Cohort Analysis of Adolescent Childbearing and Birth Progression in West-Africa

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Abstract
We examined adolescent childbearing rate and birth progression among 20-49 years old women in four selected countries from West-Africa (Liberia, Gambia, Nigeria and Ghana) using most recent round of Demographic Health Surveys were used. Birth timing probability, birth progression rate (BPR) and hazard ratio were estimated using survival analysis techniques (α=5.0%). Across countries, Adolescent First Birth (AFB) increases as the women's year of birth cohort increases and the rate was highest among Nigerian women ($r=0.773$, $p<0.001$) but lowest in Liberia ($r=0.497$, $p<0.001$). Probabilities of surviving adolescent years' interval without bearing a child were highest in Ghana for all age-cohorts, while Nigeria and Liberia exhibited similar pattern. BPR was higher among women who had AFB than women who started theirs at the later years. Across countries, hazard ratio of AFB was higher among 20-24 than 45-49 years age cohort. Policy that targets pregnancy prevention among adolescent is solicited in the region.

Keywords: First birth timing, Adolescent women, Birth progression, Adolescent pregnancy, West-Africa

Introduction
West Africa is one of the regions with high fertility rate world-wide (Population Reference Bureau, 2016). Nearly all the countries in West Africa have their Total Fertility Rate (TFR) higher than 5.0. An indication that fertility transition which has begun in some parts of sub-Saharan Africa is yet to commence in West-Africa (Population Reference Bureau, 2016). In Southern Africa for instance, countries like South Africa (TFR=2.4) and Botswana (TFR=2.8) are already in transition compared to West African countries like Niger (TFR=7.6), Burkina Faso (5.7) and Mali (6.0) which have been categorized among the top ten high fertility countries world-wide (Population Reference Bureau, 2016). This has implication on demographic dividends and attainment of sustainable development goals in the countries in the region. Many factors have been substantiated as being responsible for fertility differential among which adolescent childbearing has been consistently reported even in the developed countries (Oyefara, 2012; Ashraf, 2005).

In this study, attention was focused on adolescent childbearing because of its adverse socio-economic and health effects on the population (Pirk *et al.*, 2014; Gibbs *et al.*, 2012). Poor health conditions characterized teen mothers in developing countries where they might likely experience inadequate dietary intake, poor physical growth, obstructed labor, lack access to satisfactory health services and maternal mortality than older mothers (Zabin, 1998). Early sexual initiation and childbearing are common practices among adolescent in West-Africa countries (Measure DHS). Investigation of trends in adolescent childbearing will help to figure out whether there is future potential for fertility transition in West Africa. This study determined the rate and trend of adolescent childbearing among West-Africa countries. In addition, parity progression ratio of the women aged 45-49 years was examined for each of the selected countries.

Data and Methods
Study countries: The study was conducted among four West-African countries. These are; Nigeria, Ghana, Liberia and Gambia. The countries were selected based on data availability and preference was given to countries where surveys were conducted at the same period. We also used the level of fertility as part of the selection criteria. Therefore, two countries with TFR of at least 5.5 (Nigeria (TFR=5.5) and Gambia (TFR=5.7)) and two others with TFR below 5.0 (Ghana (TFR=4.2) and Liberia (TFR=4.7)) were selected..

Study design and sample extraction: A cross-sectional population based design approach was used for this study. The survey data-sets used were generated by the same institution (ICF Macro) in conjunction with the population affairs parastatals in each country. The sampling designs were similar and cluster design was used for data collection in all the countries (MEASURE DHS, 2015). The sample used for each of the selected countries was lower than the actual sample selected during the field work. This is because women without information on age at first birth were excluded. Further excluded were those with missing information on age and year of birth. This is because the information are sensitive to modelling the pattern of first birth timing. Also excluded were women aged <20 years. Thus the sample size used for each country was 31043, 7640, 7770 and 7324 For Nigeria, Ghana, Gambia and Liberia respectively. A sub-sample of 3555, 870, 571 and 807 was used to assess the parity progression ratio among women aged 45-49 years in Nigeria, Ghana, Gambia and Liberia respectively.

