Adolescent fertility is lower than expected in rural areas: results from 10 African HDSS

Authors

Clémentine Rossier, University of Geneva, Switzerland and INED, France
Bruno Schoumaker, Université Catholique de Louvain, Belgium
Valérie Delaunay, Institut de Recherche pour le Développement, France
Donatien Beguy, African Population and Health Research Center, Kenya
Aparan Jain, Population Council, USA
Martin Bangha, Indepth Network, Ghana
Alemseged Aregay, University of Gondar, Ethiopia
Baptiste Beck, Institut de Recherche pour le Développement, France
Karim Derra, IRSS-DRO/Clinical Research Unit of Nanoro (CRUN), Burkina Faso
Modeste Millogo, Université de Ouagadougou, Burkina Faso
Albert Nkhata Dube, Karonga Prevention Study, Malawi
Kone Siaka, Centre Suisse de Recherches Scientifiques (CSRS), Côte d'Ivoire
Marylene Wamukoya, African Population and Health Research Center, Kenya
Pascal Zabre, Centre de Recherche en Santé de Nouna (CRSN), Burkina Faso

Corresponding author:

Clémentine Rossier
Institute of Demography and Socioeconomics
University of Geneva
40 Bl Pont d'Arve
1211 Genève 4, Switzerland
Phone: ++ 41 (0)22 379 89 26
Email: clementine.rossier@unige.ch

Acknowledgments

This article was written with the support from INDEPTH, the project DEMOSTAF (Marie Skłodowska-Curie n° 690984) of the Horizon 2020 programme of the European Union, and the Evidence Project funded by USAID.

February 5th, 2019

Adolescent fertility is lower than expected in rural areas: results from 10 African HDSS

Short abstract (n=163)

Adolescent birth rate (ABR) is an important indicator of maternal health, adolescent sexual health and gender equity; it remains high in sub-Saharan Africa. While Demographic and Health Surveys (DHS) are the main source of ABR estimates, Health and Demographic Surveillance Systems (HDSS) can also be used to produce ABRs. Studies are lacking, however, in assessing the accuracy of HDSS ABR measures. In this paper, we use birth and exposure data from 10HDSS sites in six African countries to compute and compare ABRs for these areas to DHS rates of the regions where the HDSS sites are located, standardizing by education and place of residence. In rural HDSS sites, the ABR measure is 44% lower than the DHS measure, after controlling for education. Strong temporary migration of childless young women out of rural areas and different protocols for capturing temporarily absent women in the DHS and HDSS seem to explain this discrepancy. Further comparisons based on more strictly similar populations and measures seem warranted.

Word count of main text= 5260

Introduction

Addressing adolescent childbearing has been a development priority since the 1994 Cairo conference. Initially, global discourse framed adolescent childbearing as a maternal health issue. The maternal mortality rate is three times higher among young women (Nove et al. 2012), and young mothers and their children have worse health outcomes (UN 2013). Accordingly, the adolescent birth rate (ABR) was introduced as an indicator to measure progress and improvements in maternal health in the Millennium Development Goals in 2000, and was maintained as such in the Sustainable Development Goals in 2015. In recent years, more attention has been given to adolescent fertility as a marker of women's status (Hecker and Fabic 2013); it is used as one component of the latest Gender Inequality Index (UN 2010). In fact, low levels of educational attainment and a lack of job prospects for young women are important factors of early initiations into unions and childbearing. Simultaneously, early childbearing contributes to high rates of school drop-out and poor economic opportunities among young women (Coyne and Onofrio 2012). Over the years, the ABR has also become an indicator of young people's sexual and reproductive health, as it is closely related to unmet need for contraception (UN 2013).

Like other developing regions, sub-Saharan Africa (SSA) has witnessed a decline in its ABR over the past 40 years. In 1970-75, women aged 15-19 in SSA had 152 births per 1000. This reduced to 109 per 1000 by 2010-2015 (UN 2015). These levels of adolescent childbearing, however, remain strikingly higher than in other parts of the word: in 2010-2015, ABR was 16 per 1000 in Europe, 28 in North America, 30 in Asia and Oceania, and 67 in Latin America and the Caribbean.

Since the early 1980s and with over 300 surveys implemented in developing countries worldwide, the Demographic and Health Surveys (DHS) are the main source of data to monitor adolescent fertility in SSA. Given the heavy reliance on these data for fertility and mortality estimates in countries devoid of complete vital statistics, great efforts are devoted to DHS data collection, quality checks and variable preparation. In particular, analysts repeatedly scrutinize the DHS birth histories for several potential biases: birth omissions, birth displacements, as well as age misreporting. These periodic assessments show that the quality of the DHS birth histories is excellent or acceptable for most surveys and has been improving over the past 20 years (Pullum 2014). Reporting of age is often more inaccurate but since biases tend to be unsystematic, this issue is not seen as bearing heavily on fertility rates estimations (Pullum and Staveteig 2017). Nevertheless, published fertility rates that are computed from uncorrected birth data collected for the past three years can be quite different from the reconstructed fertility rates that are computed from complete birth histories over successive DHS (Schoumaker 2014). The later procedure corrects for birth omissions and displacements that can be numerous in some surveys. Even so, almost all biases that could *potentially* affect DHS uncorrected fertility estimates tend to underestimate the fertility rates rather than the opposite (Schoumaker 2014), a tendency to keep in mind as we compare ABR based on DHS data with ABR generated in HDSS sites below.

