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Modeling HIV/AIDS Epidemics in West Africa: Results for Unaids Modelling Approach from Some Selected Countries

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Abstract: The Estimation and Projection Package (EPP) developed by UNAIDS reference group have been used with some notable success in some countries of the sub-Saharan (East and South) African Countries. In this present studies, we present results for five modeling methods applied to four countries in the West African Sub region. Using five modeling assumption with respect to 2 data situations and paying attention to the parameters determining the dynamics of HIV/AIDS epidemics, we employ Epp to model the prevalence of the epidemic in four West African countries. We used these estimates to further explain the underlying trend in the epidemic in each of the selected countries. For the unedited data, our results shows that in 2005 the default model yielded 17.69% (Urban: 4.72%, Rural: 28.82%) for Nigeria, 5.23% (Urban: 4.48%, Rural: 6.18%) for Ghana, 4.75% (Urban: 5.28%, Rural: 4.33%) for Cote d'Ivoire and 0.54% (Urban: 0.49%, Rural: 0.59%) for Senegal. The computed Log-Likelihood (LL) estimates for the default model are (Urban: 187.8809, Rural: 4, 948. 3913), (Urban: 181.5688, Rural: 664.9529), (Urban: 320.0272, Rural: 388.4773) and (Urban: 45.7742, Rural: 78.0798) for Nigerian, Ghana, Cote d'Ivoire and Senegal, respectively.

Key words: Prevalence, HIV/AIDS modeling, west africa, loglikelihood, surveillance data, dynamic parameters, urban, rural

INTRODUCTION

The prevalence of HIV/AIDS epidemics is obviously higher among the sub-Saharan African Countries than any other region of the world. Notwithstanding, west African countries are among the countries in Africa that are experiencing low prevalence, except for Nigeria and Cote d'Ivoire were the situation call for attention in some specific sentinel sites(or states).

However, it is widely believed that the future of the epidemic depends on the magnitude of HIV spread in India and China (Tucker *et al*., 2005). In recent time, decline in the prevalence of the epidemic have been reported for some sub-Saharan African countries (Asamoah *et al*., 2004). To ensure that these observations are not due to measurement biases, UNAIDS Reference Group on Estimates, Modeling and Projections organized a meeting on "Evidence and causes of declines in HIV prevalence and incidence in countries with generalized epidemics" in Harare, Zimbabwe, where new data and analyses were presented (Ghys *et al*., 2006).

The reference group had earlier developed a method for estimating prevalence of HIV/AID formalized in a software package, Estimation and Projection Package (EPP) (Ghys *et al*., 2004). The EPP is currently the recommended tool for estimating and projecting HIV prevalence levels in countries with generalized epidemic. According to Ghys *et al*. (2004) a generalized epidemic are defined epidemic in which HIV is firmly established in the general population and although sub-populations at high risk may continue to contribute disproportionately to the spread of HIV, sexual networking in the generation population is sufficient to sustain an epidemic independent of sub- population at higher risk of infection. HIV prevalence among pregnant women above 1% on a national basic has been proposed as a numerical proxy for generalized epidemic. All the countries in the Sub-Saharan Africa fall into this category.

Focusing on sub-Saharan Africa generally and some selected East and South African countries, several works have been published on the application and suitability of EPP and Spectrum (AIM module) for modeling estimating and projecting HIV prevalence at the national and regional level (Brown *et al*., 2006; Ghys *et al*., 2004; Grassly *et al*., 2006; Hladik *et al*., 2006; Karingwa *et al*., 2006; Mahomva *et al*., 2006; Salomon and Murray, 2001). In these studies, we apply the UNAIDS model (under varying assumptions) to some selected countries of the West African sub-region. Our interest was to asses the level of suitability of the Model for estimating prevalence under some specified set of assumptions and to propose some guidelines for effective application.

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MATERIALS AND METHODS

Sources of data: In West Africa and all other countries in the sub-saham Africa, seroprevalence data of pregnant women attending antennal clinics, obtain through sentinel surveillance survey, is still the major sources of information about the prevalence of HIV/AIDS in the adult population. The sentinel surveillance programs is based on anonymous, unlinked testing in a selection of clinics within a country, with each clinic reporting the annual proportion of attendees that tested positive for HIV infection (Salomon and Murray, 2001). Data for the sentinel surveillance program kept by UNAIDS and WHO in the form of an epidemiological fact sheet is available for almost all the countries of the sub-Saharan Africa. The list of all the sentinel sites and their respective, observed prevalence rate have been annexed in the epidemiological fact sheet of each of the selected countries. The data is available from 1987-2002 for Nigeria, 1987-2002 for Ghana, 1987-2002 for Cote d'Ivoire and 1987-2002 for Senegal.

