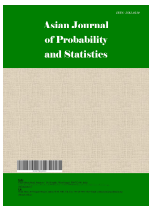

Asian Journal of Probability and Statistics

7(2): 17-27, 2020; Article no.AJPAS.56238
ISSN: 2582-0230

Estimation of Levels and Trends of Under-Five Mortality in Sub-Saharan Africa: Evidence from Summary of Birth Histories of Currently Married Women

C. O. Okoro[1*], U. C. Ikediuwa[2], F. U. Mgbudem[3], B. Uwabunkonye[4] and B. Osondu[3]

[1]Department of Statistics, Imo State University, Owerri, Nigeria.
[2]Department of Statistics, Nnamdi Azikwe University, Awka, Nigeria.
[3]Department of Public Health, Imo State University, Owerri, Nigeria.
[4]Department of Statistics, Akanu Ibiam Federal Polytechnic, Unwana, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. Author COO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors UCI, FUM, BU and BO managed the analyses of the study. Authors UCI, FUM, BU and BO managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJPAS/2020/v7i230176
Editor(s):
(1) Dr. Oguntunde, Pelumi Emmanuel, Covenant University, Nigeria.
(2) Dr. Manuel Alberto M. Ferreira (Rtd.), ISTA-School of Technology and Architecture, Lisbon University, Portugal.
Reviewers:
(1) Kayode S. Adekeye, Redeemer's University, Nigeria.
(2) Alexandrina Cardoso Escola, Escola Superior de Enfermagem do Porto, Portugal.
(3) Martin Potgieter, University of Limpopo, South Africa.
Complete Peer review History: http://www.sdiarticle4.com/review-history/56238

Original Research Article

Received: 15 February 2020
Accepted: 22 April 2020
Published: 08 May 2020

Abstract

This present study has discussed the levels and trends of under-five mortality in sub-Sahara Africa. This study aims to estimate under-five mortality using Summary of Birth Histories (SBH) of currently married women which may provide valuable information for assessing the interventions and measures already in place to achieve Sustainable Development Goals (especially goal 3). The Trussell variant which is the modified version of the Brass model was adopted to derive under-five mortality from SBH of currently married women. The result shows that the index for under-five mortality ($_5q_0$) implied by the north family of the Coale–Demeny model life tables ranges from 65.8 deaths per 1000 live births in Zambia (2018 ZDHS) to as high as 132.9 deaths per 1000 live births in Nigeria (2018 NDHS) respectively. The average estimate of under-five mortality for the countries is about 107.9 deaths per 1000 live births for

**Corresponding author: E-mail: chinonso.okoro@yahoo.com;*

currently married women and 108.4 deaths per 1000 live births for the entire women in the surveys. While the average probability of a newborn baby surviving to age 5 is about 0.8921 for currently married women that of the entire women is about 0.8915.

Keywords: Levels; trends; under-five mortality; currently married women; Sub-Sahara Africa.

1 Introduction

Mortality is the nucleus of the component of population change because it affects the size and sex composition of any population. More importantly, under-five mortality is used as a gauge of the level of health and socio-economic development of any nation. Information deduced from mortality levels and trends help in planning and policy implementation. This makes data collection and information on mortality crucial to any reasonable government in other to meet both global and local targets especially to improve public health and social wellbeing.

United Nations Inter-agency Group for Child Mortality Estimation [1] observed that, worldwide, under-five mortality rates fell from 93 in 1990 and 76 in 2000 to 39 deaths per 1,000 live births in 2018. Between 1990 and 2018, the total number of under-five deaths dropped from 12.5 million to 5.3 million. They estimated that 15,000 children on the average, died before their fifth birthday every day in 2018, which is a significant improvement compared to the 34,000 deaths recorded in 1990. Of the 5.3 million under-five deaths in 2018, there were 2.9 million boys and 2.4 million girls. On the other hand, the rate of neonatal mortality decreased from 37 (deaths) in 1990 to 18 deaths per 1,000 live births every day in 2018. The neonatal death toll decreased globally from 5.0 million in 1990 to 2.5 million in 2018. Forty-seven percent of all deaths among children under five years in 2018 was as a result of neonatal deaths due to rapid universal drop in death of children aged 1–59 months unlike their counterparts in the first four weeks of life.