The INDEPTH Network is comprised of 48 member HDSS sites in low and middle-income countries, and as of 2012, 37 of them were located in SSA (Sankoh and Byass 2012). All INDEPTH member HDSS sites conduct prospective monitoring of the population living in the area under surveillance, which often corresponds to a health district. All entries into and out of the population (immigrations, births, deaths and emigrations) are recorded at least once a year and often several times a year. The fertility data collected in INDEPTH member HDSS sites are useful in different instances. The HDSS sites sometimes replace national vital statistics systems (Byass, de Savigny, Lopez, 2014), especially in countries with multiple HDSS sites. In Ethiopia for example, the government pulls together data from several HDSS sites to inform national trends and disparities on key population and health issues, while encouraging strategic creation of HDSSs to have a more complete representation of the different regions. Births can be the object of cohort studies nested on HDSS platforms, as in a prospective study of unintended pregnancies among young women in the Nairobi HDSS (Blessing et al. 2014). Finally, a number of health interventions have been implemented in HDSS sites, and family planning studies were frequent in the heyday of demographic surveillance sites, as in the Matlab HDSS (Philips et al. 1984). In such interventions, fertility was an important outcome variable that needed to be measured with precision.

But how reliable are HDSS fertility data and ABR? Over the years, INDEPTH has put in place several mechanisms to ensure the quality and comparability of the data collected across its member sites. First, the INDEPTH Resource Kit describes its standard data collection forms and procedures (INDEPTH 2008). For example, when a site begins or when a new person enters the area under study, fieldworkers are requested to ask for an ID or vaccination card to ascertain the date of birth, to minimize age misreporting. Moreover, INDEPTH HDSS sites provide population counts, vital statistics, and corresponding datasets each year to the network. The network examines these data and statistics annually; only sites with data that are of sufficient quality are included in the online statistics generator INDEPTHStats (http://www.indepth-network.org/data-stats/indepthstats) and can continue to be a full member of INDEPTH (http://www.indepth-network.org/member-centres/types-membership).

The longitudinal design itself helps to improve the quality of the data collected in HDSS sites for many reasons. Fieldworkers review the list of household members at each surveillance round and during their visits may notice new babies and new household members. They also may identify errors made in previous rounds and correct them in the current round. In addition, fieldworkers are often part of the community themselves so at times, are aware of changes in household structures in the community. Moreover, in many sites, as in the Ouagadougou HDSS (Soura et al. 2019), key informants collect independent lists of births and deaths that are cross-checked with the vital events collected by fieldworkers. Finally, in most sites data collection has shifted to electronic devices, which has further improved the quality of the data (Mukasa et al. 2017).

For these various reasons, HDSS sites often outperform other sources of data. For instance, a recent paper compared the data collected in the Navrongo HDSS in Ghana to the census data and findings indicated that the HDSS indicators were more reliable (Wak et al. 2017). HDSS data also offer a gold standard in diverse studies. For example, HDSS data have been used to assess the progress of official vital statistics registration in the Agincourt HDSS in South Africa (Garenne et al. 2016) and the completeness of adult mortality counts in demographic surveys in the Senegalese sites (Hellenringer et al, 2014). HDSS data are also more complete than health facility statistics, since many births and deaths occur at home in the areas of concern (Byass et al. 2014). But how representative are HDSS vital rates compared to those in similar areas which are not under surveillance? In some HDSS sites, fertility or mortality rates have declined following a health or family planning intervention as in the Kisumu HDSS where adult mortality dropped after the introduction of antiretroviral therapy (ART) (Gargano et al. 2012). So vital rates monitored in HDSS sites sometimes differ from levels observed in surrounding areas; but these instances are well-documented, as they result from large-scale experimental studies. In the current validation exercise, none of the HDSS sites experienced a drop in birth rates due to an intervention.

Given that HDSS data are generally of good quality, it would be expected that HDSS fertility rates align with fertility estimates from other recognized high-quality sources, such as the DHS. But one of the only thorough assessments of HDSS fertility rates done to date shows a different picture. A comparison between the data collected in the Senegalese HDSSs and the 2002 and 2013 national censuses showed that fertility rates were much higher according to census data compared to HDSS data especially at younger ages (Ndiaye et al. 2018). The study reported for instance that in Niakhar the ABR was about 80 births per 1000 births per women in 2013 according to the census, and about 40 births per 1000 women according to HDSS data. The authors suggest that the primary reason for this discrepancy was associated with the definition of residence and how it was implemented in the two surveys. In the Senegalese censuses as in other regional censuses as well as in the DHS, individuals are counted as "residents" if they usually lived in the household for more than 6 months or arrived recently and intended to stay longer than 6 months. The definitions used in the Senegalese HDSS are broader: some individuals who have left the household for more than 6 months are also counted as residents. The Senegalese sites, which have a long history of implementation that even preceded INDEPTH, are quite unique in this regard. INDEPTH's instruments are based on the census definition of residence. HDSS sites established in 2000s, which include most of the sites, use the census / DHS 6-month definition. Thankfully, "migrant residents" -who are absent for more than 6 months- can (usually) be identified in the Senegalese HDSS databases and excluded from analyses for comparison purposes.

