Has the impact of HIV/AIDS on the mortality pattern in Uganda been over estimated?

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Abstract

Understanding mortality dynamics on the African continent has been hindered by lack of data resulting from incomplete and inaccurate vital registration systems or by the use of techniques which do not take into account sudden changes in the burden of disease, for example Coale-Demeny regional model tables, Preston's national populations, and the United Nations life table systems. Population scientists as well as planners in the region have been relying on model tables to estimate and forecast future patterns. Available information for the past decade shows that mortality in Uganda has been declining though at a slow pace. It is argued that mortality would have declined more if there were no HIV/AIDS and it is asserted that gains may have been taken away by the impact of HIV/AIDS (Blacker 2004; Feeney 2001; Heuveline 2003). This paper presents the findings about the impact of HIV/AIDS on the mortality pattern in Uganda. The study investigated whether the impact of HIV/AIDS on the mortality pattern in Uganda is being over estimated. Using Brass (1968)'s two parameter model and the InDepth (2004) model life tables for sub Saharan Africa, results indicate that like previous findings, HIV/AIDS has had an impact on the mortality pattern however it seems to be minimal for children particularly in countries where childhood mortality had already been high and the elderly than it is with adults aged 25-45 years; thus pointing to an interesting finding that in some sections of the age pattern, it is overestimated than thought. It has also been found out that inDepth MLT fits the Ugandan pattern fairly well implying by way of summary that we can predict future patterns resulting from emergent ailments. In terms of policy, results point out that while it is important to allocate resources to HIV/AIDS related program, priority should also be given to other health related programmes or having integrated health services.

Keywords: inDepth model lifetables, Mortality pattern, HIV/AIDS, Uganda

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Introduction

Mortality dynamics on the African continent has been hindered by lack of data resulting from incomplete vital registration systems or by the use of techniques which do not take into account sudden changes in the burden of disease resulting from the emergence and re-emergence of infectious diseases for instance HIV/AIDS. Population scientists have always been using model tables to estimate or forecast future mortality levels and patterns. The underlying assumption is that the mortality pattern in the population under consideration would resemble that of the model table. Though mortality levels on the African continent have been declining in the mid 20th century, it is asserted that the decline would have been more if there were no HIV/AIDS and that gains may have been taken away by the impact of HIV/AIDS (Blacker 2004).

In Uganda, as the HIV/AIDS epidemic matured in late 1990, the increase in the AIDS related morbidity and mortality mostly of prime-aged adults is believed to have reversed or stagnated what was in the past, assumed to be declining (Timaeus and Jasseh, 2004). Although much is now known about HIV/AIDS particularly with regard to the proportions of living people infected with HIV or on ART, little is known regarding the impact it has had on the mortality pattern. This is because in sub-Saharan Africa, death reporting information is incomplete and yet close to 72 percent of all the AIDS related deaths in the world (1.8million), come from this region (UNAIDS, 2010:25).

In this study, our main objective is to investigate whether the impact of HIV/AIDS on the pattern of mortality in Uganda has been over estimated. To achieve our goal, we employ the newly produced INDEPTH model lifetables (2004) to estimate mortality in Uganda. INDEPTH model pattern seems to be applicable to the contemporary sub-Saharan populations which have been severely hit by the HIV/AIDS pandemic. INDEPTH models is intended to investigate the demographic impact of HIV/AIDS on the Ugandan population by measuring the loss in life expectancy or increase in age specific mortality rates due to death from HIV/AIDS.

The significance of this paper is three folds: First, since the main objective is to estimate the impact of HIV/AIDS by examining changes in life expectancy and mortality pattern with and without the AIDS epidemic, it contributes to the literature regarding the impact of HIV/AIDS. Secondly, changes in the mortality pattern is not only a major population dynamic, but also essential in determining public health policy. Understanding such an impact would help planners and health policy makers to re-focus their attention to its implication. And thirdly, identifying the age groups most affected by HIV/AIDS. This would guide policy makers in designing effective intervention programmes.

Linkage between mortality pattern and HIV/AIDS

Usually, the pattern of age specific death rates is determined by the quality of life of a population. Without HIV/AIDS, the general pattern of age specific death rates is usually highest soon after birth, step by step declines through infancy and gradually drop until age 15 and thereafter increase with increasing age. Important to note is that the mortality pattern often depends on the level of mortality as determined by the different causes of death (INDEPTH, 2004).

