Dynamics of onset of fertile life among adolescent girls in Benin, 1996-2017

Mahouli Mireille-Marie Mintogbé[1], Mouftaou Amadou Sanni[1], Victorien Dougnon[2], Bilampoa Gnoumou[3] & Clément Ahoussinou[4]

[1]Research Laboratory in Population and Development Sciences of the University of Parakou, Benin (LaReSPD/UP)

[2]University of the Abomey Calavi (UAC), Benin

[3]Higher Institute of Population Sciences of Ouagadougou University (ISSP/UO1), Burkina Faso

[4]Institute for Analysis of Communication and Social Set (INACES), Benin

Email: clema.mintogbe@gmail.com

Abstract

Background: The issue of early onset of fertile life among adolescent girls remains very current. However, theoretical predictions predict event decline, particularly with the young generations. This study aims to analyse trends and explanatory factors of early onset of fertile life among adolescent girls aged 15 to 19 years in Benin.

Data and methods: The study uses Demographic and Health Surveys (DHS). The Kaplan Meier method and the Cox proportional risk model were used.

Findings: Early onset of fertile life has experienced saw tooth variations between 1996 and 2017. The main risk factors are: education level, age at first sexual intercourse, and socio-economic standard of living.

Conclusion: Interventions need to be strengthened and/or reoriented to effectively contribute to reducing the incidence of early onset of fertile life. This will enhance adolescent girls knowledge and skills enabling them to live a healthy, responsible and timely sexual and reproductive life.

Keywords: Fertility, adolescent girls, Benin.

Introduction

About 47,700 girls are married before the age of 18 every day (UNFPA, 2017). Annually, 16 million adolescent girls under 18 years old give birth worldwide and 70,000 of them die from pregnancy complications or childbirth (WHO, 2019). Concerning early onset of fertile life, most of births from adolescent girls under 18 years old occur in Low and Middle-Income Countries (LICs). In fact, while in Europe the birth rate per 1,000 adolescent girls aged 15-19 years is 31, this proportion is 127 per 1,000 adolescent girls in West and Central Africa (WCA) (UNFPA, 2017). In the majority of WCA countries, around 25.0 % of girls aged 15-19 years either become pregnant or are already mothers, and more than 40.0 % get married before the age of 18 years (UNESCO, 2017). At the same time, their schooling, a key factor in improving their social and economic status, remains a concern with disparities by area. In Sub-Saharan Africa (SSA), the primary and secondary school enrolment rates for girls are 68.0 % and 31.0 % respectively but in WCA countries, these proportions are 85.0 % and 32.0 % respectively (UNFPA, 2018).

Adolescent girls in Benin also face high fertility. For every 1,000 adolescent girls under age of 20 years old, 94 are already gave birth (UNFPA, 2018). This contributes to the bad picture of fertility statistics among women of reproductive age (15 to 49 years), maternal and infant morbidity and mortality, which are significant. Concerning morbidity, 18.0 % of children are born with low birth weight (less than 2.5 kg) from mothers under 20 years old, compared to 11.0 % of those born from mothers over 20 years old. Similarly, the infant mortality rate for children of women under 20 years is higher than that of children of women over 20 years old: 119 ‰ vs 98 ‰. More specifically, the risk of infant death is 1.36 times higher among children born from mothers under 18 years old. With regard to maternal mortality, 14.7 % of maternal deaths are recorded in the group of asolescents aged 15 to 19 years old (INSAE, 2019). Moreover, early onset of union persists and remains a reality in Benin. Among adolescents and young people aged 10 to 24 years old, 9.0 % and 46.4 % are already in union before 15 years old, and 18 years old respectively (ONUSIDA-Benin et al., 2018).

Apart from the consequences of early and/or forced marriage and early motherhood, there are other negative social effects such as school dropout for schoolling girls (UNESCO, 2017). This situation may also reflect the reality concerning the country's efforts to achieve the sustainable development goals (SDGs) related to girls education, adolescents reproductive health, maternal, child health and mortality (SDG 3.7). However, thanks to the widespread efforts made in recent decades to promote adolescent and youth reproductive health (AYRH), school enrolment and the improvement of the social status of women, it is hoped that fertility will decline in adolescence, especially in the young generations. What implications could be drawn in the case of Benin? What are the dynamics of onset of fertile life and its geo-spatial variations?

The objectives of this study are therefore to examine the onset of fertile life trends and its explanatory factors during adolescence and describing the changes over time.

Literature review and theoretical framework

Adolescent girls fertility and marriage remain higher in the African region than in other parts of the world. Because of their demographic, health and social consequences, the occurrence of these two events in adolescence has become a global concern since the 1990s. Within this framework, the 1994 International Conference on Population and Development (ICPD) was devoted to the issue of early pregnancy and its consequences on the health and future of adolescent girls (UN, 1995). Several African countries endorsed the goals of this conference. However, in the majority of West and Central Africa countries, nearly one-quarter of girls aged 15 to 19 years old either become pregnant or are already mothers (UNESCO, 2017). Consequently, several studies have been carried out on the issue to gain a better understanding determinants of early pregnant and motherhood. The main factors or predictors sometimes differ according to the regions of the world. In the specific context of Sub-Saharan African countries, the transition from traditional to modern society (Clark et al., 2017; Tolno, 2007), religion and ethnicity (Amouzou, 2016; Rutaremwa, 2013), early age at first menstruation (Delaunay, 1994; Kuate-Defo, 2000), lack of parent-child communication on sexual and reproductive health issues (Muthengi et al., 2015; Viner et al., 2012; Yadufashije et al., 2017) etc. are the main influencing factors. The influence of other behavioral and socio-economic factors has also been highlighted in the work carried out. The age at first sexual intercourse (Ayiga, 2015; Fuseini, 2015); the increasing frequency of premarital sexual activity (Ayiga, 2015; Clark et al., 2017); and the low use of modern contraceptives methods by adolescent girls (Mekonnen et al., 2018; Sanni et al., 2017; UNFPA, 2018) are also predisposing factors. Furthermore, the level of poverty is likely to influence the occurrence of the event (Arora et al., 2015; Ayele et al., 2018).

Mchunu et al. (2013) found that among South African adolescent girls, those in the low socioeconomic category are 1.14 times more likely to have their first pregnancy before the age of 20 years old than their counterparts in the high and very high socioeconomics categories. In Benin, 15.4 % of adolescents and young people had their first sexual intercourse before the age of 15 years old and 48.7 % before their 18th birthday. With regard to unsafe sex, only half (51.3 %) of young people used condom (SE/CNLS-TP Benin et al., 2018). Also in Benin, in the municipality of Tchaourou, Salifou & Alladatin (2017) results indicate that among adolescent girls aged 12 to 18 years those who were sexually active before the age of 15 years old were 8.5 times more likely to start their fertile life than those who had their first sexual intercourse after the age of 17 years old. This risk is 12 times higher for those who onset of union before the age of 17 years old. Unfortunately, one of the limitations of this study is the fact that it presents the situation of only one municipality out of the 77 in the country.