Under-five deaths have been associated with many factors such as economic, social, biological, environmental, political, etc. Research has shown that with improved access/affordable health care, education of mothers, child immunization, quality feeding, and improved environmental conditions, under-five mortality can be reduced to a reasonable rate. Other determinants of child mortality include early marriage, late marriage, low birth weight, pneumonia, diarrhea, malaria, respiratory infections, congenital abnormalities, illiteracy, malnutrition and unhealthy environmental conditions, place of residence, household wealth among others [2,3,4,5]. On the global scale, the chances of child survival among regions are not equal. The Sub-Saharan Africa continues to top other regions in terms of under-five mortality numbers globally. One in thirteen children died before their fifth birthday in 2018 representing, on the average 78 deaths per 1,000 live births while the high-incomes countries recorded 1 in 199 under-five deaths in the same year UN IGME [1].

UN IGME [1] observed that about 74 countries (predominantly in Sub-Saharan Africa) are yet to meet the Sustainable Development Goal (SDG) target of 25 or fewer deaths per 1,000 live births as of 2018. The Group derived under-five mortality from information on the Full Birth Histories (FBH) of women of childbearing age group using the Bayesian B-splines bias-adjusted model. Emphasis has always been on under-five mortality among 'all women' with limited estimates of under-five mortality among 'currently married women'. Therefore, the aim of this present study is to estimate under-five mortality using Summary of Birth Histories (SBH) of currently married women in Sub-Saharan Africa which may provide valuable information for assessing the interventions and measures already in place to achieve Sustainable Development Goal targets (especially goal 3). The specific objectives are: (i) to estimate levels and trends of under-five mortality among currently married women while comparing the results with the estimates from the entire women in the survey, (ii) to assess the results of (i) with other known sources.

2 Methodology

The data on Summary of Birth Histories (SBH) of women from Demographic and Health Surveys (DHS) regularly conducted in all the Sub-Saharan African countries are used in this present study. SBH data are generated by asking women questions about the number of children ever born and the number that are dead. This data on the number of children ever born and the number that is dead was extracted from the most recent DHS reports of the following counties, Benin, Guinee, Mali, Nigeria, and Zambia. The DHS reports include; 2017-18 BDHS, 2018 GDHS, 2018 MDHS, 2018 NDHS and 2018 ZDHS [6,7,8,9,10]. The five countries are among 74 countries of the world that may fail to achieve SDG targets on child mortality if the countries do not redouble their efforts UN IGME [1]. The classification of the number of children ever born and the number that is dead was done in two forms. The first is for 'all women' and the second is for 'women currently married'. Most studies on child mortality have always focused on all women [11,2,3,12] without any attempt to gain insights from the information tabulation on the number of children ever born and the number that is dead of currently married women. Indirect techniques are applied to estimate child mortality due to poor data quality and inadequate vital registration systems in Sub-Saharan African countries. Brass [13] was the first to develop a model that converts the proportions of children dead among proportions of children ever born into mortality rates. The brass model yields reasonable results if the study population assumes constant fertility and mortality in the years preceding the survey which most times may not be realistic in developing countries. It is assumed that one of the mortality patterns of Coale-Demeny [14] model life tables agrees with the age pattern of mortality of the population under study. Trussell [15,16] developed a modified version of the original Brass method which appears more robust for moderate changes in fertility and this method is adopted in this present study. The brass technique for measuring probabilities of dying between birth and exact age *j* is

$$ {}_jq_0 = k(i)D(i), \quad j = 1,2,3,5,10,15, and\ 20. \tag{1} $$

Where $k(i)$ is Trussell multipliers defined in (3) while $D(i)$ is the proportion of children dead among children ever born given as

$$ D(i) = \frac{CD(i)}{CEB(i)} \text{, } i = 1, 2, \ldots, 7 \text{ (age groups of mothers)} \tag{2} $$

The proportion of children dead is converted to life table probabilities of dying using the Trussell multipliers [K(i)]

$$ k(i) = a_i + b_i\left(\frac{P_1}{P_2}\right) + c_i\left(\frac{P_2}{P_3}\right) \tag{3} $$

where P_i (1, 2, 3) are the average parities per woman and a_i, b_i, and c_i are the Trussell variant coefficients used to estimate $k(i)$.