In sub-Saharan Africa, the classical pattern of age specific death rates is characterized by high infant and early childhood mortality; and this is followed by a swift decline until early adolescence and thereafter begins to increase with age. Although many countries in the region may be characterized by this mortality pattern, the emergence of HIV/AIDS and the re-emergence of TB as an opportunistic disease are alleged to have distorted this orthodox mortality pattern. And as a result, HIV/AIDS is thought to have led to a substantial rise in age specific deaths for the whole age range and a fall in expectation of life. According to the UNAIDS (2004) report, sub-Saharan Africa has a life expectancy of 47 years and without HIV/AIDS, it would have been 62 years.

Although Uganda is frequently taken to be a model for Africa in fighting the HIV/AIDS epidemic, it is among the hardest hit countries in the late nineties after having been first reported and diagnosed in 1982 in Rakai district. From 1982 to the end of 1990s, the impact on the health and well being of the population is reported to have worsened (*http://www.avert.org/aids-uganda.htm*). AIDS was the leading cause of adult mortality with an HIV prevalence rate of 29 percent in urban areas and 15 percent among all adults. By mid 1980s, the epidemic is reported to have spread very first to urban populations and communities along highways. In 2000, the Ministry of Health reported an estimated 800,000 people to have died of AIDS related sickness since 1982. The high number of AIDS related death was probably due to lack of treatment which would delay the onset of AIDS thus resulting in a high number of HIV infected people progressing to the end of the survival period.

According to AVERT.org, about one million Ugandans have died due of AIDS related infections. However, these figures may have been an over estimate of the true picture. The Ministry of Health gets information from antenatal (ANC) clinics and demographic surveillance systems however a small percentage of women attend ANC at least four times. Besides, like many developing nations, death registration in Uganda is either incomplete and in some cases nonexistent. In addition, data from surveillance surveys may underestimate the impact because many of the afflicted do not want to talk about their dead loved ones. This implies that many deaths either were not reported or were underestimated. Because of this, health facility based data may fail to portray the true picture of the disease burden. Therefore, examining the impact of AIDS on the population of Uganda is a challenge. In such situations, one would opt for a model life table system. However, since Uganda has been having high prevalence rates of HIV/AIDS, it is recommended to use INDEPTH model patterns to examine the impact HIV/AIDS mortality has had. In order to examine the impact, we compare the empirical lifetable extracted from the 1991 Census and the INDEPTH model pattern2 for Eastern and Southern Africa. To get the INDEPTH model pattern, Brass's two parameter model pattern was adjusted for HIV/AIDS mortality using the correction factor- γ_{x}.. The correction factor is used to correct the child mortality rates because this is the only reliable data available since the country lacks vital registration data. Since estimation of the impact on mortality is sensitive to the type of data , we have assumed that child mortality estimates from the 1991 census are accurate otherwise results and conclusions must be treated with care. In light of the above inadequacy, qualitative information at hand has been used to counterbalance the shortcomings of census data for interpretation purposes.

Data and Methods

In this paper, we use data from the 1991census to model the impact of HIV/AIDS on the Ugandan population. We then apply INDEPTH system of model life tables to explicitly examine the age patterns of mortality for this population with and without AIDS. The age pattern of mortality is estimated using the INDEPTH model life table system (standard Pattern 2 for Eastern and Southern Africa). The model captures the convolution of the age pattern of a population in relation to the standard pattern using the *logit* transformation of l_x, the probability of surviving to age *x:*

$$\lambda_x = \alpha + \beta\lambda^s_x \quad (1)$$

However,

$$\lambda_x = \text{log}it\,[l_x] = \frac{1}{2}\, In\, \left[\frac{1.0-lx}{lx}\right] \quad (2)$$

And if we substitute (2) in (1), we get

$$\frac{1}{2}\, In\left(\frac{1.0-lx}{lx}\right) = \alpha\, + \frac{1}{2}\beta In\left(\frac{1.0-lsx}{lsx}\right) \quad (3)$$

Where l_x is the survival function for the empirical mortality pattern and while l^s_x is the function for the standard model pattern. The parameter α shows the level of mortality in the population relative to the standard: a higher value of α implies a higher mortality value in the study population or a lower probability of surviving to a certain age *x* as well as lower probability of surviving between any two ages *x* and *x+n*. The parameter β represents the *slope* of mortality; and when β increases, mortality increases at older ages (ages above that at which l_x =0.5) but it decreases at younger ages. The value of α and β are estimated using ordinary least squares regression methods.