Assumptions and recommendations of the unaids model (EPP)

The parameters: The Estimation and Projection Package (EPP) has four epidemiological parameters that described the dynamic of the HIV infections (Anonymous, 2003):

- t_0- The initial year of the epidemic. AIDS case was noticed in most West African countries in the early and middle 1980s, we therefore pegged the initial year at 1980 in other to avoid complications.
- f_0- The initial proportion of the population that is in the at-risk category. The parameter determines the peak of the epidemic curve. Typical values are between 0 and 0.40.
- r- The force of infection. This governs the rate at which people in the susceptible population become infected. A large value of r will cause prevalence to increase rapidly while a small value will cause it to increase slowly. Typical values are between 0 and 10 with most around 0.5-2.5.
- Phi- The high-risk adjustment parameter. This parameter determines the degree to which susceptible people who die from AIDS are replaced by people who previously were not at-risk. Essentially, the parameter affects the distribution of new entrants to the not at risk and at risk categories. The value of phi determines the amount of decline in prevalence after it reaches a peak. A large value of phi will produce a small prevalence decline, while a small value phi will produce a large prevalence decline. Typical values are between -2 and 100.

To determine whether prevalence is declining, it is recommended that we first fit a curve with phi fixed at a value of 100, this will allowed us to fit a model with the default assumption that prevalence is not declining, which is generally the case with national epidemics (Anonymous, 2005). Having examined the default model, we fit four other models with different modeling assumptions, the Log-Likelihood (LL) indicated how much better the fit is with the optimum value of phi.

The level fit: EPP provides a fit to the adult prevalence data entered by the user, applying appropriate adjustment and calibration procedures. If surveillance system expands, one way of approaching this in EPP 2003 was to fit each site's time series of data separately, applying the appropriate population from site's catchments area and then to combine these within EPP (Brow *et al.*, 2006). However, this is time consuming and trends in individual sites can show tremendous variability given a single site's comparatively small sample size. Furthermore, recently added sites may only have one or two points of data, so it is difficult to determine a "trend". The alternative approach implemented in EPP 2005 is called level fitting, a procedure development by one of the authors (N Glassy). Level fits are based on the approximation that, while there are variations in absolute prevalence levels from one site to the next, the overall trend of rising and falling prevalence is the same throughout the region being modeled. To make level fits, we assume that the epidemic for the country being modeled is the sum of a number of curves for individual sites with different levels. Sites with long runs of data will contribute substantially to determining the shape of the underlying curve, while the lower prevalence sites recently added with relatively short data runs will help in bringing down the overall country prevalence level when they are assumed to form the regional epidemic (Brown *et al.*, 2006).

Editing data for inconsistency: In order to avoid biases in the analysis of HIV prevalence trends, it is necessary that analysis of HIV prevalence trends in ANC sites in countries with generalized epidemics should be restricted to those sites with consistent reporting over time (Cahys *et al.*, 2006). The analysis of trends should consider the magnitude of any change over a period of consistent data collection. As a rule of thumb, at least three data points showing a consistent trend in prevalence are needed to conclude there is a declining trend (Cahys *et al.*, 2006).

The different modeling scenarios: Base on the above assumptions and recommendations, we examined 5 modeling assumptions in two data situations;

- The entire data available in the epidemiological fact sheet, without regard to the number of data points recorded for each of the sites, except that sites with zero data point (not zero prevalence) where eliminated from modeling exercise.
- The edited data by eliminating from the modeling exercise, any site that does not have at least three data points.

Consequently, we have the following five modeling assumptions each for the Unedited and the edited data:

- The default model. The assumptions of the default model were prevalence is not declining and the parameter phi was fixed at 100.
- The model with level fit and phi fixed at 100.
- The model with level fit and phi not fixed.
- The model with no level fit and phi fixed at 100.
- The model with no level fit and phi not fixed.

Finally, we searched for the best modeling scenario(s) for each of the selected countries by considering the estimates of the Log-Likelihood (LL). During the fit exercise, the best LL will be indicated by a GREEN background in the cell for LL. If changes in the parameters yielded a LL that is significantly different from the original LL, the background for the LL cell will be RED. Generally, the smaller of the LLs represent the better fit (Anonymous, 2005).