The life table survival probabilities to exact age were obtained using the relation

$$ 1_j = 1 - {}_jq_0 \tag{4} $$

Using the values of 1_j the estimates of mortality levels and expectation of life at birth (e_0) can be obtained from a model life table by interpolation. The number of years before the survey to which the estimates of mortality rates refer is denoted by T_i

$$T_i = x_i + y_i\left(\frac{P_1}{P_2}\right) + z_i\left(\frac{P_2}{P_3}\right) \quad (5)$$

where $P_i(1, 2, 3)$ are also the average parities per woman and the Trussell variant coefficients for estimation of reference period are (x_i , y_i , and z_i).

3 Results

The results were obtained by applying equations 1 through 5 to the summary of birth histories of currently married women and all women that participated in the surveys. For the 2018 NDHS, the results for the currently married women in Table 1 show that the estimates for infant mortality (${}_1q_0$) and under-five mortality (${}_5q_0$) were 124.7 and 132.9 deaths per 1000 live births respectively. While in Table 2 the estimates for the index of infant mortality (${}_1q_0$) is about 121.3 deaths per 1000 live births and the under-five mortality (${}_5q_0$) is about 131.2 deaths per 1000 live births for all women respectively. Judging from the results, the estimates of child mortality are slightly higher in 'all women' than the currently married women.

Table 1. Child mortality estimates implied by 2018 NDHS (Currently Married Women)

Age group	i	Mean no. of children ever-born CEB(i)	Mean no. of children living	Dead CD(i)	Proportion of children dead D(i)	k(i)	q = D(i)K(i)	lj	T
15 - 19	1	0.7	0.62	0.08	0.1143	1.0914	0.1247	0.87526	2.0
20 - 24	2	1.84	1.62	0.22	0.1196	1.0107	0.1208	0.87916	3.5
25 - 29	3	3.03	2.66	0.37	0.1221	0.9513	0.1162	0.88384	5.3
30 - 34	4	4.21	3.64	0.57	0.1354	0.9815	0.1329	0.86711	7.1
35 - 39	5	5.15	4.44	0.71	0.1379	1.0414	0.1436	0.85643	9.0
40 - 44	6	6.06	5.09	0.97	0.1601	1.0274	0.1645	0.83554	11.2
45 - 49	7	6.67	5.38	1.29	0.1934	1.0093	0.1952	0.80480	13.8

Table 2. Child mortality estimates implied by 2018 NDHS (All Women)

Age group	i	Mean no. of children ever-born CEB(i)	Mean no. of children living	Dead CD(i)	Proportion of children dead D(i)	k(i)	q = D(i)K(i)	lj	T
15 - 19	1	0.18	0.16	0.02	0.1111	1.0914	0.1213	0.87873	1.0
20 - 24	2	1.25	1.11	0.14	0.1120	1.0107	0.1132	0.88681	2.2
25 - 29	3	2.65	2.32	0.33	0.1245	0.9513	0.1185	0.88154	4.0
30 - 34	4	3.89	3.37	0.52	0.1337	0.9815	0.1312	0.86879	6.3
35 - 39	5	4.88	4.20	0.68	0.1393	1.0414	0.1451	0.85489	8.8
40 - 44	6	5.86	4.91	0.95	0.1621	1.0274	0.1666	0.83344	11.5
45 - 49	7	6.36	5.19	1.17	0.1840	1.0093	0.1857	0.81433	14.4

The index of infant mortality (${}_1q_0$) in Tables 3 and 4 are not equal. Infant mortality (${}_1q_0$) is higher among currently married women (60.9 deaths per 1000 live births) compared to estimates from 'all women' (33.8 deaths per 1000 live births). While the under-five mortality (${}_5q_0$) among the currently married women is about 65.8 deaths per 1000 live births that of 'all women' is about 71.6 deaths per 1000 live births

respectively. Notably, the reference period (T) of the mortality estimates of all women in the survey differs from that of the currently married women.