About legislation, political and programmatic environment, Benin has ratified many international and regional conventions and charters relating to fundamental rights, reproductive health in general and adolescents and youth health (SRAJ) in particular. These are essentially: the International Convention on the Rights of the Child (CRC) of 1990, the Convention on the Elimination of All Forms of Discrimination against girls and Women (CEDAW) of 1992, the Cairo Programme of Action (ICPD) of 1994, the African Charter on Human and Peoples Rights and its additional protocol on women's rights of 2005, the African Youth Charter of 2006, and the Maputo Plan of Action of 2006. The aim of these differents plans of action is the protection of children's rights, universal and comprehensive access to reproductive health services, especially for adolescent girls. With regard to the ICPD recommendations on sexual and reproductive health of adolescents and young people, to which the country has subscribed, the aim is to create a favourable environment for adolescents and young people by enabling them to : (i) access to information and services for responsible sexuality; (ii) protect them from unwanted and/or early pregnancies; (iii) access to family planning services; (iv) preventive and curative information on STIs, HIV and AIDS; and (v) protect them from early and/or forced marriages.

At the national level, several laws and texts have been adopted. These include: (i) law n° 2003-04 of 3 March 2003 on sexual and reproductive health; and (ii) law n° 2002-07 promulgated on 24 August 2004 on the Personal and Family Code, setting the legal age of marriage and first pregnancy at 18 years old for all and prohibiting early and forced marriage.

In addition, Benin has had a national reproductive health programme since 2003, which has four components, including one on the health of adolescents and young people. This component focuses on the prevention of risky sexual behaviour, the fight against unwanted and/or early pregnancies, early motherhood and induced abortion, etc. (Equilibres & Populations, 2014). In order to ensure the continuity of the actions already undertaken, a new integrated strategic plan for reproductive, maternal, newborn, child, adolescent and youth health (SRMNEAJ) 2017-2021 has been drawn up to serve as a guide for actions towards the different targets (DSME / MS-Benin, 2017). The whole of this legislative, pragrammatic and political arsenal constitutes an important asset in the improvement adolescents and young people sexual and reproductive health. To better understand the influence of these measures and actions taken on early onset of fertile life, this study examines the dynamics of onset of fertile life during adolescence over a reference period of 21 years.

This study fills a gap because there is a paucity of literature on the issues it addresses at the national level in Benin. The results will enable political decision-makers at various levels, particularly in the area of health, rights and child protection in Benin, to better identify the issues and strategic challenges of promoting the reproductive health of adolescents and young people.

Theoretical approaches and conceptual framework

There are almost no specific theories that can be used as a reference for analyzing the factors that explain fertility among adolescent girls. The best known fertility theories examine fertility within the union, especially for women who have already begun their reproductive lives. However, the explanatory approaches that fall under the economic, socio-cultural, anthropological and institutional dimensions will be examined here.

Socio-cultural and anthropological approaches: Sociological and anthropological analyses of fertility focus on the profound cultural and social changes that are particularly related to the breakdown of traditional and social norms and the advent of modernization in all its facets. Emphasis is placed on certain factors such as socialization environment, ethnicity and religion (De Bruijn, 1999; De la Sablonnière, 2017). Two models stem from this approach: the cultural heritage model and the modernization model. The first model highlights two types of factors that may explain reproductive behaviour during adolescence. These are ethnicity and religion, which represent the channels of intergenerational transmission of traditional and normative values conveyed by society. Ethnicity, as a place of production of socio-cultural values with which individuals identify, is one of the important elements in understanding fertility behaviour. It influences parameters such as age at first sexual intercourse, age at first union, age at first pregnancy, and contraceptive practices (De Bruijn, 1999).

As for religion factor, it is perceived as "an institutionalized system of beliefs, symbols, values and practices relating to the sense of divinity" (Akoto et al., 1993). Religion, like ethnicity, are symbols of values and beliefs that impose on a people a way of thinking, living and acting that can influence choices and lifestyles regarding sexual and reproductive live.

As for the second model, it highlights the social changes between traditional and modern society. This evolution from traditional to modernism would be mainly linked to the development of new information and communication technologies. Indeed, the effects transmitted by propaganda advertising, mass media, mobile telephony, television programmes in their diversity and sometimes without control, social networks, etc. create new lifestyles and influence reproductive behaviour in adolescence (Delaunay, 1994; Vimard, 1998; Viner et al., 2012; Mushwana et al., 2015). As a result of these social changes, premarital sexuality is on the rise and exposes young girls to early pregnancy (Upchurch et al., 2001; Jokela & Keltikangas-Järvinen, 2009; Miller et al., 2013).

Economics approaches: The economic dimension plays an important role in understanding adolescent reproductive behaviour in both the traditional and modern context. The main pioneers of this approach are the economists Gary Becker of New Home Economies (Becker, 1960, cited by Kyriazis, 1987, page 168) and Richard Easterlin (1969, cited by Kyriazis, 1987, page 172) who have contributed to the understanding of reproductive behaviour from a first theory that emphasizes the cost of children as a causal factor of fertility and a second that focuses on material aspirations by involving the notion of material aspiration and rational adaptation. However, these theoretical models are more suitable for analyzing fertility within the household for nonprimiparous women. While the present study focuses on the onset of fertile life, which is a change of state for the adolescent girls. It is therefore on the

occurrence of the first event that interest is focused. However, work that has dealt with the economic dimensions is used. Thus, Easterlin (1969) points out that adolescent girls living in poor households are more likely to begin their fertile life than those living in rich households. Similarly, in an analytical approach to the economic dimension of adolescent reproductive behavior in sub-Saharan Africa, Cherlin and Riley (1986) also emphasize the relationship between poverty and adolescent reproductive behavior. They believe that a context of economic insecurity is likely to favor early sexual activity among young girls. Economic difficulties appear to be a source of motivation for monetarized sex. Sexual intercourse with financially comfortable and generally older partners allows for the satisfaction of essential needs and/or the needs of ambitions.

Institutional and political approaches: Djerabe & Haroun (2015) define institutions as a set of rules organizing society or some of its components. The institutional and political context characterized by policies on children's rights, particularly the girl child, and reproductive health around which a country is organized has a certain influence on the reproductive behaviour of individuals. These behaviours are no longer the result of individual characteristics alone but also of the structural context in which individuals evolve (Djérabé & Haroun, 2015; Doliger, 2004). Taking this parameter into account as described in the preceding paragraph makes it possible to better analyze their contribution to the dynamics of adolescent onset of fertile life.

On the basis of the various theoretical approaches thus presented and in light of the empirical studies, the following conceptual framework has been developed to meet the objectives of this study.