RESULTS

Estimates of the model parameters: In most African countries, particularly, the countries under study, cases of AIDS were noticed in early and middle 1980s (Anonymous, 2006). In order not to complicate matters, we kept the initial year of the epidemic at 1980, hence, the parameters t_0 is 1980 for all the modeling scenarios in all countries.

The estimates of the parameters defining the dynamics of HIV/AIDS in the four countries are as shown in Table 1 and 2 for the various modeling assumptions (before and after the data was edited for sites with less than three consecutive prevalence data).

Estimate of the country based prevalence: We present the results for the default model and the models with level fit were the best results were obtained for each of the countries.

Results for the default model: Before the data was edited for sites with less than three consecutive prevalence data, the default model for Nigeria (with a total of 90 surveillance sites) yielded a prevalence rate of 17.38% (urban; 4.80%, Rural; 27.37%) in 2000, 18.12% (Urban; 4.90, Rural 29.09%) in 2003 and 17.69% (Urban; 4.72%, Rural; 28.82%) in 2005 with a projected prevalence rate of 16.55% (Urban; 4.40% Rural; 27.78%) and 16.36%, (Urban; 4.37%, Rural; 27.64%) for 2009 and 2010, respectively. For Ghana (with a total of 49 sites), the prevalence rate was

Table 1: Estimate of the model parameters for the five modeling assumptions (Models for the unedited data)

	Nigeria		Ghana		Cote d'Ivoire		Senegal	
Parameter	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Default Model								
r	6.9784	1.3043	7.5758	5.5556	6.2893	7.5188	50.0000	46.7290
f_0	0.0716	0.3834	0.0666	0.0900	0.0795	0.0665	0.0085	0.0107
Phi	100	100	100	100	100	100	100	100
LL	187.8806	4,948.3913	181.5688	664.9529	320.0272	388.4773	45.7742	78.0798
Model with Level fit and phi fixed at 100								
r	8.4681	6.2725	11.4054	40.1401	8.1045	8.1974	32.8898	33.9874
f_0	0.0694	0.0884	0.0570	0.0561	0.1226	0.1025	0.0153	0.0131
Phi	100	100	100	100	100	100	100	100
LL	151.3284	853.1168	124.9684	430.4464	104.4929	219.8908	36.657	71.6057
Model with Level fit and phi not fixed								
r	8.4681	6.2725	12.6845	42.5913	8.1024	8.0544	33.0826	28.6943
f_0	0.0694	0.0884	0.0554	0.0539	0.1226	0.1044	0.0153	0.0165
Phi	100	203.31	186.63	120.53	99.17	85.96	733.00	955.13
LL	151.3284	848.4929	124.9744	423.2531	104.4455	219.8525	36.0237	71.2505
Model with no Level fit and phi fixed at 100								
r	8.1795	7.2761	11.4720	28.3449	7.8321	7.8437	33.0826	41.0536
f_0	0.0664	0.0.758	0.0550	0.0464	0.1257	0.1063	0.0153	0.0128
Phi	100	100	100	100	100	100	100	100
LL	186.3516	1,196.8426	173.6564	539.9530	128.4177	265.6948	36.7656	76.6360
Model with no Level fit and phi not fixed								
r	8.1795	7.2761	11.4720	28.3449	7.8321	7.8437	33.0826	41.0536
f_0	0.0664	0.0758	0.0550	0.0464	0.1257	0.1063	0.0153	0.0128
Phi	100	100	146.55	120.56	100	88.35	751.67	916.38
LL	186.3516	1,196.8425	173.5591	539.8072	128.4177	265.4694	36.7550	76.3738

Table 2: Estimate of the model parameters for the five modeling assumptions (Models for the edited data)