Table 3. Child mortality estimates implied by 2018 ZDHS (Currently Married Women)

Age group	i	Mean no. of children ever-born CEB(i)	Mean no. of children living	Dead CD(i)	Proportion of children dead D(i)	k(i)	q = D(i)K(i)	lj	T
15 - 19	1	0.9	0.84	0.06	0.0667	0.9133	0.0609	0.93911	2.8
20 - 24	2	1.72	1.59	0.13	0.0756	0.9507	0.0719	0.92815	4.3
25 - 29	3	2.86	2.69	0.17	0.0594	0.9344	0.0555	0.94446	5.6
30 - 34	4	4.03	3.76	0.27	0.0670	0.9816	0.0658	0.93423	6.8
35 - 39	5	5.21	4.79	0.42	0.0806	1.0492	0.0846	0.91542	7.9
40 - 44	6	5.98	5.34	0.64	0.1070	1.0368	0.1110	0.88904	9.3
45 - 49	7	6.87	5.97	0.9	0.1310	1.0166	0.1332	0.86682	11.7

Table 4. Child mortality estimates implied by 2018 ZDHS (All Women)

Age group	i	Mean no. of children ever-born CEB(i)	Mean no. of children living	Dead CD(i)	Proportion of children dead D(i)	k(i)	q = D(i)K(i)	lj	T
15 - 19	1	0.27	0.26	0.01	0.0370	0.9133	0.0338	0.96617	1.3
20 - 24	2	1.25	1.16	0.09	0.0720	0.9507	0.0684	0.93155	2.6
25 - 29	3	2.45	2.3	0.15	0.0612	0.9344	0.0572	0.94279	4.4
30 - 34	4	3.70	3.43	0.27	0.0730	0.9816	0.0716	0.92837	6.5
35 - 39	5	4.93	4.52	0.41	0.0832	1.0492	0.0873	0.91275	8.8
40 - 44	6	5.55	4.95	0.60	0.1081	1.0368	0.1121	0.88791	11.3
45 - 49	7	6.35	5.46	0.89	0.1402	1.0166	0.1425	0.85752	14.1

Child mortality estimates in Tables 5 and 6 show that the index for infant mortality ($_1q_0$) among currently married women is about 52.9 deaths per 1000 live births which is lower than the estimate of all women (57.3 deaths per 1000 live births). The summary of birth histories from the two sources produced equivalent results for the index of under-five mortality (i.e. 115.4 vs. 115.5) deaths per 1000 live births respectively. Care and caution must be taken when interpreting these results because the reference periods (T) of the mortality estimates are not the same. While the under-five mortality estimates for 'all women' in the survey refer to (5.9 years) before the survey that of the currently married women refers to (7.6 years) before the survey.

Table 5. Child mortality estimates implied by 2017-18 BDHS (Currently Married Women)

Age group	i	Mean no. of children ever-born CEB(i)	Mean no. of children living	Dead CD(i)	Proportion of children dead D(i)	k(i)	q = D(i)K(i)	lj	T
15 - 19	1	0.78	0.74	0.04	0.0513	1.0313	0.0529	0.94711	2.7
20 - 24	2	1.57	1.44	0.13	0.0828	1.0140	0.0840	0.91604	4.4
25 - 29	3	2.87	2.61	0.26	0.0906	0.9706	0.0879	0.91207	6.0
30 - 34	4	4.18	3.70	0.48	0.1148	1.0053	0.1154	0.88456	7.6
35 - 39	5	5.11	4.53	0.58	0.1135	1.0672	0.1211	0.87887	9.0
40 - 44	6	5.90	5.08	0.82	0.1390	1.0516	0.1462	0.85384	10.7
45 - 49	7	6.38	5.47	0.91	0.1426	1.0297	0.1469	0.85313	13.1

Table 6. Child mortality estimates implied by 2017-18 BDHS (All Women)

Age group	i	Mean no. of children ever-born CEB(i)	Mean no. of children living	Dead CD(i)	Proportion of children dead D(i)	k(i)	q = D(i)K(i)	lj	T
15 - 19	1	0.18	0.17	0.01	0.0556	1.0313	0.0573	0.94270	1.1
20 - 24	2	1.17	1.07	0.1	0.0855	1.0140	0.0867	0.91333	2.2
25 - 29	3	2.69	2.45	0.24	0.0892	0.9706	0.0866	0.91340	3.9
30 - 34	4	4.09	3.62	0.47	0.1149	1.0053	0.1155	0.88447	5.9
35 - 39	5	5.00	4.43	0.57	0.1140	1.0672	0.1217	0.87833	8.1
40 - 44	6	5.79	4.96	0.83	0.1434	1.0516	0.1508	0.84925	10.6
45 - 49	7	6.13	5.25	0.88	0.1436	1.0297	0.1478	0.85218	13.5

For the 2018 GDHS data, Tables 7 and 8 shows that the measure of infant mortality (${}_1q_0$) is higher among the currently married women (83.7 deaths per 1000 live births) compared to their counterparts (all women) which produced 71.8 deaths per 1000 live births. The opposite is the case for under-five mortality, among the currently married women the index for under-five mortality (${}_5q_0$) is about 103.9 deaths per 1000 live births while that of all women is about 104.8 deaths per 1000 live births. Again, their reference periods are not the same. While the index for under-five mortality (${}_5q_0$) for all women in the survey refers to (6.4 years) before the survey that of the currently married women refers to (7.1 years) before the survey. Maximum caution must be taken while discussing or interpreting the implication of the indices of infant mortality (${}_1q_0$) and under-five mortality (${}_5q_0$).