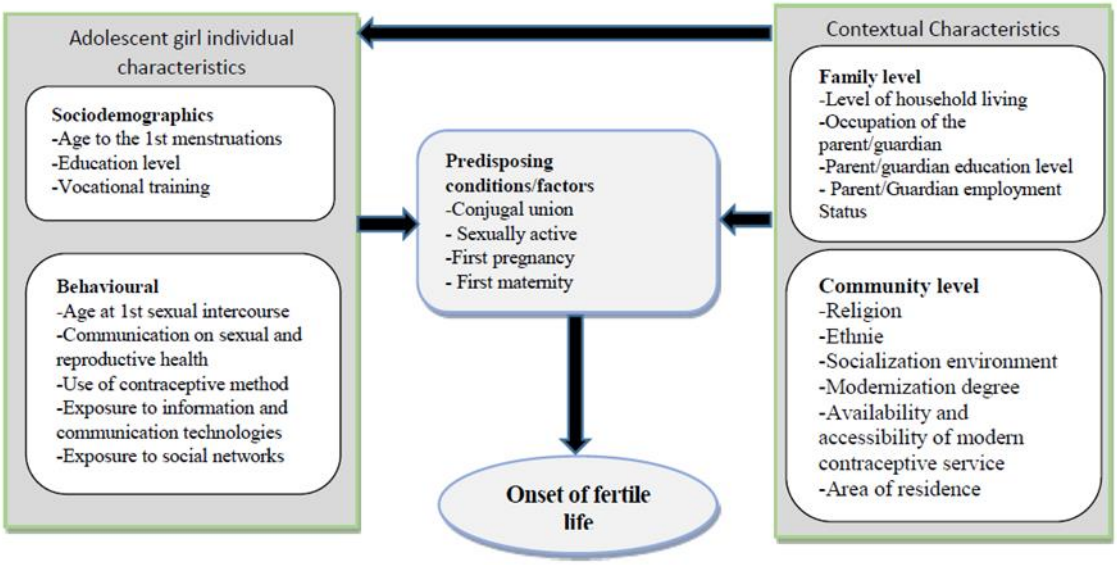

Figure 1: Conceptual framework of explanatory factors of early onset of fertile life

Data and methods

The Republic of Benin is a West African country located in the intertropical zone between the Equator and the Tropic of Cancer, more precisely between the parallels 6°30' and 12°30' north latitude and the meridian 1° and 3°40' longitude. With an elongated shape in latitude, it covers an area of 114,763 square kilometers, and has twelve (12) departments and seventy-seven (77) municipalities. The country is bordered to the north by Niger and Burkina Faso, to the south by the Atlantic Ocean, to the east by Nigeria and to the west by Togo. According to the 4th edition of the General Census of Population and Housing (RGPH-4), its population

in 2018 is estimated at 11,493,140 inhabitants resident, of which 51.0 % (5,849,081) are female, which corresponds to a sex ratio of 95.3 men per 100 women.

The majority of Benin's population is young, with nearly two thirds under 25 years old and nearly half under 15 years of age. Among women, 10.69 % are adolescent girls aged 15 to 19 years old. These are almost equally distributed according to place of residence: 10.4 % in urban area and 10.0 % in rural area (INSAE, 2016). At the socio-economic level, four over ten Beninese households (40.1 %) live below the poverty line (i.e US$1.9 per day), with disparities according to area of residence : 43.6 % in rural areas and 35.8 % in urban areas (IMF, 2018). In the education level, while the national net primary school enrolment rate is 56.9 %, half of the girls of school age (55.7 %) are enrolled in primary school. At the second cycle, only three girls over ten (32.4 %) reach this level compared to 37.2 % at national level (INSAE, 2016). Teaching on reproductive health

is addressed at the end of secondary education, but yet only briefly and succinctly, even though reforms are underway to introduce these modules earlier in the school curriculum.

Data

Data used are those of the Demographic and Health Surveys (DHS) realized in 1996, 2001, 2006, 2012 and 2017 by the National Institute of Statistics and Economic Analysis (INSAE) of Benin. First produced in 1996, the main objective of the DHS data is to collect, analyze and disseminate data on the population and family health. These national socio-demographic data are the only ones based on the reproductive health of women childbearing age, with a high focuse on those of adolescent and young girls.

DHS are nationally representative, based on two-stage stratified cluster survey. In the first step, the clusters were drawn at random from the enumeration areas list established for the General Census of Population and Housing (RGPH-1, 2, 3 and 4) and in the second step, households were drawn from the household enumerated list in each cluster. In each sampled household, all women aged from 15 to 49 years old in the household were surveyed individually, including men aged from 15 to 64 years old.

Sample sizes vary from one DHS edition to another. However, all the sample sizes are nevertheless nationally representative allowing there by comparison in time and space between the different editions.

Data sets of samples

Table 1: Number and proportion of adolescent girls aged 15 to 19 years old included in the DHS per edition.

Years DHS	Number of women aged 15 to 49 years	Number of adolescent girls aged 15 to 19 years	Proportion of adolescent girls aged 15 to 19 years	Data collection dates
1996	5 491	1049	19.0	June to August 1996
2001	6 219	1223	20.0	August to November 2001
2006	18 147	3036	17.0	August to November 2006
2012	16 599	2922	18.0	December 2011 to March 2012
2017	15928	3335	20.9	November 2017 to February 2018

Technique, collection tools and selection methods

Data collection began with the reading of the briefing note and obtaining consent. At the level of each household, all women aged 15 to 49 years old, who spent the night before the interview in the selected household, regardless of their residency status, were included. But as part of this article will be taken into account in the group of women of childbearing age adolescent girls under the age of 20 years old in order to capture the young generation effect on the event studied. The other reasons for this choice are the problems of memory bias in statements in older women.

Data collection was carried out using three types of questionnaires developed and structured in several modules: (i) household questionnaire (ii) individual women's questionnaire and (iii) individual men's questionnaire. The principal components of the individual women's questionnaire are : (i) socio-demographic characteristics (ii) reproduction (iii) contraception (iv) pregnancy and prenatal care (v) marriage and sexual activity (vi) fertility behaviours (vii) characteristics of the spouse and the woman's economic activity (viii) HIV infection and AIDS, etc. The household questionnaire includes the main sections : i) household table which collects socio-demographic information on household members ii) characteristics of household dwellings and assets, etc. iii) mosquito nets and child labour iv) HIV and AIDS infection, etc.

Variables

Onset of fertile life measurement

Onset of fertile life was measured on the basis of three events : i) having a live birth, ii) being pregnant for the first time or having been pregnant at least once regardless of the outcome (induced or therapeutic abortion, stillbirth, perinatal death), or iii) being in a conjugal union. The second event was

considered only for adolescent girls who have no children (zero or nulliparous parity) and who are in a conjugal union or not. The third event, concerns only those who do not yet have children and who are not pregnant or who have never been pregnant in the past but who are in a conjugal union. Indeed, adolescent girls are at high risk of motherhood while in union, as the purpose of any union is procreation (Delaunay, 1994). In this study, the occurrence of one of the three events described above means that the adolescent girl has onset of fertile life. On this basis, the interest variable was constructed from three main variables: i) age at first birth, ii) age at first pregnancy, and iii) age at the beginning of the conjugal union.

For childless adolescent girls who were pregnant for the first time, the age at the time of the survey was considered. For those who have been pregnant at least once in the past, the age at the time of the very first pregnancy was considered with the retrospective information collected in the DHS surveys.

These three variables were used to generate the variable of interest "age onset of fertile life", which is initially a continuous numerical variable with values ranging from 11 to 19 years.