	Nigeria		Ghana		Cote d'Ivoire		Senegal	
Parameter	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Default Model								
r	9.91808	1.3043	15.1515	5.5556	6.7568	7.5188	50.0000	50.0000
f_0	0.0504	0.3834	0.0330	0.0900	0.0740	0.0665	0.0085	0.0070
Phi	100	100	100	100	100	100	100	100
LL	129.6071	2,588.7815	115.8294	587.9525	232.9612	192.3112	45.7742	1094615
Model with Level fit and phi fixed at 100								
r	9.7768	3.5607	13.4741	29.2886	7.1947	7.7394	32.8898	39.6525
f_0	0.0577	0.1396	0.0435	0.0472	0.1411	0.1231	0.0153	0.0126
Phi	100	100	100	100	100	100	100	100
LL	109.3323	611.3765	92.5264	401.9017	58.7709	90.9033	36.0657	65.1412
Model with Level fit and phi not fixed								
r	9.7768	4.4061	15.1515	26.7888	7.2242	7.7394	33.0826	30.6441
f_0	0.0577	0.1181	0.0330	0.0464	0.413	0.1231	0.0153	0.0146
Phi	56.34	32.53	578.16	125.91	191.64	98.50	733.0000	960.1400
LL	109.2596	592.5020	105.8016	386.1828	58.4534	90.5742	36.0237	65.2219
Model with no Level fit and phi fixed at 100								
r	9.5913	6.5461	13.3900	26.9704	7.2242	7.8508	33.0826	45.0222
f_0	0.0567	0.0847	0.0426	0.0456	0.1413	0.1238	0.0153	0.0119
Phi	100	100	100	100	100	100	100	100
LL	124.4687	763.3860	103.1916	471.5702	60.3840	94.4313	36.7656	65.7195
Model with no Level fit and phi not fixed								
r	9.5913	6.5461	13.3900	26.9704	7.2242	7.8508	33.0826	45.0222
f_0	0.0567	0.0847	0.0426	0.0456	0.1413	0.1238	0.0153	0.0119
Phi	100	327.11	578.16	113.48	549.16	100	751.67	574.0900
LL	124.4687	762.8071	102.8196	471.4897	60.0847	94.4313	36.7550	68.6688

5.41% (Urban: 4.48%, Rural: 6.18%), 5.45% (Urban: 4.47%, Rural: 6.25%) and 5.23% (Urban: 4.27%, Rural: 6.03%) in 2000, 2003 and 2005, respectively with a projected rate of 4.87% (Urban: 3.93%, Rural: 5.66%) for 2009 and 4.84% (Urban: 3.89%, Rural: 5.62%) for 2010. The situation for Cote d'Ivoire (a total of 53 sites) was 4.88% (Urban: 5.39%, Rural 4.48%), 4.94% (Urban: 5.47%, Rural: 4.51%) and 4.75% (Urban: 5.28%, Rural 4.33%) in 2000, 2003 and 2005, respectively with a projected rate of 4.42% (Urban: 4.94%, Rural: 4.01%) in 2009 and 4.39% (Urban: 4.90%, Rural: 3.97%) in 2010. And the prevalence rate for Senegal (with a total of 11 sites) was 0.54% (Urban: 0.38%, Rural 0.69%), 0.57% (Urban: 0.48%, Rural 0.66%) and 0.54% (Urban: 0.49%, Rural: 0.59%) in 2000, 2003 and 2005, respectively with a projected rate of 0.43% (Urban: 0.42%, Rural: 0.45%) in 2009 and 0.41% (Urban: 0.39%, Rural: 0.42%) in 2010 (Fig. 1).

Similarly, after the data have been edited for sites with less than three surveillance data, we had respectively for 2000, 2003 and 2005: 16.76% (Urban: 3.34%, Rural: 27.37%), 17.44% (Urban: 3.36%, Rural: 29.09%) and 16.98% (Urban: 3.20%, Rural: 28.82%) for Nigeria; 4.39% (Urban: 2.19%, Rural: 6.18%), 4.40% (Urban: 2.12%, Rural: 6.25%) and 4.19% (Urban: 1.96%, Rural: 6.03%) for Ghana; 4.71% (Urban: 5.00%, Rural 4.48%), 4.76% (Urban: 5.06%, Rural: 4.51%) and 4.57% (Urban: 4.87%, Rural 4.33%) for Cote d' lvoire; 0.25%, (Urban: 0.38%, Rural: 0.13%),0.35% (Urban: 0.48%, Rural 0.22%) and 0.38% (Urban: 0.49%), Rural: 0.28%) for Senegal, while the projected prevalence rate in 2009 and 2010 were, respectively 15.81% (urban: 2.91%, rural :27.78%) and 15.60% (Urban:2.87%, Rural:27.64%) for Nigeria; 3.85% (Urban: 1.68%, Rural: 5.66%) and 3.81% (Urban: 1.64%, Rural: 5.62%) for Ghana; 4.25% (Urban 4.45%, Rural: 4.01%) and 4.21% (Urban: 4.51%, Rural: 3.97%) for Cote d'ivoire; 0.38% (Urban: 0.42%, Rural 0.34%) and 0.37% (Urban: 0.39%, Rural: 0.34%) for Senegal.