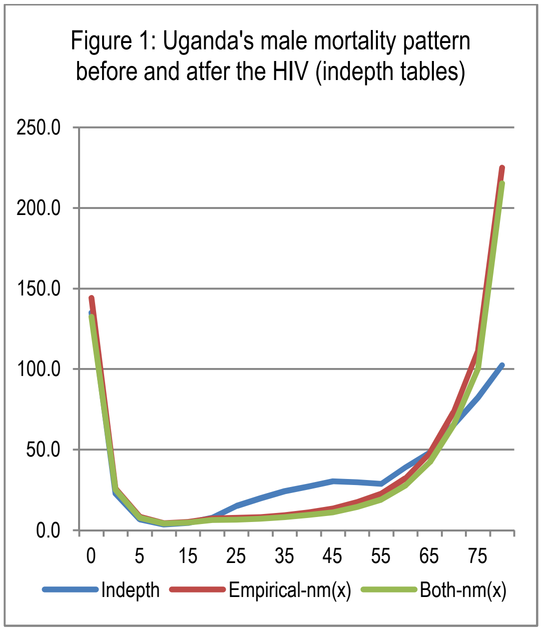
To investigate the impact of HIV/AIDS on the mortality pattern, we use life table techniques. First, we produce life tables using the INDEPTH model patterns to show the mortality pattern after the demographic effects of epidemic have become apparent. Second, we consider the 1991 empirical lifetables - the point before onset of high levels of AIDS mortality.

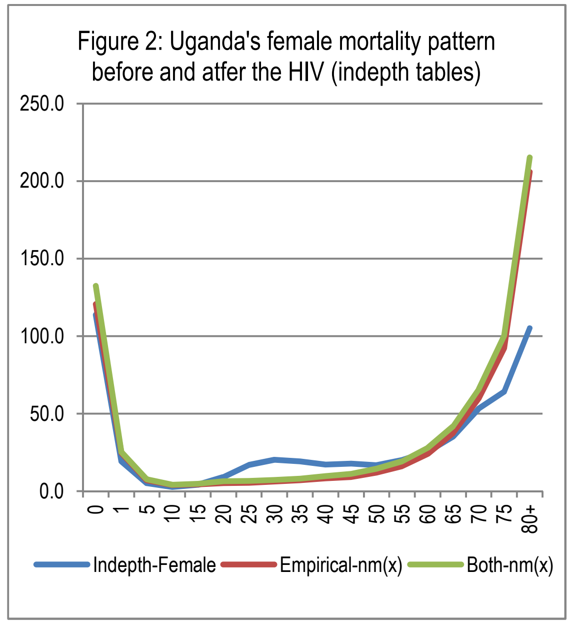
Results

The empirical age specific mortality schedules are compared with the inDepth model life table computations (see figure 1&2). Admittedly, AIDS has had an impact on the early adulthood mortality pattern in Uganda indicated by the hump. However, the picture for women is substantially different peaking between 20 – 45 years compared to that of males which peaks at 25 – 55 years and besides, the size of the hump shows that the impact is more pronounced among men. Two probable alternative reasons would seem to be responsible for the difference in peaking: First, for women, it could be due to maternity which increases their risk of contracting HIV, because for them to conceive, they must have unprotected sex; and delivery process which increases the rate of progressing to AIDS. Second, for men, this is their prime-reproductive health age range within which they must have children and also libido is high. Similar to other studies, HIV/AIDS epidemic clearly reduces the life expectancies at birth in the affected populations; however, there is uncertainty about its effects on the mortality pattern. The question is whether the impact on the pattern is over estimated or underestimated? In Ugandan context for example, our study estimates the impact of HIV/AIDS on life expectancy to be 4 years lower than what it would have been if the epidemic was absent. With regard to the age specific death rates, death rates in the affected ages rise by 27 – 163 percent among males (see figure 1& table 1&2) and 76 – 231 percent among females (figure 2 & table 3&4); possibly because of high sexual activity in these age groups. Having understood the impact of HIV/AIDS on the mortality pattern in Uganda, and its lack of uniformity in changes in the age pattern overtime and the use of inDepth system of life tables helps us to improve our capacity to ascertain the impact of emergent and re-emerging diseases and perhaps forecast future patterns.