Variable description: The dependent variable was Adolescent First Birth (AFB). That is having the first child at ages below 20 years. The main independent variable is the age and this was examined as birth cohorts of women. For instance, women who were 20 years at the time of the 2013 survey were born in 1993. Although, the date of birth was reconciled with the timing of the survey to get the actual year of birth. The year of first birth of each woman was also obtained in the same manner. During further analysis, variables like; residence, household wealth, religion and level of education were used. Other variables like region, ethnicity, age at first sexual intercourse and age at first marriage were not included in the analysis.

Data analyses: The data were weighted and analyzed by estimating proportion who had their first birth at ages <20 years (y_t) by the year of birth of cohort (x) of women. The correlation and regression (equation 1) parameters ζ_0 and $\zeta_1$were estimated for this proportion and year of birth. This was used to obtain the adolescent first birth rate (equation 2) in each of the countries.

$$y_t = \zeta_0 + \zeta_1 x + \varepsilon_i \quad (1) \text{ and } \quad \zeta_1 = r_t = \frac{d\left(\frac{n_c}{N_c}\right)}{dt} \quad (2)$$

Where; ε_i is the error term, n_c is the number of women in a cohort who had their 1st birth before age 20 years and N_c the total number of women in that cohort. Further, the survival probability (equation 3) of a woman having passed through adolescent period without first birth was estimated for the countries.

$$S\left(t_{(j-1)}\right) = \prod_{i-1}^{j-1} P\left(T > t_{(i)} \middle\backslash T \geq t_{(i)}\right) \quad (3)$$

At the multivariate level of analysis, Cox-regression (equation 4) was fitted to examine the hazard ratio of AFB by age as a measure of trend while controlling for other variables. The indicators used for this analyses were; time to event which is age at first birth in years, event status which was dichotomized as 1 if a woman had her first birth at ages <20 years and 0 if otherwise. The covariates used were age group, place of residence, household wealth, religion and level of education.

$$log\{h_i(t)/h_0(t)\} = \beta_1 x_{1i} + \beta_2 x_{2i} + \cdots + \beta_\eta x_{\eta i} \quad (4)$$

The coefficients $\beta_1, \beta_2, \ldots, \beta_\eta$ were estimated using maximum likelihood method. Estimates of the β's are values which are most likely on the basis of the observed data to predict adolescent first birth. In this case, there are n women amongst whom are K distinct AFB occurs at times $t_{(1)}, t_{(2)}, \ldots, t_{(k)}$, so that $t_{(i)}$ is the i-th ordered first birth timing. There are n-K right censored data and only one individual have first birth at ages <20 years so there are no ties. The set of individuals who are at risk at time $t_{(i)}$ is denoted by $R(t_{(i)})$. The quantity $R(t_{(i)})$ is the risk set. For the particular AFB at time $t_{(i)}$ conditionally on the risk set $R(t_{(i)})$, the probability (p) (equation 5) that the birth is the individually observed is;

$$p = \frac{exp\left\{\sum_{j=1}^{\eta} \beta_j X_{ji}\right\}}{\sum_{I \in R(t_{(i)}} exp\left\{\sum_{j=1}^{\eta} \beta_j X_{ji}\right\}} \quad (5)$$

The sum on the denominator is over all individuals in the risk set at that time. Each of the k adolescent birth contributes a factor and hence the conditional likelihood function for the data is the product of such expressions at all known AFB times and represented in equation (6)

$$L(\beta) = \prod_{i=1}^{k} \left[\frac{exp\{\sum_{j=1}^{\eta} \beta_j X_{ji}\}}{\sum_{I \in R(t_{(i)}} exp\{\sum_{j=1}^{\eta} \beta_j X_{ji}\}} \right] \quad (6)$$

Thereafter, the conditional log-likelihood was obtained as shown in equation (7)

$$LL(\beta) = \sum_{i=1}^{k} \sum_{j=1}^{\eta} \beta_j X_{ji} - \sum_{i=1}^{k} log_e \left[\sum_{I \in R(t_{(i)}} exp\{\sum_{j=1}^{\eta} \beta_j X_{ji}\} \right] \quad (7)$$

Maximum likelihood estimates of β_i's were obtained by solving equations (6) and (7) simultaneously.