Results for the model with level fit and phi fixed at 100: For the unedited data, the model with level fit and phi fixed at 100 for Nigeria resulted in prevalence rate of 5.81% (Urban; 5.05%, Rural; 6.46%) in 2000, 15.48% (Urban; 4.68, Rural 6.17%) in 2003 and 5.26% (Urban; 4.49%, Rural; 5.93%) in 2005 with a projected prevalence rate of 5.12% (Urban; 4.40% Rural; 5.74%) and 5.13%, (Urban; 4.42%, Rural; 5.74%) for 2009 and 2010, respectively. For Ghana, the prevalence rate was 4.10% (Urban: 3.99%, Rural: 4.19%), 3.95% (Urban: 3.61%, Rural: 4.23%) and 3.89% (Urban: 3.49%, Rural: 4.22%) in 2000, 2003 and 2005, respectively with a projected rate of 3.90% (Urban: 3.53%, Rural: 4.20%) for 2009 and 3.91% (Urban: 3.56%, Rural: 4.19%) for 2010. For Cote d'Ivoire, we observed 8.34% (urban: 9.36%, Rural 7.52%), 8.36% (Urban: 9.46%, Rural: 7.46%) and 8.43% (Urban: 9.54%, Rural 7.53%) in 2000, 2003 and 2005, respectively with a projected rate of 8.50% (Urban: 9.57%, Rural: 7.64%) in 2009 and 8.49% (Urban: 9.56%, Rural: 7.64%) in 2010. While the prevalence rate for Senegal was 0.99% (Urban: 0.99%, Rural 0.99%),

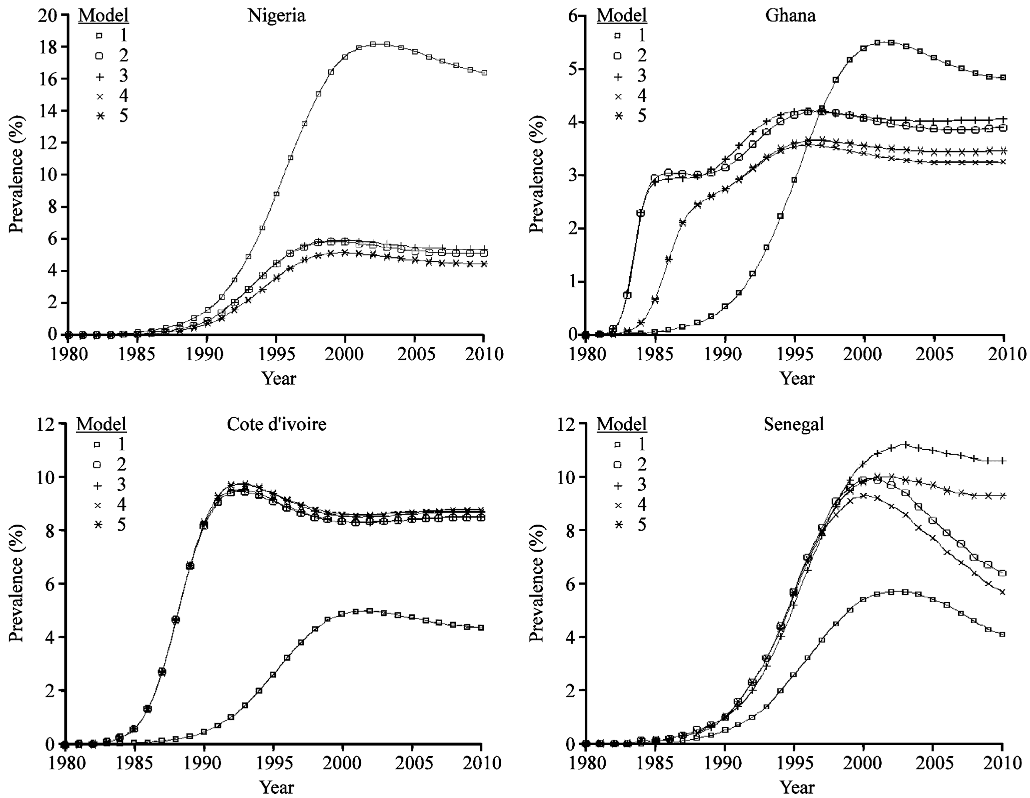

Fig. 1: Models for the prevalence of HIV/AIDS in West Africa

0.94% (Urban: 0.95%, Rural 0.93%) and 0.84% (Urban: 0.86%, Rural: 0.583) in 2000, 2003 and 2005, respectively with a projected rate of 0.67% (Urban: 0.68%, Rural: 0.66%) in 2009 and 0.64% (Urban: 0.65%, Rural: 0.63%) in 2010.