The percentage change among children and to some extent the elderly is negative, indicating less death in the HIV/AIDS situation than in a population without the epidemic; possibly because more of the resources were withdrawn from other health related programmes to the HIV/AIDS sector. This implies that probably those who would die of AIDS end-up dying of other diseases; because persons exposed to other diseases increase, and the force of mortality leads to more death from other diseases other than AIDS (Preston et al. 2001). Alternatively, results may also imply difficulty in classification (given that several death occur at home and are not reported) of the cause of death among infants where AIDS related deaths remain hidden because of generally high infant mortality regime.

Our paper also points to an intriguing finding that apart from early adults (age range 20-55), the mortality pattern is similar for infants, children and to some extent the elderly. The difference in the empirical and inDepth (AIDS) mortality pattern is insignificant for infants and children (as visualized between 0-20 years) and the gap curve for the elderly is trivial though it is likely to increase with age. Three reasons may be used to explain this: First, in high infant mortality countries like Uganda, the effect of HIV/AIDS may not easily be noticed. Second, HIV/AIDS affected or afflicted children (orphans) who died seem to have done so towards the end of 1990s or early 2000s. Third, when modeling, such a pattern is common when infant and child mortality rates are used as inputs (Gani et al, 2003). The pattern of the elderly is more explicit for females and this could indicate that the impact on the mortality pattern seems not to be as enormous as being thought.





Conclusion

Our findings indicate that, in line with other finding in the region, HIV/AIDS has had an impact on the mortality pattern in Uganda however, the impact seems to be minimal for the children and the elderly than it is with those aged 20 – 50 years; pointing to an interesting finding that in some sections of the age pattern, the impact of mortality seems to be minimal.

As a matter of policy, the mortality pattern suggests less death among children and the elderly and that the inDepth model fits quite well. This implies that while resources need to be allocated to HIV/AIDS related programmes, priority should be given to other health related sectors. Also, it may imply the need to strengthen birth and death registration. By way of summary, what is known after using the appropriate life table model (inDepth MLT) is that, we are able to predict future mortality regimes resulting from emergent diseases.

Table 1: INDEPTH Model estimates of the life table for Males, Uganda 1991

Age	n	lx	$_nd_x$	$_na_x$	$_nm_x$	$_nL_x$	T_x	e_x
0	1	100000	12409	0.35	0.13497	91934	4133205	41.3
1	4	87591	7508	0.34	0.02271	330544	4041271	46.1
5	5	80083	2627	0.5	0.00667	393850	3710726	46.3
10	5	77457	1325	0.5	0.00345	383970	3316876	42.8
15	5	76132	1722	0.5	0.00458	376353	2932906	38.5
20	5	74409	2834	0.5	0.00777	364961	2556553	34.4
25	5	71575	5175	0.5	0.01500	344938	2191592	30.6
30	5	66400	6282	0.5	0.01986	316294	1846654	27.8
35	5	60118	6846	0.5	0.02415	283473	1530359	25.5
40	5	53271	6766	0.5	0.02712	249443	1246886	23.4
45	5	46506	6564	0.5	0.03037	216119	997443	21.4
50	5	39942	5541	0.5	0.02981	185857	781324	19.6
55	5	34401	4603	0.5	0.02868	160499	595466	17.3
60	5	29798	5294	0.5	0.03900	135756	434968	14.6
65	5	24504	5253	0.5	0.04803	109386	299212	12.2
70	5	19251	5416	0.5	0.06548	82714	189826	9.9
75	5	13835	4724	0.5	0.08234	57365	107112	7.7
80+	5	9111	3717	0.5	0.10252	36263	49747	5.5