According to Beninese legislation, articles 180 and 181 of the fifth section of Act No. 2015-08 on the Children's Code of the Republic of Benin protects minors, i.e. girls under 18 years old, against early pregnancy and early mariage (AN-Bénin, 2015). Then, the legal age recognized for marriage between two persons of the opposite sex is 18 years old. Any union or pregnancy before that age is said to be early and may be detrimental to the underage girl, particularly concerning health, education and social welfare issues. Accordingly, and in view of theoretical and empirical considerations, this study considers that the occurrence of one of the three events before the age of 18 years old is considered to be early. Thus, the variable of interest has been recoded into two (02) modalities: 1 "Start of fertile life before the age of 18 years" and 0 "If not".

Explanatory variables

According to the literature, the study context and the possibilities offered by the available data sets, the explanatory variables used : age at first sexual intercourse, level of education, ethnicity, religion, socio-economic standard of living, department of residence, contraceptive's method used and residence's area.

The socio-economic life index variable, is a composite variable that was generated using a principal component analysis (PCA) with the characteristics of housing and the household goods. These are : type of drinking water supply; type of toilets; flooring materials; type of fuel used for cooking; number of people per room; availability of electricity; and possession of goods such as: television, radio, car, bicycle or bike. Scores are assigned to households based on the number of consumer goods owned and the type of dwelling. Next, five quintiles are constructed by classifying households according to their scores and dividing the distribution into five equal categories, each representing 20,0 % of the population.

Methods

The simple decomposition method followed by a survival analysis with Kaplan Meier estimation and time-dependent covariate approach, specifically the Cox-proportional hazard model were used.

Simple decomposition method

The simple decomposition method applied in this study aims to locate the sources of change in the dynamics of onset of fertile life during adolescence (Eloundou et al., 2017; Eloundou-Enyegue & Giroux, 2010). It has made it possible to estimate the contribution of two components. These are the structure of the adolescent girls population (compositional effect) involved in each survey and the proportion of adolescent girls experiencing the event study (behavioural effect). For the second component, specific rates (i.e., the ratio of the number of adolescent girls of age x who are onset of fertile life before age of 18 years to the number of adolescent girls of age x) by age group and year of observation were calculated. The objective is to locate the sources behind the temporal variation of the phenomenon over the study period and therefore to check the hypothesis of the possible effect of sample variations between the different surveys that could affect the results comparison.

The application of the decomposition method was done according to the following steps:

i) determination of the rate of onset of fertile life by age for each observation year from a cross-tabulation between the variable of interest "early onset of fertile life" and the variable "age at the time of the survey". The rate of early onset of fertile life was determined for the five age-specific (15, 16, 17, 18 and 19 years old) and for the observation year,

ii) calculation of the change between two periods t1 and t0 was carried out by the difference between the overall rate of early onset of fertile life observed in year t1 and that observed in year t0;

iii) compositional / strutural effect for the period t1 and t0 was determined by the difference between the proportions (%) of adolescent girls by age between t1 and t0 multiplied by the sum of the age-specific early onset of fertile life rates over the period t1 and t0, all divided by 2. Next, the sum of the age composition effects gave the overall composition effect over the period t0 and t1 ;

iv) behavioural effect for the period t0 and t1 was determined by the difference between the specific age of early onset of fertile life rates between t1 and t0 multiplied by the sum of the specific age proportions of adolescent girls on t1 and t0, divided by 2. Next, the sum of the specific age behavioural effects gave the overall behavioural effect over the period t0 and t1.

These last two calculations were reproduced for the four periods: 1996-2001, 2001-2006, 2006-2012 and 2012-2017. Finally, the share of the overall change relative to the two components (structure effect and behavioural effect) was determined by dividing the overall value of the composition effect and the overall value of the behavioural effect by the value of the change observed over the two periods t1 and t0.

Assuming the early onset of fertile life per edition as a weighted average of performance by age group, the theoretical formula for the change decomposition phase is as follows :

$$Y=\sum wjt*yjt$$

With:

- Y: Overall average of adolescent girls who began their reproductive lives before 18 years old,
- yjt: value of the onset of fertile life rate for specific age group "j" in year t, and
- wjt: proportion of adolescent girls in group "j" in year t.

From the first formula above, between two periods follows this one below:

$$\Delta Y = Yt1 - Yt0$$

With

- Y: Change in early onset of fertile life in adolescence between the period t0 and t1;
- If the change between the two periods is negative, then the trend to enter fertile life before age of 18 yeras old is downward. Otherwise, it is an upward change.

Based on the first two formulas above, the overall change breaks down as follows:

$$\Delta Y=\sum Yj * \Delta Wj + \sum Wj * \Delta yj$$

With:

- ΔY : total change
- $\sum Yj * \Delta Wj$: composition effect
- $\sum Wj * \Delta yj$: behavioural effect

The results of the 3rd formula allow us to situate among the effects of behaviour or structure of adolescent girls, the most predominant and responsible component for the dynamics or trend of early onset of fertile life over reference period.

Survival analysis method

This analysis involves the following steps: the establishment of the survival table and the development of survival function curves per year based on the Kaplan Meier (KM) estimator, which is a method adapted to the event history analysis (Le Goff & Forney, 2013). The main goal of the KM estimation method is to estimate the survival function S(t), i.e., the distribution over time of the probability of not experiencing the early onset of fertile life. If "T" is the moment of the occurrence of early onset of fertile life, then the survival function is in the form: $S(t) = P(T > t)$. S(t) is the product of all probabilities of not experiencing the event since the beginning of the observation period. The estimator of S(t) is as follows:

$$\hat{S}(t)=\prod_{t_j \le t}\left(\frac{n_j - d_j}{n_j}\right)$$ With :

tj= timing of the onset of fertile life;

nj= the at-risk adolescent girls population to experience the onset of fertile life just before time j;

dj= number of adolescent girls who began their fertile live at the time t j.

Once, the survival function is established, the probability of occurrence of the onset of fertile life for an adolescent between "t0" and "t1", denoted F(t), and the cumulative intensity of the risk denoted H(t) are determined as follows :

$$\hat{F}(t)=1-\hat{S}(t)$$

$$\hat{H}(t)=\sum_{t_j \le t}\frac{d_j}{n_j}$$

The distribution of H(t) over time, also known as the hazard function, allows to analyse the evolution of risk over time for an adolescent girl at the start of fertile life. It describes the probability over time that the event will occur.

An important step in implementing this method is the precision of conceptual elements, the information on which is presented in table 2.

Table 2: Summaries of KM modelling elements

Main study elements and benchmarks	Description
Event studied	Early onset of fertile life
Study population	Adolescent girls 15-19 years old
Study population still at risk	Adolescent girls 15-17 years old
Start of observation or origin event (time t = 0)	10 years old
Right truncations	Adolescent girls aged 15 to 17 years old who have never experienced early onset of fertile life. This group includes both those who are likely to experience the event before the exact age of 18 years old and those who will experience it after age of 18 years old
Duration of observation (time before event or outing)	For adolescent girls who have experienced early onset of fertile life: duration = age at onset of fertile life. For those who have not yet begun their fertile life: duration = age at the time of the survey.

