducing under-five mortality, many countries in west Africa still belong to groups of countries in the world with high number of under-five deaths. Only two countries, Senegal and Niger were able to meet the MDG target of reducing under-five mortality to two third levels of 1990.

Further findings have revealed that most of these under-five deaths are caused by infectious diseases which stands at 55% in west Africa (IGME-report-2015-child-mortality-final_236.pdf, 2016; Ending Preventable Maternal and Child Deaths, 2016; GHO, 2016). This finding is corroborated by another study, which report Nigeria has one of the west African countries consistently belonging to the top groups of countries that contributes large percentage towards the global under-five deaths caused by infectious disease, such as Meningitis, malaria, diarrhoea, and AIDS (Black et al., 2010).

Despite the introduction of pneumococcus vaccine, the deaths from pneumonia remains high in this region. Malaria which is a vector borne infection with no vaccine still remains to be among the highest killer diseases in West Africa (Jasseh et al., 2014; Ndugwa et al., 2008). Another factor of high malaria death prevalence is due to the difficulty to control the vector. Mortality from diarrhoeal diseases also remains high, which could be due to high morbidity from diarrhoea due to lack of access to potable water among the poor populations in West African region.

The Under-five deaths from infectious diseases must be reduce in west Africa if the region is going to meet the sustainable development goals of reducing under-five deaths to less than 25/1000 livebirths in 2030. This requires many interventions such as improving the livelihood of the citizens through education so that they can adopt better preventive measures such as vaccination, practice of good environmental sanitation, food and water hygiene, prevention of HIV/AIDS infections and sleeping under insecticide treated bed nets. Furthermore, the clinicians in west Africa should implement better treatment protocols to ensure better treatment outcomes (You et al., 2015).

There is some weakness that can be attributed to UNICEF data due to incidence of over reporting and under reporting due to various reason. However, has earlier mentioned there is a general agreement between the reports and some of the articles as all of them indicated that the high mortality is caused infectious diseases among the under-five in West Africa. The UNICEF is also trying to improve it methods of estimation to ensure accuracy and the findings in this review is substantiated by other findings, which are done through verbal autopsy, which is acceptable standard practices of estimating mortality.

What can be concluded from this review is that West African countries still need to work hard to reduce the under-five mortality from infectious conditions.

It can be seen most of the major infectious disease killers in this region are diseases of poverty therefore with improve economic status

Table 3
Top eight infectious diseases causing under-five deaths in West African countries in percentages 2015.

Country	Pneumonia	Sepsis	tetanus	Diarrhoea	Malaria	AIDS	Measles	Meningitis
Benin	15	7	0	11	12	1	1	2
B-Faso	13	7	0	8	21	1	2	2
Cabo Verde	14	4	0	5	0	1	1	1
Côte d'Ivoire	15	9	1	7	17	2	0	2
Gambia	14	9	0	9	4	2	0	2
Ghana	12	9	0	7	11	1	0	1
Guinea	16	7	0	8	20	1	0	3
Guinea Bissau	17	9	0	9	4	4	1	3
Liberia	16	8	0	9	13	1	1	3
Mali	13	7	0	9	24	1	1	2
Mauritania	15	9	1	10	4	1	1	1
Niger	21	6	0	11	11	0	0	5
Nigeria	17	5	1	10	14	3	1	2
Senegal	15	10	0	10	4	1	1	2
Sierra Leone	14	6	0	10	20	0	2	1
Togo	14	9	1	7	17	2	0	2

Source: Committing to Child Survival: A promised renewed, progress report 2015.

the mortality from most of these diseases will greatly decrease. This is evidence by the differences in under-five mortality between West African countries, which are mostly low and middle-low income countries and high-income countries. Infectious diseases only contributes 10% to the total under-five deaths in high income countries, while in west and central Africa it contributes 54% to the under-five deaths Y (Ending Preventable Maternal and Child Deaths, 2016).

Finally judging from the above findings from various reports and articles it can be concluded that the West African countries have a high rate of under-five mortality, which are mostly caused by infectious diseases. Therefore, there is high prevalence of under-five deaths caused by infectious diseases in West Africa.

4.1. Recommendations

The West African region needs to implement effective strategies to reduce under-five mortality. These include increasing the immunization coverage for vaccine preventable illnesses and scaling up malaria control programmes. One of the major contributors to under-five mortality are infectious diseases, if deaths from these diseases are reduced the countries of West Africa might meet the SDG target 3.2.

Funding source

Not applicable.

Ethical approval

Not applicable.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijans.2019.100175>.

References

- Atlas 2018-eng_1.pdf [Internet]. [cited 2019 May 20]. Available from: http://www.who.int/sites/default/files/Atlas%202018-eng_1.pdf.
Black, R. E., Cousens, S., Johnson, H. L., Lawn, J. E., Rudan, I., Bassani, D. G., et al.