Ndiaye et al (2018) showed, however, that even after removing these migrant residents from the HDSS databases and thus working with a comparable definition of residence in the HDSS and census data, the population counted in the census for the Senegalese sites was smaller compared to HDSS counts. For example, the population aged 15 to 59 was 20% smaller in the census data than in the HDSS data for Mlomp in 2013. The authors concluded that even when using the same definition of residence, the longitudinal nature of the HDSS yielded larger resident counts. Unlike census fieldworkers, HDSS fieldworkers have a list of prior residents that they can refer to; they can remind household respondents about members who left the residence for less than 6 months. The Senegalese comparison further indicated that temporary female migrants have very low fertility rates compared to sedentary residents, and sedentary residents are the ones who are overwhelmingly captured by the census. The TFR in Mlomp in 2002, for instance, was 4.8 children per woman according to the census but 3.0 according to the HDSS data for the same year. Once all sedentary women in the Mlomp HDSS database were kept in the analysis, age-specific fertility rates computed from HDSS data also amounted to 4.8 children per woman, like the census figure just cited.

This study indicates that HDSS sites can be expected to feature lower fertility rates, especially at younger ages, compared to cross-sectional operations like the census or the DHS, because of the inclusion of a relatively larger numbers of non-childbearing temporary female migrants in the denominator. The

Senegalese analysis was limited however, as the sites did not use the standard 6-month definition of residence - unlike more recent INDEPTH member sites. Moreover, all HDSS Senegalese sites were rural with well-documented and large circular (temporary) migratory patterns of women between their villages and cities.

In the current study, we propose to extend this analysis to a larger set of 10 sites disseminated across SSA, both rural and urban, and to focus on ABR only. We will compare the HDSS ABR to DHS ABR for the administrative regions where the HDSS sites are implemented, standardizing the HDSS population along the education and residence of the DHS region. While the comparison has its limits (the areas, periods and indicators do not match perfectly), the analysis will help to further explore the possibility of a large mismatch between ABR measures from longitudinal versus cross-sectional data collection efforts.

Data and methods

The DHS recently published guidelines to assist analysts compare DHS fertility and mortality estimates with other data sources (Pullum, Assaf and Staveteig, 2017). As indicated in these guidelines, the two estimates that would be compared need to cover the same territory and identical calculation method such as births in the last 2 years or last 3 years. Even when these conditions are met, random variations as well as differences in the sampling strategy or questionnaire wording could lead to differences in the estimates. Given all these possible sources of variation, it is striking that the ABRs produced by the DHS match closely those produced by Performance, Monitoring and Accountability 2020 (PMA2020) surveys in four countries (Indonesia, Uganda, Kenya, Ethiopia). In Nigeria, however, the difference between the two sources was larger (17%) (Pullum, Assaf and Staveteig, 2017, p. 19).

In order to rigorously compare ABRs produced in the HDSS with DHS estimates, one would need to sample a sufficient number of clusters within the HDSS sites during one of the DHS operations. In the absence of such custom-made DHS data, the current study renders these two data sources *as comparable as possible* using available DHS data. DHS data are representative at the national and regional levels, and for rural and urban residence of the population within each region. While it is easy to match each HDSS with a DHS region, the area covered by the HDSS site is much smaller than the DHS region. Moreover, the HDSS are usually located in the most disadvantaged (under-developed and rural) parts of the region (but not always), rendering a simple comparison irrelevant. In this paper, we calculated ASFRs for women from 10 HDSS located in six countries in SSA (Burkina Faso, Côte d'Ivoire, Ethiopia, Kenya, Malawi, and Senegal) disaggregating them by level of education and residence. We considered other socioeconomic indicators but others were not systematically collected across all sites; moreover, the level of education and residence were only available for all women-years under consideration in seven sites. In these sites, we standardized the ASFRs in the HDSS by matching the population composition in the HDSS to that of the corresponding DHS region.

To recruit INDEPTH member sites, a call to participate in a comparative fertility analyses workshop was sent to all sites. A total of 18 sites were selected and participated in a one-week workshop organized in Accra in May 2015. Of these, 10 sites completed the analyses needed for this paper (Table 1): three sites in Senegal (Bandafassi, Niakhar, Mlomp); three sites in Burkina Faso (Nouna, Nanoro, Ouagadougou); one site in Ethiopia (Kilite), one site in Kenya (Nairobi) and one site in Malawi (Karonga) (Beguy et al. 2015, Crampin et al. 2012, Delaunay et al., 2013, Derra et al. 2012, Kone et al. 2014, Pison et al. 2014, Rossier et al. 2012, Sie et al. 2010). Two of these HDSS sites are located in capital cities and are completely urban (Nairobi and Ouagadougou); six sites are completely rural (the three Senegalese sites, Nouna and Nanoro, Karonga); and the two remaining rural sites include towns, i.e. an area which is identified as urban according to national statistical offices. The average population under surveillance in these sites is estimated at 55,000 individuals, ranging from a low of 8,000 in Mlomp to a high of 93,000 in Nouna.

When compared to the sample of the corresponding DHS region, the number of women aged 15 to 19 is larger even in the smallest HDSS site (Table 2). As mentioned, the sites in Senegal have long historical data series, having begun data collection in the 1960s, 1970s and 1980s. Nouna, in northern Burkina Faso, began the surveillance program back in 1992; all other sites participating to this study are relatively recent. All six countries have had a DHS recently (between 2010 and 2014); the last column of Table 1 shows the year of the most recent DHS survey, and the DHS region in which the HDSS is located.