Cox's model and study of variables changes in effects

This method was used to determine the explanatory factors for the early onset of fertile life in adolescence due to the nature of the data. The study focused on adolescent gils aged 15 to 19 years old, and early onset of fertile life was defined as experiencing the event at an age below 18 years old. This indicates that only adolescent girls aged 18 and 19 years old at the time of the surveys are qualified. Adolescents aged 15-17 years old who have not yet experienced the onset of fertile life are still at risk of experiencing the event before the end of their childhood (≤17 years). Therefore, data analysis is censored and an appropriate method is survival analysis with time-dependent covariate (Allison, 1984; Courgeau & Éva, 1989; Blossfeld & Götz, 2002; Ritschard, 2004). This analytical technique allows for the inclusion of adolescent girls aged 15 to 17 years old who are still at risk and for whom information was not yet available at the time of the surveys as being censored. For this purpose, the Cox proportional hazard model with time-dependent covariates is used. It is a survival analysis model that expresses the instantaneous risk of experiencing the event after a given exposure duration as a function of a linear combination of fixed and/or time-varying explanatory factors. The model is presented as follows:

$$\text{Log } h(t) = a(t) + b1\ X1 + b2\ X2 + \cdots + biXi \ ; \text{ With}$$

h(t): instantaneous risk or hazard. It is the probability that the onset of fertile life occurs at the time t;

a(t) : a time function. The evolution of risk over time is given by the term a(t), which represents the reference risk function ;

bi: is the coefficient Exp(β) associated with each covariate xi ;

Xi: set of modelled explanatory variables.

Testing the overall significance of the models and interpreting the results

The reference method is the maximum likelihood method. The estimation of the model parameters is carried out by maximizing the log-likelihood (Likelihood Ratio: LR) with respect to the vectors of the parameters (1, 2,…, k) thus minimizing the -LR. The LR tends towards a Chi-square with p degrees of freedom; p being the number of models by year is made from the likelihood ratio test. Thus, deviance (value of -2Log) was considered as

the part of the model not explained, a possible decrease of which reflects the contribution of the explanatory variables included in the improvement of the model quality. The Chi-square value and its significance were also considered.

About estimated coefficients, Exp(β) or hazard ratio are interpreted. The exponential of each coefficient (βi) is interpreted as a relative risk with respect to the reference modality. This coefficient is the probability that the event will occur over the probability that it will not occur. Since the covariates used in the analysis are all nominal or categorical, the interpretation of the corresponding coefficient is made in relation to the reference modality. When:

βi= 1 : there is no difference between adolescent girls in the group of the modality considered and those belonging to the reference modality ;

βi<1 : adolescent girls in this category considered are Exp(β) times less likely to onset fertile life early compared to those in the reference category ;

βi>1 : adolescent girls in this category considered are Exp(β) times more likely to onset of fertile life earlier.

Analysis of changes in the effect of variables between two periods and interpretation procedure

The objective of this part is to study the dynamic role and estimated effect of each explanatory factor of onset of fertile life between 1996 and 2017. Effect changes are calculated over four periods: (i) 1996 to 2001 (ii) 2001 to 2006, iii) 2006 to 2012 and iv) 2012 to 2017. To study changes in effects, the student method was used (Amadou Sanni, 2001). This method consists to calculate the difference between the regression coefficients of each variable between two surveys. Thus, for an explanatory factor X of coefficients 1 and 2, respectively over the "t1" and "t2" periods, and the respective standard deviations ET (1) and ET (2), the size (2 - 1) represents the variation in the effect of factor X (∆X) between "t1" and "t2". A negative result means that the estimated value of the effect of this factor decreased over the period considered. A positive value is an upward change sign in the impact of this factor. Finally, when the size (2- 1) is zero the effect of the variable has not changed.

To appreciate the size level significance of the effect obtained between two periods, the quantity [ET (β2)2 + ET (β1)2]0.5 is the coefficient change (β2-β1) standard deviation.

The statistical variation in the effect significance of the X factor between "t1" and "t2" is appreciated on the basis of Student "t" statistic given by the relationship: : $t=\frac{(\beta 2-\beta 1)}{[ET(\beta 2)2 + ET (\beta 1)2]0,5}$.

When:

t € [1.645 ; 1.95] then ∆X indicates a significant change at 10 % ;*

t € [1.96 ; 2.57] then ∆X indicates a significant change at 5 % ; **

t € [2.58; 3.29] then ∆X indicates a significant change at 1 % ; ***

t € [3.30 ; +∞[then ∆X indicates a significant change at 1 ‰ ; ***

Results

Trends of onset of fertile life among adolescent girls and sources of change

The aim of this analyse is to examine the onset of fertile life prevalence and determine for each year the component (composition or behavioural effect) responsible for the change.

The proportion of adolescent girls who started their fertile life early is: 24.51 %; 20.66 %; 21.92; 17.02 and 20.45 % respectively in 1996, 2001, 2006, 2012 and 2017-2018. The prevalence of early onset of fertile life declined by 15.72 % between 1996 and 2001 and increased by 6.09 % in the second period (2001-2006). Over the last two periods, it initially fell by 22.35 % and then increased again by 20.15 %, almost proportionally as before. The Chi-square test reveals that the decreases observed over the periods 1996-2001 (p=0.042) and 2006-2012 (p=0.005) are statistically significant as is the increase over the last period 2012-2017 (p=0.002).

These differences can easily be seen in figure 2 below where the confidence intervals for the last two periods (2006-2012 and 2012-2017) do not overlap.

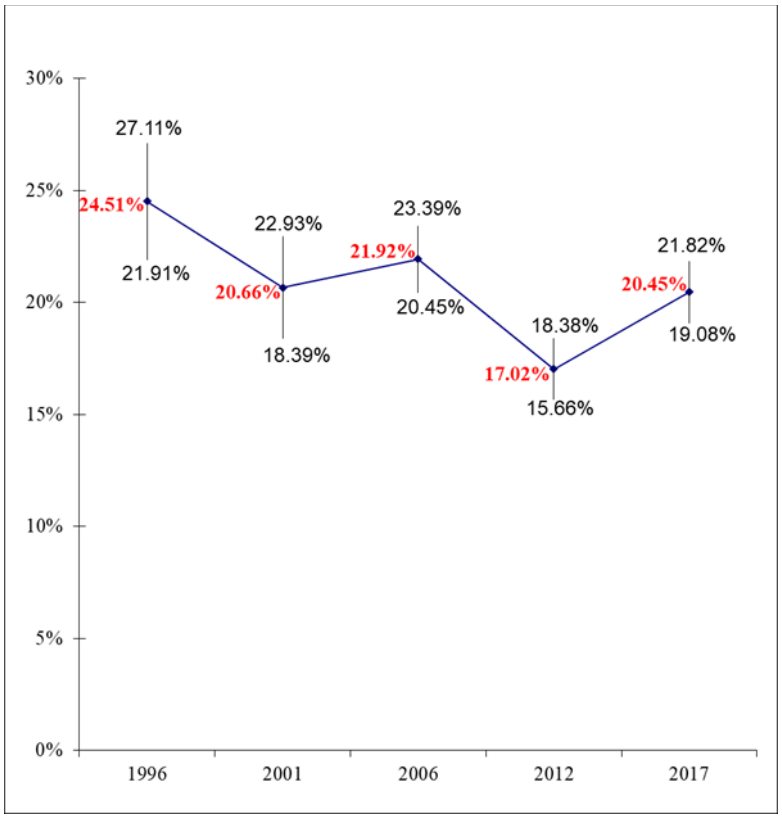

Figure 2: Trend of early onset of fertile life entry prevalence with confidences intervals, 1996 to 2017

However, these differences could be affected by fluctuations in sample sizes if the main component is structural effect. This is why, the decomposition method is used to find the sources of these changes.