Table 2: Abridged lifetable for males, Uganda 1991

Age	1000q(x)	d(x)	1000m(x)	l(x)	L(x)	p(x)	T(x)	e_x
0	131.38	13138	144.06	100000	91197.5	0.83618	4570045	45.70
1	96.91	8418	25.75	86862	326891.7	0.91929	4478847	51.56
5	40.16	3150	8.2	78444	384345.6	0.96906	4151955	52.93
10	21.34	1607	4.31	75294	372453.3	0.97666	3767610	50.04
15	25.38	1871	5.14	73687	363760.0	0.96933	3395156	46.08
20	36.09	2592	7.35	71817	352604.1	0.96303	3031396	42.21
25	37.88	2622	7.72	69225	339569.5	0.96122	2678792	38.70
30	39.71	2645	8.1	66603	326402.4	0.95779	2339223	35.12
35	44.81	2866	9.17	63958	312626.0	0.95085	2012820	31.47
40	53.69	3280	11.03	61092	297261.5	0.94098	1700194	27.83
45	64.66	3738	13.36	57812	279716.3	0.92645	1402933	24.27
50	83.06	4492	17.33	54074	259142.2	0.90539	1123217	20.77
55	107.20	5315	22.65	49583	234625.0	0.87290	864074	17.43
60	149.40	6614	32.29	44267	204803.1	0.82152	629449	14.22
65	212.66	8008	47.59	37654	168250.6	0.74437	424646	11.28
70	310.21	9197	73.43	29646	125240.1	0.63823	256396	8.65
75	436.51	8926	111.67	20450	79932.3	0.39055	131156	6.41
80+	1000.00	11523	224.96	11523	51223.3	0.00000	51223	4.45

Table 3: INDEPTH Model estimates of the life table for females, Uganda 1991

Age	n	l_x	$_nd_x$	$_na_x$	$_nm_x$	$_nL_x$	T_x	e_x
0	1	100000	10597	0.35	0.11381	93112	4613798	46.1
1	4	89403	6487	0.34	0.01905	340487	4520686	50.6
5	5	82916	2102	0.5	0.00514	409325	4180199	50.4
10	5	80814	1073	0.5	0.00267	401387	3770874	46.7
15	5	79741	1566	0.5	0.00397	394788	3369487	42.3
20	5	78174	3454	0.5	0.00904	382236	2974699	38.1
25	5	74720	6068	0.5	0.01693	358430	2592463	34.7
30	5	68652	6617	0.5	0.02025	326716	2234033	32.5
35	5	62035	5644	0.5	0.01906	296062	1907317	30.7
40	5	56390	4592	0.5	0.01698	270470	1611255	28.6
45	5	51798	4383	0.5	0.01767	248032	1340784	25.9
50	5	47415	3804	0.5	0.01672	227565	1092752	23.0
55	5	43611	4140	0.5	0.01993	207705	865187	19.8
60	5	39471	4711	0.5	0.02539	185577	657481	16.7
65	5	34760	5637	0.5	0.03530	159706	471904	13.6
70	5	29123	6826	0.5	0.05310	128549	312198	10.7
75	5	22297	6147	0.5	0.06396	96116	183649	8.2
80+	5	16150	6718	0.5	0.10504	63953	87532	5.4

Table 4: Abridged lifetable for females, Uganda 1991

Age	1000q(x)	d(x)	1000m(x)	l(x)	L(x)	p(x)	T(x)	e_x
0	111.75	11175	120.50	100000	92736.3	0.85622	5051944	50.52
1	92.31	8199	24.45	88825	335375.4	0.92544	4959208	55.83
5	34.42	2775	7.00	80626	396190.0	0.97301	4623832	57.35
10	19.29	1501	3.89	77850	385498.8	0.97972	4227642	54.30
15	21.30	1626	4.31	76349	377679.8	0.97672	3842144	50.32
20	25.31	1891	5.13	74723	368886.2	0.97421	3464464	46.36
25	26.28	1914	5.32	72832	359374.0	0.97182	3095578	42.50
30	30.14	2137	6.12	70918	349247.0	0.96770	2736204	38.58
35	34.53	2375	7.03	68781	337967.6	0.96288	2386957	34.70
40	39.81	2644	8.12	66406	325421.1	0.95787	2048989	30.86
45	44.55	2841	9.11	63762	311709.6	0.94912	1723568	27.03
50	57..51	3504	11.84	60922	295849.1	0.93314	1411858	23.17
55	76.79	4409	15.97	57418	276068.0	0.90586	1116009	19.44
60	112.94	5987	23.94	53009	250078.7	0.85970	839941	15.85
65	171.15	8048	37.43	47022	214991.9	0.78926	589863	12.54
70	258.50	10075	59.37	38974	169685.0	0.69209	374871	9.62
75	374.56	10824	92.17	28900	117436.6	0.42766	205186	7.10
80+	1000.00	18075	205.99	18075	87749.0	0.00000	87749	4.85

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