Table 7. Child mortality estimates implied by 2018 GDHS (Currently Married Women)

Age group	i	Mean no. of children ever-born CEB(i)	Mean no. of children living	Dead CD(i)	Proportion of children dead D(i)	k(i)	q = D(i)K(i)	Lj	T
15 – 19	1	0.78	0.71	0.07	0.0897	0.9329	0.0837	0.91628	2.3
20 – 24	2	1.73	1.57	0.16	0.0925	0.9601	0.0888	0.91121	3.9
25 – 29	3	2.79	2.49	0.30	0.1075	0.9393	0.1010	0.89900	5.5
30 – 34	4	3.79	3.39	0.40	0.1055	0.9845	0.1039	0.89610	7.1
35 – 39	5	4.66	4.10	0.56	0.1202	1.0511	0.1263	0.87369	8.7
40 – 44	6	5.22	4.46	0.76	0.1456	1.0383	0.1512	0.84883	10.6
45 – 49	7	5.32	4.49	0.83	0.1560	1.0179	0.1588	0.84119	13.1

Table 8. Child mortality estimates implied by 2018 GDHS (All Women)

Age group	i	Mean no. of children ever-born CEB(i)	Mean no. of children living	Dead CD(i)	Proportion of children dead D(i)	k(i)	q = D(i)K(i)	lj	T
15 – 19	1	0.26	0.24	0.02	0.0769	0.9329	0.0718	0.92824	1.2
20 – 24	2	1.26	1.14	0.12	0.0952	0.9601	0.0914	0.90856	2.5
25 – 29	3	2.52	2.25	0.27	0.1071	0.9393	0.1006	0.89936	4.3
30 – 34	4	3.57	3.19	0.38	0.1064	0.9845	0.1048	0.89521	6.4
35 – 39	5	4.49	3.95	0.54	0.1203	1.0511	0.1264	0.87359	8.7
40 – 44	6	5.06	4.32	0.74	0.1462	1.0383	0.1518	0.84815	11.2
45 – 49	7	5.15	4.36	0.79	0.1534	1.0179	0.1561	0.84385	14.1

For the 2018 MDHS, Tables 9 and 10 shows that the index of infant mortality ($_1q_0$) appears higher among currently married women (64.2 deaths per 1000 live births), compared to their counterpart all women which is about 45.7 deaths per 1000 live births. While the index for under-five mortality ($_5q_0$) is about 121.7 deaths per 1000 live births for currently married women and 119.1 deaths per 1000 live births for all women respectively. There is a relative difference in reference period between the estimates from the two data sources. While the index for under-five mortality ($_5q_0$) for all women in the survey refers to (6.3 years) before the survey that of the currently married women refers to (6.6 years) before the survey.

Table 9. Child mortality estimates implied by 2018 MDHS (Currently Married Women)

Age group	i	Mean no. of children ever-born CEB(i)	Mean no. of children living	Dead CD(i)	Proportion of children dead D(i)	k(i)	q = D(i)K(i)	lj	T
15 – 19	1	0.79	0.73	0.06	0.0759	0.8457	0.0642	0.93577	2.3
20 – 24	2	1.85	1.69	0.16	0.0865	0.9404	0.0813	0.91867	3.7
25 – 29	3	3.31	2.95	0.36	0.1088	0.9413	0.1024	0.89762	5.2
30 – 34	4	4.74	4.16	0.58	0.1224	0.9943	0.1217	0.87834	6.6
35 – 39	5	5.88	4.98	0.9	0.1531	1.0645	0.1629	0.83707	8.0
40 – 44	6	6.64	5.53	1.11	0.1672	1.0516	0.1758	0.82421	9.7
45 – 49	7	6.86	5.59	1.27	0.1851	1.0289	0.1905	0.80952	12.2