Table 3 below shows that, contrary to the low structural effect, the behavioural effect accounts for a large proportion of the change in onset of fertile life : 75.96 %; 122,01 % ; 85.42 % and 98.51 % respectively for the periods: 1996-2001, 2001-2006, 2006-2012 and 2012-2017. It is rather behavioural effect, i.e adolescent girls attitude of onset of fertile life before 18 years old that is responsible for the changes observed between 1996-2017.

Table 3: Summary of decomposition analysis results over the four periods

Periods	Total change (%)	Composition effect	Behavioural effect
1996-2001	-15.72	24.04	75.96
2001-2006	6.09	-22.01	122.01
2006-2012	-22.35	14.58	85.42
2012-2017	20.15	1.49	98.51

The above results show a dominant trend related to the behavioural effect, which varies from period to period and between generations. This demographic component is the most dominant responsible for the dynamic and variation of early onset of fertile life observed between 1996 to 2017 among adolescent girls aged 15-19 years old in Benin. These preliminary results towards understanding the event studied, need to be reinforced by an explanatory method for identifying and assessing the evolution of explanatory factors effects over the reference period.

Probability of survival at early onset of fertile life

The survival probability of early onset of fertile life is high when the value is greater than or equal to 0.98, moderate when it is between 0.97 and 0.95, and low when it is less than or equal to 0.94. Table 4 results showed that before 14 years old, adolescent girls survival probability is high in all five years of observation. At 14 years old, this probability is moderate and then low beyond that age (Table 4). Contrary to the situation recorded in 1996, 2001 and 2006, the probability of survival became low from age of 16 years in 2017. An analysis over the reference period shows that the probability of survival at onset of fertile life before the legal age is

lower among adolescent girls in 1996 (p1996 =0.9113) than in 2017 (p2017 =0.9390).

Table 4: Summary of survival table indicators and survival probability by year

Descriptifs indicators	Observation year				
	1996	2001	2006	2012	2017-2018
Number of adolescent girls at risk (N)	1049	1223	3036	2922	3335
Number of events	257	253	665	498	683
Censored Cases	792 (75.5 %)	970 (79.3 %)	2371 (78.1 %)	2424 (83.0 %)	2652 (79.5 %)
Probability of survival					
11	0.9990467	0.9959117	0.9963768	0.9938398	0.9964018
12	0.9961832	0.9958949	0.9923967	0.9934573	0.9942823
13	0.9961686	0.9851608	0.9843438	0.9854419	0.9878935
14	0.9663462	0.9698745	0.9604061	0.9690468	0.9564951
15	0.9492537	0.9456428	0.9450317	0.9589837	0.9570788
16	0.9109015	0.9397810	0.9381059	0.9557154	0.9451138
17	0.9113924	0.9417476	0.9423688	0.9600000	0.9390935

There are significant differences in survival curves between years (Log Rank=27.586; p<0.001). Indeed, trend analysis of the survival functions in Figure 2 shows that over time, i.e. before the age of 18, survival at early onset of fertile life is on average later in 2012. In chronological order, the average late survival at early onset of fertile life for the other years is observed in 2001 followed by the trend in 2017, 2006 and then 1996 (Figure 2).

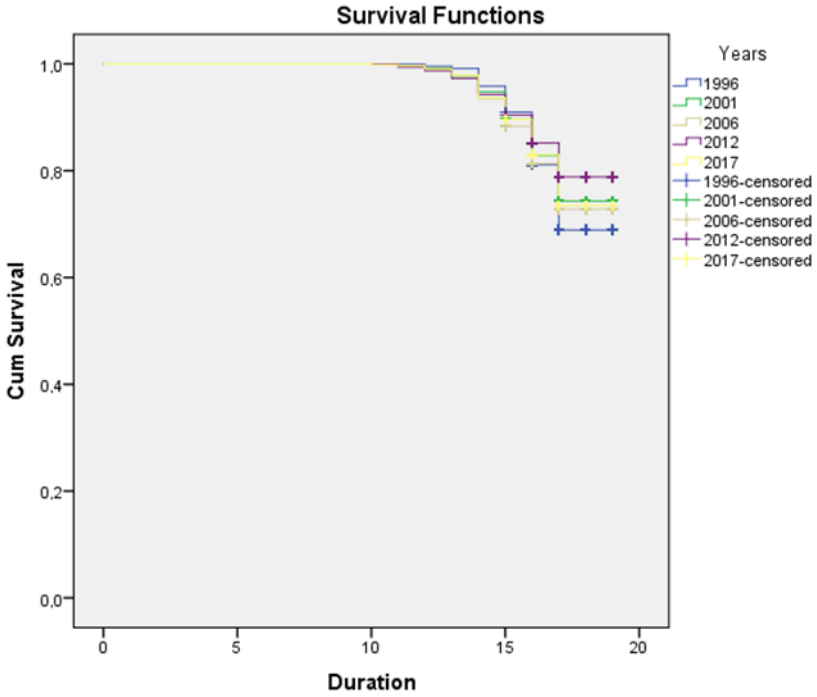

Figure 3: Survival functions S(t) of onset of fertile life by year

Explanatory factors for onset of fertile life and variation in the effect of variables coefficients

Educational level, age at first sexual intercourse and socioeconomic standard of living significantly influence early onset of fertile life for each observation year (table 5).

Compared to adolescent girls with secondary or higher education level, those who have never attended school have a higher risk of being more likely to begin their fertile life : 4.51 times more in 1996; 3.44 times more in 2001; 2.61 times more in 2006 and 2.33 times more in 2012 (p<0.001). Similarly, those with primary education level also

have a higher risk of onset of fertile life: 2.67 ($p<0.05$) in 1996; 1.87 ($p<0.05$) in 2001; 1.71 ($p<0.001$) in 2006; and 1.78 ($p<0.001$) in 2012. In 2017 year, this risk is 0.81 times less ($p<0.05$) or 19,0 % less likely for adolescent girls with primary education level. In terms of change between two years, the coefficient of this factor has decreased significantly in almost all periods.

This trend reflects a gradual decline in the widely demonstrated positive effect of education on the onset of fertile life in adolescence. In 2017, contrary to the first fourth years, compared to adolescent girls with secondary or higher education level, those who have primary education level were 0.81 times less likely to begin their fertile life ($p<0.05$).

The risk of onset of fertile life earlier is higher among adolescent girls who have had sexual intercourse earlier: 2.47 times more ($p<0.001$) in 1996; 2.09 times more ($p<0.001$) in 2001; 2.14 times more ($p<0.001$) in 2006; 2.15 times more ($p<0.001$) in 2012 and 2.36 times more ($p<0.001$) in 2017. The influence of this factor has remained almost constant over time.