After the data have been edited for sites with less than three surveillance data, we had respectively for 2000, 2003 and 2005: 7.06% (Urban: 4.14%, Rural: 9.52%), 7.15% (Urban: 3.84%, Rural: 9.97%) and 6.95% (Urban: 3.64%, Rural: 9.79%) for Nigeria; 3.11% (Urban: 3.06%, Rural: 3.16%), 3.01% (Urban: 2.71%, Rural: 3.26%) and 2.95% (Urban: 2.53%, Rural: 3.29%) for Ghana; 10.07% (Urban: 10.97%, Rural 9.34%), 10.17% (Urban: 11.09%, Rural: 9.42%) and 10.25% (Urban: 11.17%, Rural 9.51%) for Cote d' lvoire; 0.90%, (Urban: 0.99%, Rural: 0.81%),0.86% (Urban: 0.95%, Rural 0.78%) and 0.78% (Urban: 0.86%), Rural: 0.70%) for Senegal, while the projected prevalence rate in 2009 and 2010 were, respectively 6.62% (urban: 3.49%, rural 9.36%) and 6.59% (Urban: 3.49%, Rural: 9.30%) for Nigeria; 2.89% (Urban: 2.41%, Rural: 3.28%) and 2.89% (Urban: 2.42%, Rural: 3.28%) for Ghana; 10.28% (Urban 11.19%, Rural: 9.55%) and 10.27% (Urban: 11.18%, Rural: 9.54%) for Cote d'ivoire; 0.61% (Urban: 0.68%, Rural 0.54%) and 0.58% (Urban: 0.65%, Rural: 0.51%) for Senegal.

Results for the model with level fit and phi not fixed: The model with level fit and phi not fixed for the unedited data yielded for Nigeria, a prevalence rate of 5.92% (urban; 5.05%, Rural; 6.66%) in 2000, 5.67% (Urban; 4.68%, Rural 6.51%) in 2003 and 5.49% (Urban; 4.49%, Rural; 6.36%) in 2005 with a projected prevalence rate of 5.38% (Urban; 4.40% Rural; 6.23%) and 5.39%, (Urban; 4.42%, Rural; 26.23%) for 2009 and 2010, respectively. For Ghana, the prevalence rate was 4.12% (Urban: 4.06%, Rural: 4.16%), 4.05% (Urban: 3.89%, Rural: 4.18%) and 4.04% (Urban: 3.88%, Rural: 4.17%) in 2000, 2003 and 2005, respectively with a projected rate of 4.06% (Urban: 3.95%, Rural: 4.15%) for 2009 and 4.07% (Urban: 3.96%, Rural: 4.15%) for 2010. For Cote d'Ivoire the prevalence was 8.34% (urban: 5.35%, Rural 7.51%), 8.34% (Urban: 9.46%, Rural: 7.44%) and 8.42% (Urban: 9.53%, Rural 7.52%) in 2000, 2003 and 2005, respectively with a projected rate of 8.50% (Urban: 9.56%, Rural: 7.64%) in 2009 and 8.49% (Urban: 9.55%, Rural: 7.65%) in 2010. And the prevalence rate for Senegal was 1.05% (Urban: 1.06%, Rural 1.05%), 1.12% (Urban: 1.08%, Rural 1.15%) and 1.10% (Urban: 1.05%, Rural: 1.15%) in 2000, 2003 and 2005, respectively with a projected rate of 1.06% (Urban: 1.01%, Rural: 1.11%) in 2009 and 1.06% (Urban: 1.00%, Rural: 1.10%) in 2010.

When the data have been edited for sites with less than three surveillance data, we had, respectively for 2000, 2003 and 2005: 5.90% (Urban: 4.04%, Rural: 7.48%), 5.05% (Urban: 3.61%, Rural: 6.27%) and 4.21% (Urban: 3.32%, Rural: 4.98%) for Nigeria; 2.81% (Urban: 2.31%, Rural: 3.22%), 2.90% (Urban: 2.39%, Rural: 3.31%) and 2.90% (Urban: 2.35%, Rural: 3.35%) for Ghana; 10.35% (Urban: 11.61%, Rural 9.33%), 10.43% (Urban: 11.70%, Rural: 9.40%) and 10.50% (Urban: 11.75%, Rural 9.49%) for Cote d' lvoire; 0.93%, (Urban: 1.06%, Rural: 0.80%),1.02% (Urban: 1.08%, Rural 0.96%) and 1.02% (Urban: 1.05%), Rural: 0.98%) for Senegal, while the projected prevalence rate in 2009 and 2010 were, respectively 2.75% (urban: 3.00%, rural: 2.53%) and 2.49% (Urban: 2.99%, Rural:2.05%) for Nigeria; 2.86% (Urban: 2.27%, Rural: 3.34%) and 2.85% (Urban: 2.26%, Rural: 3.33%) for Ghana; 10.52% (Urban 11.75%, Rural: 9.54%) and 10.51% (Urban: 11.74%, Rural : 9.53%) for Cote d'ivoire; 0.98% (Urban: 1.01%, Rural 0.96%) and 0.98% (Urban: 1.00%, Rural: 0.95%) for Senegal.