Table 1 about here

Table 2 about here

All HDSS sites collect data on births that take place in the surveillance area and this information is linked to the mother's and household/dwelling's unique identifiers. Routine data collected for all births include: the date of birth, the sex of the child, the mother's age at the time of birth, and whether the birth was a singleton or a multiple birth. First, we prepared the data in an event-history format by creating a "core residency file" based on a "beginning/end of state" file of women aged 15 to 49, including their date of birth and unique identifier. Second, births were added as new events to this "core residency file". For the analysis, we computed HDSS ASFRs by calendar year using events and exposures recorded in the sites, for all available years. Third, we picked the year of the latest DHS -2 survey for comparison; fertility rates with DHS data are computed using the births reported for the five years preceding the survey. For that year (year of DHS -2), we also included women's educational level and place of residence (urban/ rural) in the database, whenever possible. Three HDSS sites had no or incomplete data on educational attainment (Bandafassi, Mlomp, Nairobi).

While we were interested in adolescent births reported at each age and especially in births to very young women (before age 16), DHS sample sizes at the regional level were too small to allow for this distinction. Moreover, the level of fertility before age 15 was found to be negligible in the HDSS sites. We therefore focused on the ABR computed for the 15-19 age group as a whole in the two data sources. We computed the DHS ABRs for the 10 regions using tfr2, a Stata program designed to compute fertility rates from the DHS using all births reported in the last 5 years (Schoumaker 2013). DHS regional samples were weighted.

We further compared the distribution of women 15-19 by educational level in the two sources (none, some primary, some secondary or more), and recalculate the ABRs for the HDSS, applying to the HDSS the educational distribution found at the regional level in the DHS. We did the same for place of residence (urban/rural) for the few HDSS sites that were rural but with a town qualifying as urban. HDSS and DHS define "urban" by their respective national statistical offices, which varies by country (Dorelien et al. 2013).

Finally, to test whether the mismatch between the two sources is linked to less fertile temporary migrants who are captured more often in the HDSS data, as seen in the Senegalese HDSS-census comparison, we conducted an additional analysis in two sites: one urban Ouagadougou (Burkina Faso) and one rural Niakhar (Senegal). In these two sites, we compared the fertility of sedentary adolescents to the fertility of mobile ones. In the rural site, adolescent fertility was compared for those who stayed in the surveillance site and those who migrated out of the surveillance site (for example to the city) and then returned; in the urban site, adolescent fertility was compared between those who entered the city migrating (typically from rural areas), and those who remained urban residents. We also compared the share of "absent resident" (i.e. did not sleep the night before) in these two sites and in the DHS at the regional level.

Results

Large differences in ABR levels and rates of ABR decline at the local level

There are large differences in ABRs across the ten HDSS sites. ABRs range from a low of 20 births per 1000 women aged 15-19 old in Mlomp in Senegal (i.e. close to the North American average in 2010-2015) to a high of 140 in Taboo in Côte d'Ivoire (i.e. the average for SSA in the early 1970s) (Table 2 and Figure 1). As expected, these differences are strongly linked to the share of young women who reached secondary level of education (Figure 2) (correlation =-0.60).

Figure 1 about here

Figure 2 about here

Figure 3 shows the comparisons of the ABR estimates for the Senegal sites to the national ABR estimate of the UN Population Division (Figure 3). The three Senegal sites were the only HDSS sites in this analysis that had long histories for comparison. In Senegal, at the national level, the ABR has been declining steadily over the last three decades. The speed and timing of this decline, however, varies in the three Senegalese sites. Mlomp, which had a low ABR already in the 1980s, witnessed virtually no further change during the subsequent decades. In Niakhar, we observe a decline comparable to that at the national level in the 1980s and 1990s, and an acceleration of this decline in the 2000s. On the other hand, in Bandafassi, the most remote of the three sites, the ABR started to decline only in 2000s.

Figure 3 about here

Adolescent birth rates measured in the rural HDSS are lower than in the corresponding DHS region

When comparing the ABRs calculated in the HDSS sites to those from the region of the DHS where the HDSS exists, no clear pattern emerged (Figure 4, Table 2). While ABRs are lower in most HDSS sites compared to the DHS region, ABRs are similar in Ouagadougou, Nairobi and Karonga, and ABR is much higher in the Taboo HDSS site.

Figure 4 about here

As mentioned, this first comparison is relatively uninformative, since the majority of women in most HDSS sites are less educated relative to the average person residing in the DHS region, although women in some HDSS are relatively close to the regional average in terms of education or even fare better than the region (Kilite). To account for these differences in educational levels, and as explained in the method section, for seven HDSS sites with recent data on women's education, we applied educational achievement from the DHS region to the ABR measured in the HDSS for various educational groups. At equivalence educational structure with the DHS region, Figure 5 and Table 2 show that the HDSS feature lower rates of adolescent childbearing. There is only one exception to this pattern: Ouagadougou, which is the only urban site remaining in this analysis, where the ABR calculated from the HDSS data is very close to that of the DHS.

Controlling for the educational distribution in the HDSS across the seven sites, we find that the ABR is 39% lower in the HDSS than in its DHS region. When excluding Ouagadougou, the ABR in the HDSS is 44% lower than in the corresponding DHS region, still controlling for education. These large differences cannot be explained by confidence intervals around the sample measures of the DHS.

Figure 5 about here

We refined the standardization by considering women's place of residence in the sites. We only did this for two HDSS sites because eight sites are entirely urban or entirely rural and the place of residence is already accounted for when computing the fertility rates at the regional level. In the two cases (Taabo in Côte d'Ivoire and Kilite in Ethiopia), the HDSS adolescent fertility rates computed when standardized by place of residence did not vary from the original measure.