The results also show that compared to adolescent girls in the very high socioeconomic category, those in other socioeconomic standard of living quintile have a higher risk of onset of fertile life whatever the year of the observation. Among those in the very low socioeconomic standard of living category, the risk is higher: 1.69 ($p<0.01$) in 1996; 1.94 ($p<0.05$) in 2001; 2.04 ($p<0.001$) in 2006; 2.19 ($p<0.001$) in 2012 and 1.71 ($p<0.001$) in 2017. As for the temporal changes of the effect of this factor, non-significant sawtooth variations are observed (Table 5) with only one exception over the 2012-2017 period in the low socio-economic standard of living category where a slight but significant increase effect was recorded [$\Delta\exp(\beta)2012\text{-}2017=0.48$; $p<0.01$].

During 2001 and 2006, adolescent girls living in rural area were 0.34 and 0.67 times ($p<0.001$) less likely to onset of fertile life than those living in urban areas.

As for the use of traditional contraceptive methods, in 2012 and 2017, these users are more likely (2.06 and 1.69 times more, $p<0.01$] to begin early their fertile life than those who do not use any contraceptive method.

Table 5: Adjusted Cox regression Exp(β) showing trends of onset of fertile life among adolescent girls in Benin, 1996-2017 and change in factors effects

Covariables	Exp(B) values by observation year					Change in effects between two years observation			
	1996	2001	2006	2012	2017	$\Delta X_{1996-2001}$	$\Delta X_{2001-2006}$	$\Delta X_{2006-2012}$	$\Delta X_{2012-2017}$
Educational level achieved									
Never schooled	4.51***	3.44***	2.61***	2.33***	1.06	-1.07	-0.83***	-0.28	-1.27***
	(0.533)	(0.278)	(0.144)	(0.128)	(0.105)	(0.601)	(0.313)	(0.192)	(0.165)
Primary	2.67 **	1.87**	1.71***	1.78***	0.81**	-0.80	-0.16	0.07*	-0.97***
	(0.536)	(0.300)	(0.149)	(0.139)	(0.111)	(0.614)	(0.334)	(0.203)	(0.177)
Secondary and more (Ref)									
Age at first sexual intercourse									
Under 15 years old	2.47***	2.09***	2.14***	2.15***	2.36***	-0.38*	0.05	0.01	0.21
	(0.139)	(0.138)	(0.085)	(0.101)	(0.084)	(0.195)	(0.162)	(0.132)	(0.131)
Ages 15 years and more (Ref)									
Contraceptive use									
Never (Ref)									
Traditional	1.18	0.58**	0.88	2.06***	1.69***	-0.60	0.30	1.18***	-0.37
	(0.259)	(0.218)	(0.129)	(0.177)	(0.152)	(0.338)	(0.253)	(0.219)	(0.233)
Modern	0.96	1.07	0.92	0.80	1.42	0.11	-0.15	-0.12	0.62
	(0.279)	(0.257)	(0.158)	(0.310)	(0.352)	(0.379)	(0.301)	(0.347)	(0.469)
Ethnie									
Adja and related	0.35***	0.32**	2.86	0.82	0.54*	-0.03	2.54***	-2.04**	-0.28
	(0.391)	(0.455)	(0.756)	(0.421)	(0.363)	(0.599)	(0.882)	(0.865)	(0.555)

Fon and related	0.77	0.32***	2.73	0.50**	0.60*	-0.45	2.41***	-2.23***	0.10
	(0.334)	(0.380)	(0.734)	(0.347)	(0.271)	(0.505)	(0.826)	(0.811)	(0.440)
Yoruba and related	0.69	0.38**	2.38	0.56	0.47***	-0.31	2.00**	-1.82**	0.09
	(0.391)	(0.418)	(0.735)	(0.355)	(0.285)	(0.572)	(0.845)	(0.816)	(0.455)
Bariba and related	0.90	0.67	3.77*	0.67	0.89	-0.23	3.10***	-3.1***	0.22
	(0.396)	(0.490)	(0.718)	(0.350)	(0.211)	(0.630)	(0.869)	(0.798)	(0.408)
Lopka yoa and related	0.80	0.62	3.37*	0.65	1.11	-0.18	2.75***	-2.72***	1.46
	(0.364)	(0.491)	(0.712)	(0.343)	(0.196)	(0.611)	(0.864)	(0.790)	(0.395)
Foreign ethnicities (Ref)									
Religion									
Endogenous	1.15	0.59*	1.05	0.63**	1.08	-0.56*	0.46	-0.42*	0.45
	(0.222)	(0.256)	(0.168)	(0.193)	(0.207)	(0.338)	(0.306)	(0.255)	(0.283)
Muslim	0.72	0.91	0.95	0.77	0.93	0.19	0.04	-0.18	0.16
	(0.219)	(0.244)	(0.155)	(0.174)	(0.152)	(0.327)	(0.289)	(0.233)	(0.231)
Catholic	0.73	0.93	0.84*	0.86	0.87	0.20	-0.09	0.02	0.10
	(0.209)	(0.243)	(0.145)	(0.167)	(0.152)	(0.320)	(0.282)	(0.221)	(0.225)
No religion (Ref)									
Socioeconomic life index									
Very weak	1.69*	1.94**	2.04***	2.19***	1.71***	0.25	0.1	0.15	-0.48*
	(0.314)	(0.334)	(0.184)	(0.211)	(0.161)	(0.458)	(0.381)	(0.279)	(0.265)
Low	1.94**	1.98**	1.56**	1.78***	1.75***	0.04	-0.42	0.22	-0.03
	(0.310)	(0.332)	(0.181)	(0.207)	(0.160)	(0.454)	(0.378)	(0.274)	(0.261)
Average	1.40	1.79*	1.82***	1.64**	1.71***	0.39	0.03	-0.18	0.07
	(0.322)	(0.343)	(0.177)	(0.200)	(0.159)	(0.470)	(0.385)	(0.267)	(0.255)
High	1.70*	2.02**	1.45**	1.29	1.52***	0.32	-0.57	-0.16	0.23
	(0.315)	(0.342)	(0.173)	(0.197)	(0.153)	(0.464)	(0.383)	(0.262)	(0.249)
Very high (Ref)									
Residence area									

Urban (Ref)									
Rural	0.96	0.34***	0.67***	0.89	1.00	-0.62***	0.33*	0.22	0.11
	(0.158)	(0.161)	(0.096)	(0.109)	(0.093)	(0.225)	(0.187)	(0.145)	(0.143)
Departements									
Atlantique/Littoral (Ref)									
Atacora/Donga	1.36	1.52	1.40	1.14	0.90	0.16	-0.12	-0.26	-0.24
	(0.404)	(0.425)	(0.230)	(0.278)	(0.242)	(0.586)	(0.483)	(0.360)	(0.368)
Borgou/Alibori	0.89	1.92*	1.71**	0.86	0.97	1.03*	-0.21	-0.85**	0.11
	(0.414)	(0.389)	(0.229)	(0.284)	(0.236)	(0.568)	(0.451)	(0.364)	(0.369)
Mono/Couffo	1.68*	1.30	1.27	0.53**	1.44	-0.38	-0.03	-0.74*	0.91**
	(0.313)	(0.341)	(0.253)	(0.290)	(0.302)	(0.462)	(0.424)	(0.384)	(0.550)
Oume/Plateau	0.69	1.08	1.43**	0.80	1.20	0.39	0.35	-0.63**	0.4
	(0.345)	(0.288)	(0.181)	(0.193)	(0.199)	(0.449)	(0.340)	(0.264)	(0.277)
Zou/Collines	1.89***	1.21	1.33*	0.85	1.16	-0.68*	0.12	-0.48**	0.31
	(0.242)	(0.258)	(0.158)	(0.165)	(0.161)	(0.353)	(0.302)	(0.228)	(0.230)
-2log-likelihood	2962.06	2940.53	8937.65	6688.88	9466.39				
Chi-square values	153.50	225.02	433.49	289.01	250.16				
Chi2 Significance	<0.001	<0.001	<0.001	<0.001	<0.001				