Table 10. Child mortality estimates implied by 2018 MDHS (All Women)

Age group	i	Mean no. of children ever-born CEB(i)	Mean no. of children living	Dead CD(i)	Proportion of children dead D(i)	k(i)	q = D(i)K(i)	lj	T
15 – 19	1	0.37	0.35	0.02	0.0541	0.8457	0.0457	0.95429	1.4
20 – 24	2	1.57	1.44	0.13	0.0828	0.9404	0.0779	0.92213	2.7
25 – 29	3	3.15	2.81	0.34	0.1079	0.9413	0.1016	0.89840	4.4
30 – 34	4	4.59	4.04	0.55	0.1198	0.9943	0.1191	0.88086	6.3
35 – 39	5	5.73	4.86	0.87	0.1518	1.0645	0.1616	0.83838	8.5
40 – 44	6	6.51	5.42	1.09	0.1674	1.0516	0.1761	0.82393	10.9
45 – 49	7	6.74	5.47	1.27	0.1884	1.0289	0.1939	0.80613	13.6

Table 11 shows that the index for under-five mortality ($_5q_0$) obtained from the summary of the birth histories of currently married women appear higher than the estimates by UN IGME for each country included in the study. This is reasonable since UN IGME estimates are for 2018 while the estimates derived from the selected DHS reports refer to approximately 7 years before the survey (i.e. around 2011) judging from the reference period of the countries. On the overage, the implied mortality level (north family of the Coale–Demeny model life tables) is about 17. 4 while the median is 16.9 for all the countries. The index for under-five mortality ($_5q_0$) from 2017-18 BDHS and 2018 MDHS are slightly outside the UN-IGME 90 percent uncertainty interval estimates while the remaining countries (2018 NDHS, 2018 ZDHS & 2018 GDHS) are consistent with the UN IGME [1] interval estimates. On the other hand, the estimates of the index for under-five mortality ($_5q_0$) obtained from the summary of birth history of 'all women' exhibited the same pattern observed among currently married women. The only difference is in the average reference period which is approximately 6 years against 7 years (mentioned above) while the mean of the implied mortality level (north family) is 17. 2 and the median is also 16.9 for all the countries. The UN IGME [1] estimates is used to assess the estimates obtained in this study but not as a direct comparison of estimates since the reference period, data sources and techniques are not the same. The estimates of UN

IGME were derived from the Full Birth History while the present study used Summary of Birth History respectively.

Table 11. Under-Five Mortality ($_5q_0$) estimates derived from SBH of currently married women, their implied levels of mortality and probability of surviving to age 5 implied by (North family of Coale–Demeny model life tables) and estimates from other sources

Year/Source	Under-Five Mortality (deaths per 1000 live births)	U5MR with 90 percent uncertainty interval (UN-IGME)			Implied mortality level	Implied probability of surviving to age 5	Reference period (T)
		U5MR	Lower bound	Upper bound			
2018 NDHS	132.9	120	97	151	15.9	0.86711	7.1
2018 ZDHS	65.8	58	44	76	19.9	0.93423	6.8
2017-18 BDHS	115.4	93	82	106	16.9	0.88456	7.6
2018 GDHS	103.9	101	81	128	17.6	0.89610	7.1
2018 MDHS	121.7	98	81	117	16.6	0.87834	6.6
Mean	107.9	94	77	115.6	17.4	0.89207	7.0

U5MR = Under-five mortality rate

Table 12. Under-Five Mortality ($_5q_0$) estimates derived from SBH of all women, their implied levels of mortality and probability of surviving to age 5 implied by (North family North family of Coale–Demeny model life tables) and estimates from other sources

Year/Source	Under-five mortality (deaths per 1000 live births)	U5MR with 90 percent uncertainty interval (UN-IGME)			Implied mortality level	Implied probability of surviving to age 5	Reference period (T)
		U5MR	Lower bound	Upper bound			
2018 NDHS	131.2	120	97	151	16.0	0.86879	6.3
2018 ZDHS	71.6	58	44	76	19.6	0.92837	6.5
2017-18 BDHS	115.5	93	82	106	16.9	0.88447	5.9
2018 GDHS	104.8	101	81	128	17.5	0.89521	6.4
2018 MDHS	119.1	98	81	117	16.7	0.88086	6.3
Mean	108.4	94	77	115.6	17.3	0.89154	6.3

4 Discussion

This present study has discussed the levels and trends of under-five mortality in Sub-Sahara Africa. The aim of this study is to derive estimates of under-five mortality from Summary of Birth Histories (SBH) of currently married women in Sub-Saharan Africa which may provide valuable information for assessing the interventions and measures already in place to achieve SDG targets (especially goal 3). The modified version of the Brass model, the Trussell variant was adopted to estimate under-five mortality from SBH of currently married women. The model produced results that are consistent with other known sources.