Are heavy internal migration flows explaining low ABR measured in rural HDSS sites?

As explained earlier, the ability to capture household members who are temporarily away is different in the HDSS and in the DHS and most likely explains the differences observed in ABRs using data from these two sources. We assume that the impact of the movements of non-reproductive women on the measurement of adolescent fertility will be different in rural and in urban areas. In rural areas, adolescents who go away for some time to work or study for example, and do not have babies while they are away (but then come back to their household) are included in the denominator of the HDSS ABR calculation, which reduces the fertility rates. By capturing essentially non-mobile (i.e. more often childbearing) young women, the DHS narrows the denominator and measures higher adolescent fertility rates. In urban areas, the situation can be expected to be different. Young migrants from rural areas (who may move for a few months because they are free of reproductive tasks to work or assist family members or visit) will rarely give birth and will have fertility rates closer to urban adolescents; young urban residents who are temporarily absent from the city for similar reasons are also likely to avoid childbearing.

Table 4 about here

To test these hypotheses, we first computed the fertility rates of temporarily migrating and non-migrating adolescents in the rural HDSS of Niakhar in Senegal (in. 2012). Table 4 shows that between 8% and 17.5% of adolescent were temporarily absent (for more than one month) in the Niakhar HDSS in 2012, depending on the month. In addition, the number of temporary migrants varies by season with young women leaving more often in the summer (long vacation) (Delaunay and Enel 2009). In contrast, only 7.6% of women aged 15 to 19 did not sleep in the household the night before according to the DHS regional data (the DHS data collection went from the end of January to the end of October 2014). The fertility rate of young women in the HDSS who did not move in 2012 (93 per 1000) is much higher than the fertility rate of mobile adolescents (18 per 1000). The ABR of sedentary adolescents in the Niakhar HDSS is in fact close to the ABR measured in the DHS for the entire region for that period (81 per 1000).

A similar analysis for the Ouagadougou urban HDSS in Burkina Faso shows that the proportion of adolescents who are temporary out-migrants (in this case defined as members who did not sleep in the dwelling the night before the survey but were absent for less than 6 months) is about 10%; this proportion does not vary by season. In the DHS data for that region and year, the share of women 15 to 19 who did not sleep in the household the night before was 2.4%. Among recent in-migrants (who have not been sleeping in the dwelling for more than 6 months) in this site, the proportion of young women who visit (mainly from rural areas) is highest during the summer. We also observe that non-mobile adolescents and temporary out-migrants have comparable -and very low- birth rates. In addition, adolescents who arrived and stayed for more than 6 months had similarly low fertility rates in their first 6 months of stay (result not shown).

Conclusion

While the comparisons conducted here are only an approximation and further efforts are needed to match DHS and HDSS data more precisely, the results of these analyses lead us to conclude tentatively that the DHS- and other cross-sectional data collection operations- may give a somewhat exaggerated picture of adolescent fertility levels in African rural areas where temporary migration is widespread. The very frequent occurrence of temporary migration in these contexts, especially at younger ages, is impossible to document fully in cross-sectional data collection efforts. Moreover, as temporary migrants are usually not giving birth when they are away, this omission can lead to an overestimation in fertility rates. While many of these young women come back after some time, their "infertile" time is not factored into the DHS –or other cross-sectional- measure of adolescent fertility of rural residents. By not counting all young women who are gone temporarily, adolescent fertility appears higher than it is in reality. In the rural HDSS sites, where temporary out-migrants are kept in the denominator, adolescent fertility rates are 44% lower compared to DHS regional measures, controlling for educational status. While we focused here on adolescent fertility, our results seem to indicate the same bias at older ages.

The DHS measure is not wrong per se, as it amounts to a measure of fertility rate in a population that is closer to the “de facto” population (who slept in the housing unit the night preceding the survey in the housing unit). National measures of fertility rates in the DHS are not affected by the biases discussed here, due to temporary internal migration flows. However, our results raise the question of the description of rural-urban fertility differentials in African countries where populations are highly mobile. A cross-sectional operationalization of the 6-month definition of household membership (as in the DHS) makes this difference appear drastic, while a longitudinal implementation of the same 6-month definition of household membership (as in the HDSS) attenuates the urban-rural fertility contrast. When sites opt for a larger definition of residence as in the Mlomp HDSS in Senegal, where women are kept in the databases up to two years of absence, fertility levels appear even lower, opening another debate about the amount of time that is appropriate to define residents as temporarily absent.

But is measurement the real problem or is it the indicator that is used? Period measures of fertility (ABR, ASFR, TFR) have repeatedly been shown to perform poorly in situations of calendar changes and of migration. Since migrants tend to start childbearing in the years after moving to a new country, and since the period preceding childbearing back home is not counted in the country of arrival, the age-specific fertility rates of migrants measured in the arrival country tend to be high, leading to large differences between native and non-native age-specific fertility rates and TFRs (Sobotka and Lutz 2011). Cohort measures are not as sensitive to interactions between mobility and fertility trajectories. In Switzerland, for example, the completed family size of Swiss women is slightly higher than that of foreign women when measured at the end of women’s reproductive years; but the TFR (annual period measure of fertility) of foreign women is much higher than that of natives (Burkimsher, Rossier, Wanner, 2018). Similarly, in the African context and with respect to internal migration, a cohort perspective will probably show in a few years that today’s young and often mobile rural women will -when they will be in their forties- have fewer children than current period measures would lead us to think.