***p < 1 %, **p < 5 %, *p < 10 % ; Ref = Terms of reference NB: The values in brackets are the standard deviations associated with each coefficient

Discussion

The results of the descriptive analysis show that early onset of fertile life among adolescent girls is still a reality in Benin. The probability of survival became low from age of 16 years in 2017. These results indicate that early onset of fertility in adolescence is still observed in Benin like in the other countries of the Sub-Sahara Africa such as Togo, Kenya, Uganda, South Africa, etc. where prevalence is 16,5 %, 15,0 %, 31,4 %, 19,2 % respectively (Badohoun, 2015; Beguy et al., 2013; Mturi, 2015; Rutaremwa, 2013). The persistence of the onset of fertile life in adolescence need more emphasis because of the health and social consequences (Neal et al., 2016; Socolov et al., 2017; Tessema et al., 2017; November & Sandall, 2018). These consequences represent impediments that delay the achieving of the country's goals for reproductive health (RH), education, and girls empowerment.

Among the explanatory factors, non educated adolescent girls or those having at least a primary education level are at higher risk of starting their fertile live earlier. These findings converge with those found in other African countries such as Nigeria (Osili & Long, 2008); Kenya (Chicoine, 2012) and Ghana (Canning et al., 2016). However, in the case of Benin, an atypical trend can be observed over the last observation year (2017). Indeed, adolescent girls at the primary level are less likely to onset their fertile life earlier than those having at least a secondary education level or higher. This could be explained by the fact that in primary level, most girls would probably not yet have reached puberty (i.e onset of the first menstruation) because of schooling before the age allowed in primary school (6 years), which is increasingly observed in Benin. Moreover, with their young age and being in primary school, there is the influence of parents/guardians. The situation of adolescents at secondary level or higher who are at greater risk of early onset of fertile life is also linked to their young age. It has been found that already at the age of 10 years old (first cycle of secondary school level) and 16 years old (university), this age interval coincides with the period of puberty and adolescence that begins, sometimes far from the parents/guardians for those who continue their schooling in another city/locality different than the one where the parents/guardians reside. It is also in this age range that the probability of the event occurring is higher as indicated by the KM results.

This study also shows that early first sexual intercourse increases the risk of onset of fertile life. This finding has been made in other previous studies, including those by Kouame (2015), Mchunu et al., (2013) in Côte d'Ivoire and South Africa. However, in the context of Benin, a temporal decline in the positive effect of this factor is expected. This expected result is based on the numerous interventions implemented for adolescents and young people throughout the country over the past decades. There are also the evolution of the socio-cultural context in relation to the more demanding reproductive behaviours in the traditional society compared to the current one. The traditional system is particularly characterized by early and / or forced marriages for young pubertal girls, which justified early sexual intercourse and early motherhood. These practices are less and less over time. Moreover, the various interventions implemented in the light of the many international, regional and national conventions and resolutions to which the country has subscribed with regard to adolescents and young people sexual and reproductive health. The goal of these actions is to help reduce the extent of the onset fertile life in adolescence, or at least the influence of some keys factors. It is therefore imperative to ask whether the various interventions have any effect on the early onset of fertile live.

The finding that a low socioeconomic standard of living has a positive effect on early onset of fertile life has been found in other previous studies (Arora et al., 2015; Favara et al., 2016; Wand & Ramjee, 2012). However, there is a growing risk among adolescent girls in the higher socioeconomic standard of living category. This could be the result of the need for ambition that is developing among adolescents and young people nowdays. High economic purchasing power offers opportunities for the satisfaction of certain needs of ambition or luxury specific to the period of adolescence and youth such as: attending nightclubs, consumption of drugs and alcoholic beverages, exposure to media and social networks, participation in entertainment activities (birthdays, relaxing at the beach, various peer-to-peer activities, etc.) likely to encourage the adoption of risky sexual behaviours. There is also the relaxation of parental control.

Furthermore, the differences in risk between rural and urban adolescent girls found in this study are contrary to those observed by Antoine (2008) in Madagascar and Palamulent et al., (2007) in South Africa in their studies. The trends observed in Benin could be explained by the concomitant influence of other covariates in the regression model. It should also be noted that premarital sexuality and fertility are more developed in urban areas than in rural areas. It can be deduced from this that the event of early onset of fertile life is no longer specific to rural area alone, as Delaunay (1994) finds among adolescent girls in Senegal.

Limitations of the study

Although this study examined the dynamics of onset of fertile life between 1996 and 2017 among adolescent girls and identified some explanatory factors, the findings and conclusions may have been affected by a number of aspects. First, the social desirability bias associated with the underreporting of information related to premarital fertility that must be socially misperceived. Second, it is likely that some of the explanatory variables considered in this study like department of residence, area of residence, religion and contraceptive use may have changed after the onset of fertile life. The data collected for these variables may not reflect the adolescent girl situation before the event actually, even though the retrospective approach is used in DHS surveys.

This may explain why urban adolescent girls are at higher risk of onset of fertile life when it is known, for example, that an unplanned/desired pregnancy or childbearing experience may lead the adolescent girl to move to the cities or urban area, with a view of finding a small income-generating activity to survive alone or with her child. This contextual reality and insufficiency, may also account for the mixed results found about the residence area factor.

Conclusion

This study concludes that over the study period, early onset of fertile life among adolescent girls under 20 years old persists in Benin. The significantly higher risk of experiencing the event before the age of 18 years old is mainly attributed to the education level, especially among those who have never been at school; to the earliness of the first sexual intercourse; and to the household socioeconomic standard of living, especially in the lower socioeconomic categories.

Early onset of fertile life is a major risk to the sexual, reproductive and child health; the future and socio-economic well-being of adolescent girls in Benin. In light of this, there is a need to strengthen and reorient policies and programmes on sexual and reproductive health (SRH), girls school enrolment and retention, and the socioeconomic well-being of young women. For example, school curricula should include SRH related modules earlier, given the age of learners at enrolement to secondary level, without losing sight of recent early psychosocial development, which triggers curiosity to discover the opposite sex. Specifically, SRH strategies should include uneducated, apprenticed or out-of-school adolescents girls; provide specific services regarding contraceptive methods to adolescent girls. Although, the promotion of birth control services, contraceptive methods services have become a medicalized or politicized issue, it remains nevertheless a social and cultural concern. These strategies will help to reduce the incidence of early onset of fertile life and to strengthen the knowledge and skills of adolescent girls to live a healthy, responsible and timely sexual and reproductive life.

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Conflicts of Interest

Authors declared that there is no conflict of interest concerning this manuscript.

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