DISCUSSION

We have presented different models representing the various approaches to modeling HIV/AIDS prevalence using EPP in some selected West African countries. We

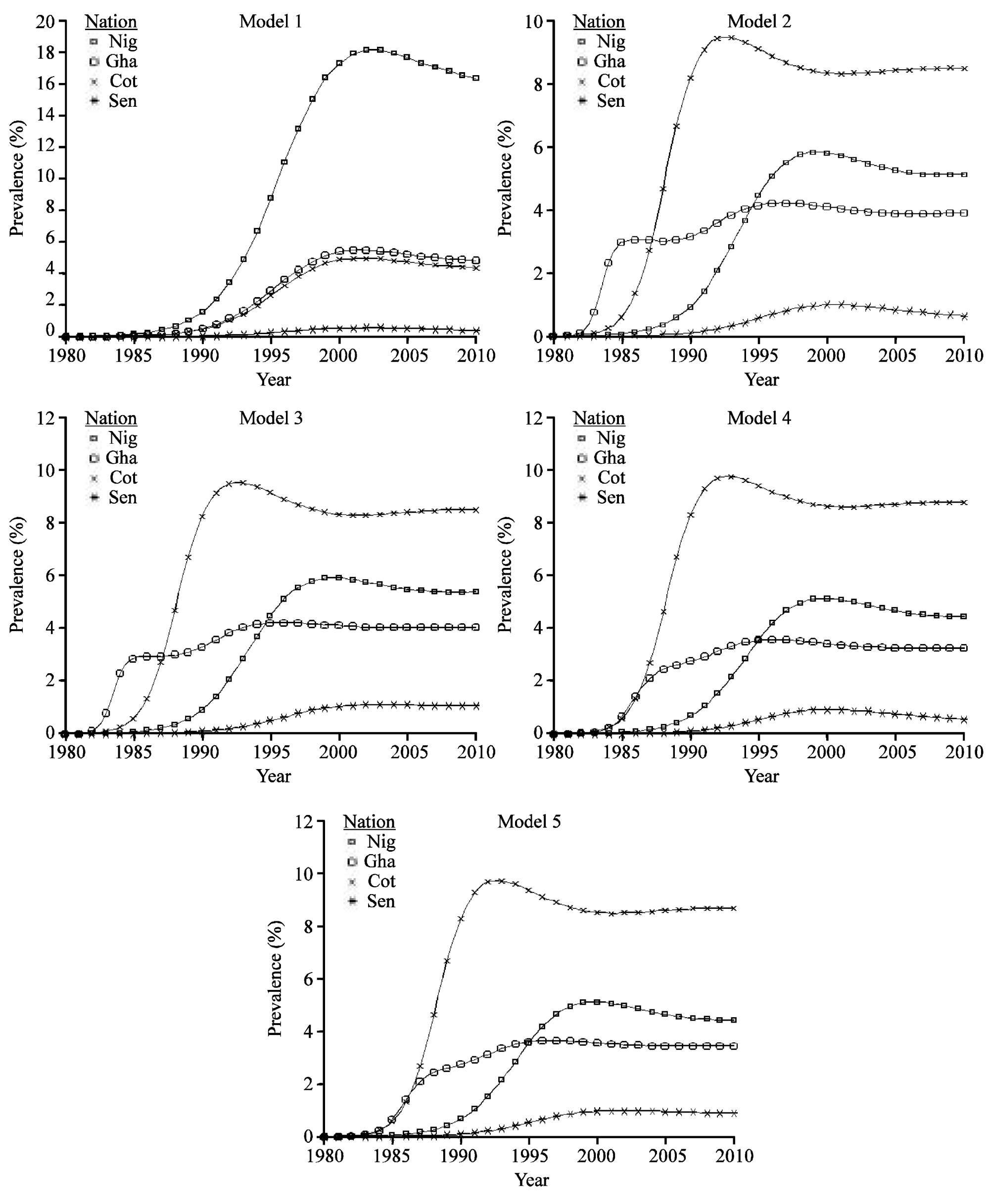

Fig. 2: Comparison of HIV/AIDS Prevalence for the four countries Under different Modeling assumptions

presented models for the urban and rural epidemic in the four counting using five modeling approaches; the default model, a model with level fit and phi fixed at 100, a model with level fit and phi not fixed, a Model with no level fit and phi fixed at 100 and a model with no level fit and phi not fixed.