There are two additional take-home messages from these results. First, adolescent childbearing, like the unmet sexual and reproductive health needs of adolescents and overall development levels, are tremendously uneven in SSA today. HDSS sites in the INDEPTH Network represent this diversity and are therefore great places not only to study it, but also to test interventions aimed at bettering young people’s SRH in a variety of African contexts. Second, the analysis presented in this study highlights the challenges inherent to using INDEPTH fertility data. While the data are complex and not always well documented, it is difficult to engage with researchers from various HDSS sites to conduct comparative analysis. The experience of convening a workshop was a solution but it is a costly one and analysts cannot be away from the site for more than a week at a time. Another important weakness of INDEPTH data in many sites, which diminishes interest in using it, is the lack of time-varying socioeconomic indicators, such as level of education, poverty status, income level, etc.. INDEPTH member sites need to make an effort to continuously capture and update data on education in all sites; they also need to collect continuous data on other basic socioeconomic indicator, such as household assets and marital status. Data on parity and more specifically, the rank of each birth, is also missing from most sites. As there is a great deal of socioeconomic inequalities within low-income countries, studies of vital rates - including in HDSS sites- cannot be undertaken without a consideration for this diversity. The Sustainable Development Goals indicators call for a systematic disaggregation by socioeconomic status.

References

Beguy, D., Elung'ata, P., Mberu, B., Oduor, C., Wamukoya, M., Nganyi, B., & Ezeh, A. (2015). Health & demographic surveillance system profile: the Nairobi urban health and demographic surveillance system (NUHDSS). *International journal of epidemiology*, *44*(2), 462-471.

Beguy, D., Mumah, J., & Gottschalk, L. (2014). Unintended pregnancies among young women living in urban slums: Evidence from a prospective study in Nairobi City, Kenya. *PloS one*, *9*(7), e101034.

Burkimsher M., C. Rossier, P. Wanner (2018) *Who has more children in Switzerland: Swiss or foreign women? Why the TFR is a misleading measure*, LIVES Working Paper 2018/73

Byass, P., de Savigny, D., Lopez, A. D., 2014, Essential evidence for guiding health system priorities and policies: anticipating epidemiological transition in Africa, *Global Health Action*, *7(1),* p.23359

Coyne CA, D Onofrio BM. (2012). Some (but not much) progress toward under- standing teenage childbearing: A review of research from the past decade. *Adv Child Dev Behav* 2012;42:113

Crampin, A. C., Dube, A., Mboma, S., Price, A., Chihana, M., Jahn, A., ... & Floyd, S. (2012). Profile: the Karonga health and demographic surveillance system. *International journal of epidemiology*, *41*(3), 676-685.

Delaunay, V., & Enel, C. (2009). Les migrations saisonnières féminines: le cas des jeunes bonnes à Dakar. *Du genre et de l'Afrique. Hommage à Thérèse Locoh, Paris, INED*, 389-402.

Delaunay, V., Douillot, L., Diallo, A., Dione, D., Trape, J. F., Medianikov, O., ... & Sokhna, C. (2013). Profile: the Niakhar health and demographic surveillance system. *International journal of epidemiology*, *42*(4), 1002-1011.

Derra, K., Rouamba, E., Kazienga, A., Ouedraogo, S., Tahita, M. C., Sorgho, H., ... & Tinto, H. (2012). Profile: Nanoro health and demographic surveillance system. *International journal of epidemiology*, *41*(5), 1293-1301.

Dorélien, A., Balk, D., & Todd, M. (2013). What Is urban? Comparing a satellite view with the Demographic and Health Surveys. *Population and Development Review*, *39*(3), 413-439.

Garenne, M., Collinson, M. A., Kabudula, C. W., Gómez-Olivé, F. X., Kahn, K., & Tollman, S. (2016). Improving completeness of birth and death registration in rural Africa. *The Lancet Global Health*, *4*(9), e604-e605.

Gargano, J. W., Laserson, K., Muttai, H., Odhiambo, F., Orimba, V., Adamu-Zeh, M., ... & Broz, D. (2012). The adult population impact of HIV care and antiretroviral therapy in a resource poor setting, 2003–2008. *Aids*, *26*(12), 1545-1554.

Helleringer, S., Pison, G., Masquelier, B., Kanté, A. M., Douillot, L., Duthé, G., ... & Delaunay, V. (2014). Improving the quality of adult mortality data collected in demographic surveys: validation study of a new siblings' survival questionnaire in Niakhar, Senegal. *PLoS medicine*, *11*(5), e1001652.

Heckert, J., & Fabic, M. (2013). Improving Data Concerning Women's Empowerment in Sub-Saharan Africa. *SFP*, *44*(3), 319-344.

INDEPTH (2008), *INDEPTH Resource Kit for Demographic Surveillance Systems*, http://www.indepth-network.org/Resource%20Kit/INDEPTH%20DSS%20Resource%20Kit/INDEPTH%20DSS%20Resource%20Kit.htm

Kone, S., Baikoro, N., N'Guessan, Y., Jaeger, F. N., Silué, K. D., Fürst, T., ... & Esso, E. L. (2014). Health & demographic surveillance system profile: the Taabo health and demographic surveillance system, Côte d'Ivoire. *International journal of epidemiology*, *44*(1), 87-97.

Mukasa, O., Mushi, H. P., Maire, N., Ross, A., & de Savigny, D. (2017). Do surveys with paper and electronic devices differ in quality and cost? Experience from the Rufiji Health and demographic surveillance system in Tanzania. *Global health action*, *10*(1), 1387984.