The average estimate for the index of infant mortality ($_1q_0$) obtained from the study is approximately 66 deaths per 1000 live births for the entire women in the surveys while that of the currently married women is about 77 deaths per 1000 live births respectively. Although their reference periods are not the same, the infant mortality ($_1q_0$) estimates of the entire women refer to the average of 1.2 years before the survey while that of the currently married women is about 2.4 years before the survey. The index of infant mortality ($_1q_0$) obtained from the two sources is higher than the 2018 UN IGME infant mortality estimate of 53

deaths per 1000 live births for sub-Saharan Africa. The result of infant mortality ($_1q_0$) from the Brass model should be interpreted with caution, since many authors have reported that the technique produces a high or unreliable estimate of infant mortality ($_1q_0$) mostly due to poor quality of data reported by mothers in the 15 – 19 age group [2,3,16,12]. Even at that, the results obtained appear credible because the reference periods are not the same.

The results further indicate that among the currently married women the index for under-five mortality ranges 65.8 deaths per 1000 live births in Zambia (2018 DHS) to as high as 132.9 deaths per 1000 live births in Nigeria (2018 DHS) respectively. The estimates for the selected countries fall within the 90 percent uncertainty interval provided by UN IGME for 2018 [1], except for 2017-18 BDHS and 2018 MDHS that are slightly above the upper bound of the given interval. Comparing the results with the exact under-five mortality estimates of the UN IGME for the same countries in 2018, it was observed that the estimates of UN IGME are lower than the present estimates. On the other hand, the results of the index for under-five mortality ($_5q_0$) among 'all women' in the survey maintained the same pattern observed among the currently married women. The results from the summary of birth histories appear reasonable since the reference periods and methods of estimation are different (see Table 12). While the index for under-five mortality ($_5q_0$) from both currently married women and the entire women in the survey refers to approximately 7 and 6 years (i.e. 2011 and 2010) respectively before the survey that of UN IGME refers to 2018.

Judging from the reference periods in Tables 11 and 12, it appears the index for under-five mortality ($_5q_0$) is higher in 'all women' for (2018 NDHS, 2018 ZDHS, 2017-18 BDHS, and 2018 GDHS) except the 2018 MDHS. While the raw scores for the index of under-five mortality ($_5q_0$), shows that among currently married women under-five mortality ($_5q_0$) is higher in 2018 NDHS and 2018 MDHS; equivalent to all women in 2017-18 BDHS, and lower than all women in 2018 ZDHS and 2018 GDHS respectively. The average estimate of under-five mortality ($_5q_0$)for the countries, is about 107.9 deaths per 1000 live births for currently married women while that of all women is about 108.4 deaths per 1000 live births. These estimates are close to the 2010 UN IGME estimate of (102 deaths per 1000 live births) for Sub-Sahara Africa and higher than the 2018 UN IGME estimate of 78 deaths per 1000 live births for the same region. Sub-Sahara African countries with under-five mortality above 50 deaths per 1000 live births must redouble their efforts since they have about ten years to achieve 25 or fewer deaths per 1000 live births. This will also help to save eleven million under- five children globally of which more than half of the number live in Sub-Saharan Africa by 2030 UN IGME [1]. The UN IGME 2018 estimate is used to assess the performance of the estimates derived from the SBH of the two groups of women in this study. It is not a direct comparison of results since the data sources, method of estimation and reference periods are not the same. UN IGME UN IGME [1] derived the 2018 under-five mortality estimates from Full Birth Histories (FBH) of women while the present study used Summary of Birth Histories (SBH).