Results

The data show that majority of the women had their first birth at adolescent age and this was mostly prevalent in Liberia (76.2%), followed by Gambia (66.8%), Nigeria (57.3%) and Ghana (54.7%). In all the countries under investigation, adolescent first birth occurred mostly among women that were born between 1990 and 1993 and it increased steadily within the period. For instance, the range was 73.0%-98.2% among Nigerian women while it was 78.0%-96.3% in Gambia, 83.9%-97.5% in Liberia and 69.0%-79.4% in Ghana which seems to have the least distribution. Across the countries, there was significant positive correlation between women's year of birth and proportion who had their first birth at ages less than 20 years. Figure 1 shows that the proportion of women who had their first birth as adolescent was similar in pattern but the distribution varies across countries. Figure 2 depicts the pattern of the timing of first birth over years, the probability of surviving an interval without bearing first birth was highest in Ghana, while Nigeria and Liberia exhibited similar pattern and to some extent particularly in the later years the pattern shown among Gambia women was similar to that of Nigeria and Liberia.

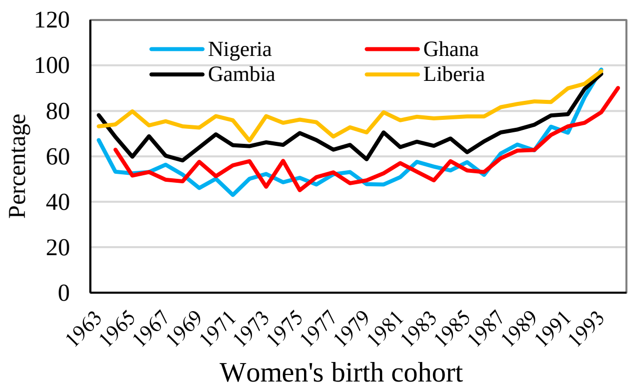

Figure 1: Distribution of women's birth cohort by percentage who had first birth as adolescent according to selected countries in West Africa

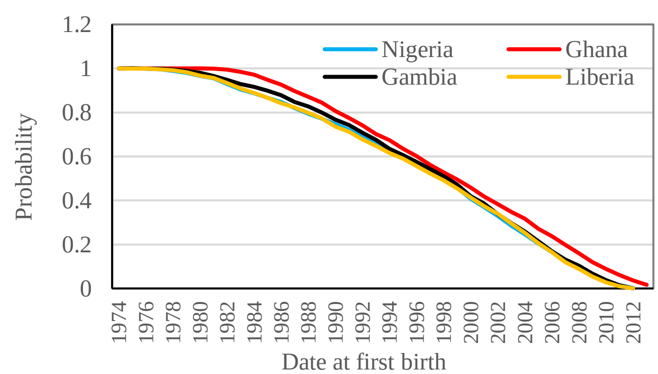

Figure 2: Distribution of probability of surviving an interval without first birth by timing of first birth according to selected countries in West Africa

The data show the comparison of birth progression rate between women ages between 45-49 years who began their childbearing as adolescent and those who started theirs at the age of 20 years or more. When this was compared in each country, the data is evident that women who started childbearing as adolescent had higher birth progression rate through all the parities than their counterparts who postponed childbearing till after adolescent periods. Among the women ages 45-49 years who began their childbearing as adolescent, the rate at which such women progressed in childbearing from parity 1-10 was lowest in Ghana, followed by Gambia, Liberia and highest among Nigerian women.

The multivariate analysis shows that the hazard of having first birth during adolescent was higher among women in the age cohort 20-24 years than the oldest age cohort (45-49 years). In Nigeria, having controlled for specific variables, the hazard ratio of AFB among age cohorts 20-24 years was 1.49(C.I=1.40-1.58, p<0.001) times higher than that of those in age group 45-49 years. This was the pattern exhibited in all the four countries, but the ratio was highest in Ghana. Also, in these countries, to some extent, the hazard ratio of adolescent first birth reduces as the birth cohort reduces but rises consistently among the younger women's birth cohort. For instance, in Ghana, the hazard ratio of AFB was 1.05(0.91-1.19), 0.84(0.74-0.96), 0.90(0.78-1.02), 0.92(0.81-1.05) and 1.49(1.30-1.69) times likely among women in the birth cohort 40-44, 35-39, 30-34, 25-29, 20-24 years than that of women in birth cohort 45-49 years. In Nigeria and Gambia, the hazard of bearing first child during adolescent periods was higher among the Muslims than the Christians and this was statistically significant with Nigeria data. The converse pattern, although not statistically significant was exhibited among Ghanaians and Liberians.