Ndiaye Cheikh Tidiane, Bruno Masquelier, Gilles Pison, Ndèye Binta Diémé, Samba Ndiaye, Valérie Delaunay, Ibrahima Diouf, Ousmane Ndiaye, Paul Senghor, Pape Niokhor Diouf. Évaluation externe des données de recensement au Sénégal par l'utilisation des données d'observatoires de population, *Chapitre 20 in :* Delaunay V., Desclaux A., Sokhna C. (éd.), 2018. *Niakhar, mémoires et perspectives. Recherches pluridisciplinaires sur le changement en Afrique*. Marseille et Dakar, Éditions de l'IRD et L'Harmattan Sénégal, *(pp 401-423).*

Nove A, Matthews Z, Neal S, et al. (2012) Maternal mortality in adolescents compared with women of other ages: Evidence from 144 countries. *The Lancet Glob Health* ;2:e155

Phillips, J. F., Simmons, R., Chakraborty, J., & Chowdhury, A. I. (1984). Integrating health services into an MCH-FP program: lessons from Matlab, Bangladesh. *Studies in family planning*, *15*(4), 153-161.

Pison, G., Douillot, L., Kante, A. M., Ndiaye, O., Diouf, P. N., Senghor, P., ... & Delaunay, V. (2014). Health & Demographic Surveillance System Profile: Bandafassi Health and Demographic Surveillance System (Bandafassi HDSS), Senegal. *International journal of epidemiology*, *43*(3), 739-748.

Pison, G., Beck, B., Ndiaye, O., Diouf, P. N., Senghor, P., Duthé, G., ... & Delaunay, V. (2018). Profile: Mlomp Health and Demographic Surveillance System (Mlomp HDSS), Senegal. *International Journal of Epidemiology*.

Pullum, T., and S. Staveteig. 2017. *An Assessment of the Quality and Consistency of Age and Date Reporting in DHS Surveys, 2000-2015*. DHS Methodological Report No. 19. Rockville, Maryland, USA: ICF.

Pullum, T. W., and S. Becker. 2014. *Evidence of Omission and Displacement in DHS Birth Histories*. DHS Methodological Reports No. 11. Rockville, Maryland, USA: ICF International.

Pullum, T., S. Assaf, and S. Staveteig. 2017. *Comparisons of DHS Estimates of Fertility and Mortality with Other Estimates*. DHS Methodological Reports No. 21. Rockville, Maryland, USA: ICF.

Rossier, C., Soura, A., Baya, B., Compaoré, G., Dabiré, B., Dos Santos, S., ... & Lankoandé, B. (2012). Profile: the Ouagadougou health and demographic surveillance system. *International journal of epidemiology*, *41*(3), 658-666.

Sie, A., Louis, V., Gbangou, A., Müller, O., Niamba, L., Stieglbauer, G., ... & Becher, H. (2010). The health and demographic surveillance system (HDSS) in Nouna, Burkina Faso, 1993–2007. *Global health action*, *3*(1), 5284.

Sankoh, O., & Byass, P. (2012). The INDEPTH Network: filling vital gaps in global epidemiology. *Int J Epidemiol* 41: 579–588. https://doi.org/10.1093/ije/dys081

Schoumaker, B. (2013). A Stata module for computing fertility rates and TFRs from birth histories: tfr2. *Demographic Research*, *28*, 1093-1144.

Schoumaker, B. 2014. *Quality and Consistency of DHS Fertility Estimates, 1990 to 2012*. DHS Methodological Reports No. 12. Rockville, Maryland, USA: ICF International.

Sobotka, T. and Lutz, W., 2011. Misleading policy messages derived from the period TFR: Should we stop using it? *Comparative Population Studies*, *35*(3).

United Nations, Department of Economic and Social Affairs, Population Division (2013). *Adolescent Fertility since the International Conference on Population and Development (ICPD) in Cairo* (United Nations publication).

United Nations, Department of Economic and Social Affairs, Population Division (2015). *World Fertility Patterns 2015* – Data Booklet (ST/ESA/ SER.A/370).

United Nations Development Programme (2010), *Human development Report 2010*. (United Nations publication).

Wak, G., Bangha, M., Azongo, D., Oduro, A., & Kwankye, S. (2017). Data Reliability: Comparison between Census and Health and Demographic Surveillance System (HDSS) Outputs for Kassena-Nankana East and West Districts, Ghana. *Population Review*, *56*(1).

Table 1. 10 HDSS sites in six African countries, and last DHS in their region

	Starting year*	Population 2014	Location	DHS year and region
Senegal				*2014*
Bandafassi	1970	13 000	rural	Kedougou
Niakhar	1962	43 000	rural	Fatick
Mlomp	1985	8 200	rural	Ziguinchor
Burkina Faso				*2010*
Nouna	1992	93 000	rural	Bouche de Mouhoun
Nanoro	2009	54 780	rural	Center West
Ouagadougou	2009	82 387	urban	Ouagadougou
Côte d'Ivoire				*2011-12*
Taabo	2008	45 766	rural	Sud sans Abidjan
Ethiopia				*2011*
Kilite	2009	65 848	rural	Tigray
Kenya				*2014*
Nairobi	2003	61 695	urban	Nairobi
Malawi				*2010*
Karonga	2002-04	35 730	rural	Northern

* The year the HDSS started does not corresponds to the date from which we have data on adolescent fertility; sometimes the sites widened their area and data is available after that change; in other cases early data were damaged or lost.