Unedited data: For Nigeria, the estimates of the LL for the default model (Urban LL: 187.8809, Rural LL: 4,948.3913) showed no significant difference from those of the other models, as observed during the fitting exercise, except for the rural models were the estimate of the LL for the Default model was significantly different from the LL for the second and third models. However, the second model (Urban LL: 151.3284, Rural LL: 853:1168) and the third model (Urban LL: 151.3284, Rural LL: 848:4929) resulted in the better fit for Nigeria. Essentially, there is an evidence of prevalence decline, particularly among the Rural sites.

The situation remain true for all the other countries modeled- the second and the third model posses the least LL estimates with the third model performing averagely better in the four countries see Fig. 2, Table 1. Furthermore, we noted that the fourth and the fifth model usually almost result in both the same parameter as well as prevalence estimates.

For the unedited data, the peak prevalence estimates for the 5 models were 18.14% (2002), 5.83% (1999), 5.92% (2000), 5.14% (2000) and 5.14% (2000) for Nigeria; 5.51% (2001 and 2002), 4.22% (1997), 4.23% (1996), 3.59% (1996) and 3.67% (1996 and 1997) for Ghana; 4.99% (2002), 9.46% (1993), 9.54% (1993), 9.75% (1993) and 9.74% (1993) for Cote d'Ivoire; 0.57% (2002 and 2003), 0.99% (2000 and 2001), 1.12% (2003), 0.93% (2000) and 1.00% (2001 and 2002) for Senegal.

The edited data: For the edited data, the other models did not show any significant difference from the default models, except for the Nigerian rural epidemics. Apart from that, the second and the third models also presented LL estimates that are generally lower than those of the other models (Table 1) with the third model resulting in a better fit for all the 4 countries, while the fourth and the fifth models results in almost the same parameters and prevalence estimates.

Furthermore, the peak prevalence estimates for the 5 models were 18.14% (2002), 5.83% (1999), 5.92% (2000), 5.14% (2000) and 5.14% (2000) for Nigeria; 5.51% (2001 and 2002), 4.22% (1997), 4.23% (1996), 3.59% (1996) and 3.67% (1996 and 1997) for Ghana; 4.99% (2002), 9.46% (1993), 9.54% (1993), 9.75% (1993) and 9.74% (1993) for Cote d'Ivoire; 0.57% (2002 and 2003), 0.99% (2000 and 2001), 1.12% (2003), 0.93% (2000) and 1.00% (2001 and 2002) for Senegal.

Looking at the various models in Fig. 2 there is a clear indication that prevalence in Cote d'Ivoire is averagely higher than those of the other countries, except for the default model (model1), where the prevalence estimates for Nigeria is higher than those of the other countries while the prevalence estimates for Senegal is generally low throughout the models. In addition to that, at the onset of the epidemic, the epidemic in Ghana was modeled to be higher than that of Nigeria, which has for some years now, overtaken the situation in Ghana.

Except for Nigeria and Ghana were the default model resulted in higher prevalence estimates, estimates of the default model are consistently lower than estimates from any other modeling assumption for Cote d'Ivoire and Senegal. In the case of Ghana, the estimates for the default model were lower (prior to the peak prevalence) than those of the other models, Fig. 1. It is therefore, our considered opinion that in modeling HIV/AIDS prevalence in west-Africa or at least any of the 4 countries considered, level fit should be used, but the decision as to whether phi should be fixed or not should be a function of how strictly the investigator is interested in the minimization of the LL.

In essence, whether the entire data was used or the edited data, 'level fit' was a necessary modeling assumption in the West African setting. Mentioning must also be made of the fact that the estimates of the parameters are generally lower when the edited data was used than when the whole data was used.

CONCLUSION

The model incorporating Level fit and phi not fixed remained generally better for all the Countries (whether the data have been edited for sites not having up to three data point, not withstanding). In all the Modeling assumptions, Estimates of prevalence remained higher for Cote d'Ivoire than the rest Countries, except for the default model where Nigeria had the highest prevalence estimate.

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