With respect to women's education, as expected, the hazard ratio of AFB reduces as the level of education increases across the countries. However, variation existed in the pattern within each of the countries. In all the countries, the risk of AFB was strikingly higher among women who have no formal education and those with primary education than their counterparts with higher education. In Ghana for instance, the hazard of adolescent first birth was 6.47(4.16-10.04, p<0.001), 7.07(4.55-10.97, p<0.001) and 4.53(2.93-6.98, p<0.001) among women with no formal education, primary and secondary respectively than those with higher education. In three of the countries, Nigeria, Ghana and Gambia, household wealth was significantly related to AFB and higher risks were consistently found among women in lower household wealth categories than those from households that their wealth was considered as rich. The hazard curve of patterns of AFB in relation to birth cohorts of women are shown in Figures 3(a-h) for all the countries. The data show slight disparity in the patterns whether or not the models adjusted for other variables.

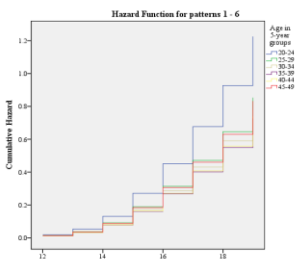

Figure 3a: Unadjusted survival pattern of AFB [Nigeria]

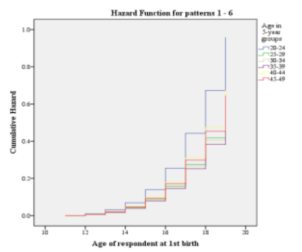

Figure 3c: Unadjusted survival pattern of AFB [Ghana]

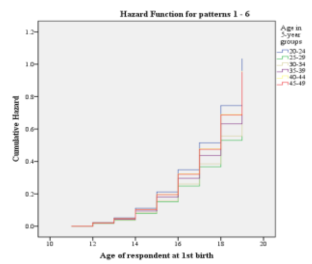

Figure 3e: Unadjusted survival pattern of AFB [Gambia]

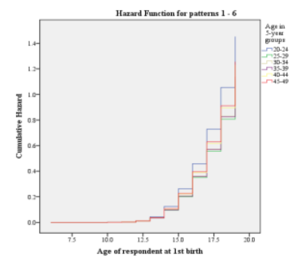

Figure 3g: Unadjusted survival pattern of AFB [Liberia]

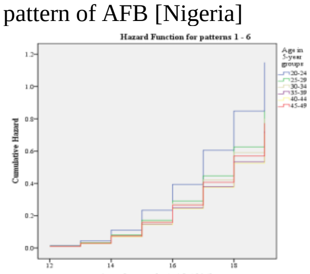

Figure 3b: Adjusted survival pattern of AFB [Nigeria]

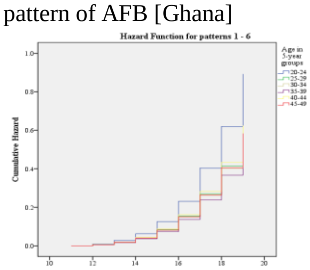

Figure 3d: Adjusted survival pattern of AFB [Ghana]

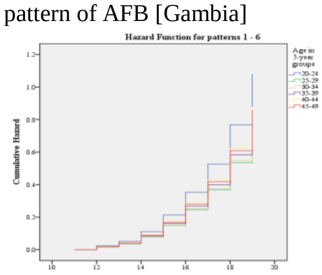

Figure 3f: Adjusted survival pattern of AFB [Gambia]

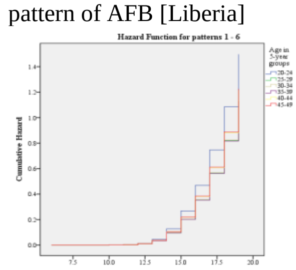

Figure 3h: Adjusted survival pattern of AFB [Liberia]

Conclusion

Adolescent childbearing remains a problem in West-Africa. There was a variation in AFB across the four countries included in this study and fertility tends to be higher in the countries where its incidence or progression probability was higher. The adolescent childbearing among women in West-Africa countries follows an increasing trend. Education was identified as one of the important factors influencing AFB in the region. UNFPA and other partners have been working with several countries to promote adolescent sexual and reproductive health in West Africa and many countries have policies and programmes to that effect, therefore such programmes and policies should be sustained in the region.