- (2010). Global, regional, and national causes of child mortality in 2008: A systematic analysis. *The Lancet*, 375(9730), 1969–1987.
Ending Preventable Maternal and Child Deaths: A Promise Renewed [Internet]. Ending Preventable Child and Maternal Deaths: A Promise Renewed. [cited 2016 Oct 28]. Available from: <http://www.apromiserenewed.org/>.
Etard, J.-F., Hesran, J.-Y.L., Diallo, A., Diallo, J.-P., Ndiaye, J.-L., Delaunay, V. Childhood mortality and probable causes of death using verbal autopsy in Niakhar, Senegal, 1989–2000. *Int J Epidemiol* [Internet]. 2004 Dec 1 [cited 2016 Oct 29]; 33(6):1286–92. Available from: <http://ije.oxfordjournals.org/content/33/6/1286>.
Gayawan, E., Adarabioyo, M.I., Okewole, D.M., Fashoto, S.G., Ukaegbu, J.C. (2016). Geographical variations in infant and child mortality in West Africa: a geo-additive discrete-time survival modelling. *Genus* [Internet]. 2016 Dec [cited 2016 Oct 14];72(1). Available from: <http://genus.springeropen.com/articles/10.1186/s41118-016-0009-8>.
GHO | By category | Number of deaths (thousands) - Data by WHO region [Internet]. WHO. [cited 2016 Oct 15]. Available from: <http://apps.who.int/gho/data/view.main.CM1300N?lang=en>.
Global, regional, and national causes of child mortality in 2000–13, with projections to inform post-2015 priorities: an updated systematic analysis – Lancet-2013-Global-child-mortality.pdf [Internet]. [cited 2016 Oct 29]. Available from: <http://www.who.int/immunization/diseases/tetanus/Lancet-2013-Global-child-mortality.pdf>.
Golding N, Burstein R, Longbottom J, Browne AJ, Fullman N, Osgood-Zimmerman A, et al. Mapping under-5 and neonatal mortality in Africa, 2000–15: a baseline analysis for the Sustainable Development Goals. *Lancet Lond Engl* [Internet]. 2017 Nov 11 [cited 2019 Apr 29];390(10108):2171–82. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5687451/>.
IGME-report-2015-child-mortality-final_236.pdf [Internet]. [cited 2016 Oct 29]. Available from: http://data.unicef.org/wp-content/uploads/2015/12/IGME-report-2015-child-mortality-final_236.pdf.
Jasseh, M., Howie, S.R.C., Gomez, P., Scott, S., Roca, A., Cham, M., et al. Disease-specific mortality burdens in a rural Gambian population using verbal autopsy, 1998–2007. *Glob Health Action* [Internet]. 2014 Oct 29 [cited 2016 Oct 15];7(0). Available from: <http://www.globalhealthaction.net/index.php/gha/article/view/25598>.
Morakinyo, O.M., Fagbamigbe, A.F. (2017). Neonatal, infant and under-five mortalities in Nigeria: An examination of trends and drivers (2003–2013). *PLoS ONE* [Internet]. 2017 Aug 9 [cited 2019 May 17];12(8). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5549979/>.
Ndugwa, R.P., Ramroth, H., Müller, O., Jasseh, M., Sié, A., Kouyaté, B., et al., (2008). Comparison of all-cause and malaria-specific mortality from two West African countries with different malaria transmission patterns. *Malar J* [Internet]. 2008 [cited 2016 Oct 31];7:15. Available from: <https://doi.org/10.1186/1475-2875-7-15>.
Reiner RC, Olsen HE, Ikeda CT, Echko MM, Ballestreros KE, Manguerra H, et al. Diseases, Injuries, and Risk Factors in Child and Adolescent Health, 1990 to 2017: Findings From the Global Burden of Diseases, Injuries, and Risk Factors 2017 Study. *JAMA Pediatr* [Internet]. 2019 Apr 29 [cited 2019 May 20];e190337–e190337. Available from: <https://jamanetwork.com/journals/jamapediatrics/fullarticle/2732143>.
Umar, L.W., Osinus, K. (2014). Successes and challenges of under-five child mortality reduction in West Africa. *Niger J Paediatr* [Internet]. 2014 Jan 1 [cited 2016 Oct 14]; 41(4):295–301. Available from: <http://www.ajol.info/index.php/njp/article/view/107269>.
UN-IGME-Child-Mortality-Report-2018.pdf [Internet]. [cited 2019 May 20]. Available from: <https://www.unicef.org/media/47626/file/UN-IGME-Child-Mortality-Report-2018.pdf>.
World Bank Country and Lending Groups – World Bank Data Help Desk [Internet]. [Cited 2016 Oct 20]. Available from: <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519>.
You, D., Hug, L., Ejdemyr, S., Idele, P., Hogan, D., Mathers, C., et al. (2015). Global, regional, and national levels and trends in under-5 mortality between 1990 and 2015, with scenario-based projections to 2030: A systematic analysis by the UN Inter-agency Group for Child Mortality Estimation. *The Lancet*, 386(10010), 2275–2286.