5 Conclusion

The average estimate of under-five mortality for the countries, implied by the north family of the Coale–Demeny model life tables is above 100 deaths per 1000 live births among currently married women and the all women in the surveys. The rates of under-five mortality are still above the SDG target of 25 or fewer deaths per 1000 live births by 2030. The Sub-Saharan Africa countries must redouble their efforts to achieve SDG targets (especially goal 3). The strategies already in place must be re-evaluated and reinforced. The health care delivery systems, immunization, disease/ infection control mechanisms, maternal and child health outcomes, etc. should be at the center of government policy. All hands must be on deck for countries in sub-Saharan Africa to meet child mortality targets to save more than half of the eleven million under-five children (in that region) which are the risk of death. Monitoring and evaluation of the status of a child and maternal health outcomes in Sub-Saharan should be on a quarterly basis by donor agencies and monthly

basis by individual countries. Measures should be put in place to check the issue of diversion of funds (meant for child and maternal health outcomes), corruption, terrorism, child or early marriage, poor girl education etc. as they can disrupt policy implementation in that region.

Competing Interests

Authors have declared that no competing interests exist.

References

[1] United Nations Inter-agency Group for Child Mortality Estimation. Levels & Trends in Child Mortality. Report 2019. United Nations Children's Fund; 2019.

[2] Nwogu EC. Estimation of levels and trend of infant and childhood mortality in Nigeria. Global Journal of Pure and Applied Sciences. 2004;10(3):451- 457.

[3] Nwogu EC, Nweke JC. Levels, trend and age pattern of under-five mortality in Nigeria: Evidence from NDHS, FUTO Journal Series. 2016;2(1):205- 217.

[4] Van Malderen C, Amouzou A, Barros AJD, et al. Socioeconomic factors contributing to under-five mortality in sub-Saharan Africa: a decomposition analysis. BMC Public Health. 2019;19:760. Available:https://doi.org/10.1186/s12889-019-7111-8

[5] Wegbom AI, Essi ID, Kiri VA. Survival analysis of under-five mortality and its associated determinants in Nigeria: Evidence from a survey data. International Journal of Statistics and Applications. 2019;9(2):59-66.

[6] Institut National de la Statistique (INS) et ICF. Enquête Démographique et de Santé en Guinée 2018. Conakry, Guinée, et Rockville, Maryland, USA: INS et ICF; 2018.

[7] Institut National de la Statistique (INSTAT), Cellule de Planification et de Statistique Secteur Santé-Développement Social et Promotion de la Famille (CPS/SS-DS-PF) et ICF. Enquête Démographique et de Santé au Mali 2018. Bamako, Mali et Rockville, Maryland, USA: INSTAT, CPS/SS-DS-PF et ICF; 2019.

[8] Institut National de la Statistique et de l'Analyse Économique (INSAE) et ICF. Enquête Démographique et de Santé au Bénin, 2017-2018. Cotonou, Bénin et Rockville, Maryland, USA: INSAE et ICF; 2019.

[9] National Population Commission (NPC) [Nigeria] and ICF. Nigeria Demographic and Health Survey 2018. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF; 2019.

[10] Zambia Statistics Agency, Ministry of Health (MOH) Zambia, and ICF. Zambia Demographic and Health Survey 2018. Lusaka, Zambia, and Rockville, Maryland, USA: Zambia Statistics Agency, Ministry of Health, and ICF; 2019.

[11] Dahiru T, Aliyu A, Oyefabi MA, Idiris SH, Umar AA. Levels and trends of child mortality in Zaria local government area of Kaduna State, Nigeria. International Journal of Statistics and Applications. 2004;8(1):1-8.

[12] Venkatacharya KA. Indirect estimation of infant and child mortality using child survivorship data: Current methods and research issues in fertility and mortality estimation in Africa. Proceedings of a Workshop on the estimation of Fertility and Mortality in Africa, held at RIPS, University of Ghana, Legon; 1983.

[13] Brass W. Uses of census and survey data for the estimation of vital rates. Paper prepared for the African Seminar on Vital Statistics, Addis Ababa, 14-19 December 1964. United Nations document E/CN.14/CAS.4IVS/7; 1964.

[14] Coale AJ, Demeny P. Regional model life tables and stable populations. 2nd ed, Prenceton University Press, Princeton, USA.; 1983.

[15] United Nations. Step-by-Step Guide to the Estimation of Child Mortality", Population Studies No. 107; 1990.

[16] United Nations. Manual X: Indirect Techniques for Demographic Estimation, New York; 1983.

Peer-review history:
The peer review history for this paper can be accessed here (Please copy paste the total link in your browser address bar)
http://www.sdiarticle4.com/review-history/56238