Table 2: Adolescent birth rates in HDSS sites and in the corresponding region at the time of last DHS

	Number 15-19		Ratio 15-19 to 15-49		ABR				TFR	
HDSS sites	**HDSS** Year of DHS last survey - 2 (in person years)*	DHS Last survey (unweighted)	HDSS Year of DHS last survey -2	DHS Last survey	HDSS Year of DHS last survey -2	DHS (5 last years) and 95% confidence interval	HDSS corrected with DHS educational distribution*	HDSS corrected with DHS urban distribution	HDSS Year of DHS last survey -2	DHS (5 last years)
Bandafassi	696	90	0.24	0.22	0.113	0.194 (0.141—0.248)		Only rural	5.07	6.52
Niakhar	2121	146	0.23	0.25	0.065	0.081 (0.057—0.105)	0.035	Only rural	6.11	6.43
Mlomp	510	103	0.23	0.23	0.026	0.083 (0.053—0.114)		Only rural	3.24	4.66
Nouna	3862	230	0.21	0.16	0.138	0.165 (0.145—0.186)	0.138	Only rural	5.47	6.77
Nanoro	2266	304	0.23	0.19	0.088	0.134 (0.108—0.160)	0.067	Only rural	4.83	6.54
Ouagadougou	4148	317	0.23	0.24	0.055	0.050 (0.036—0.065)	0.043	Only urban	3.13	3.26
Taabo	886	137	0.13	0.20	0.213	0.134 (0.106—0.162)	0.096	0.202	5.51	4.74
Kilite	4526	458	0.28	0.26	0.027	0.098 (0.073—0.122	0.027	0.025	2.91	2.03
Nairobi	2786.6	125	0.15	0.12	0.098	0.081 (0.058—0.104)		Only urban	2.75	2.90
Karonga	1765.2	968	0.23	0.23	0.146	0.171 (0.157—0.188)	0.105	Only rural	5.11	5.74

* The quantities are calculated for DHS year -2 except for Nanoro and Ouagadougou which used year of last DHS -1, because they started data collection in 2009). Nouna and Niakhar also provided their computation only for year -1.

Table 3: Fertility rates of adolescent women who are visitors, present residents and absent resident in the Niakhar HDSS (2012) and the Ouagadougou HDSS (2009)

	Niakhar HDSS (2012)				Ouagadougou HDSS (2009)			
Women aged 15-19	**Visitors***	**Present resident**	**Absent resident****	**Total**	**Visitors#**	**Resident**	**Absent resident##**	**Total**
Distribution January 1st	-	92.0% 2081	8.0% 182	100% 2263	5.6% 283	84.7% 4284	9.7% 488	100% 5055
Distribution July 1st	-	82.5% 1840	17.5% 389	100% 2229	20.3% 1169	69.3% 3988	10.4% 597	100% 5754
ABR	-	93.3	18.01	58.57		5.62	4.93	5.54

* Not monitored in Niakhar ** who were gone for more than one month that year and returned # who have resided for less than 6 months ## gone for less than six month and returned

Figure 1

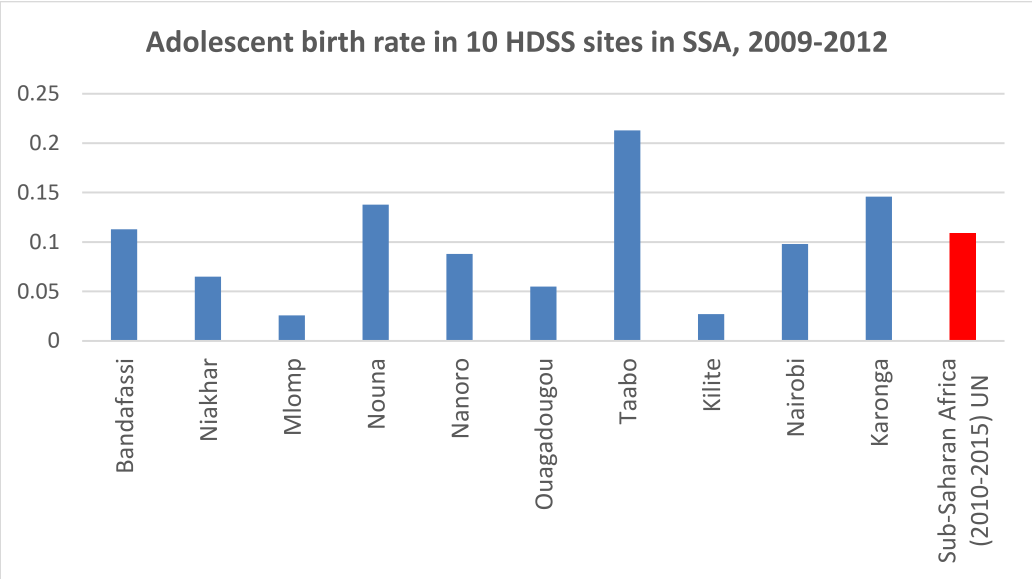
Adolescent birth rate in 10 HDSS sites in SSA, 2009-2012
0.25
0.2
0.15
0.1
0.05
0
Bandafassi
Niakhar
Mlomp
Nouna
Nanoro
Ouagadougou
Taabo
Kilite
Nairobi
Karonga
Sub-Saharan Africa (2010-2015) UN

Figure 2

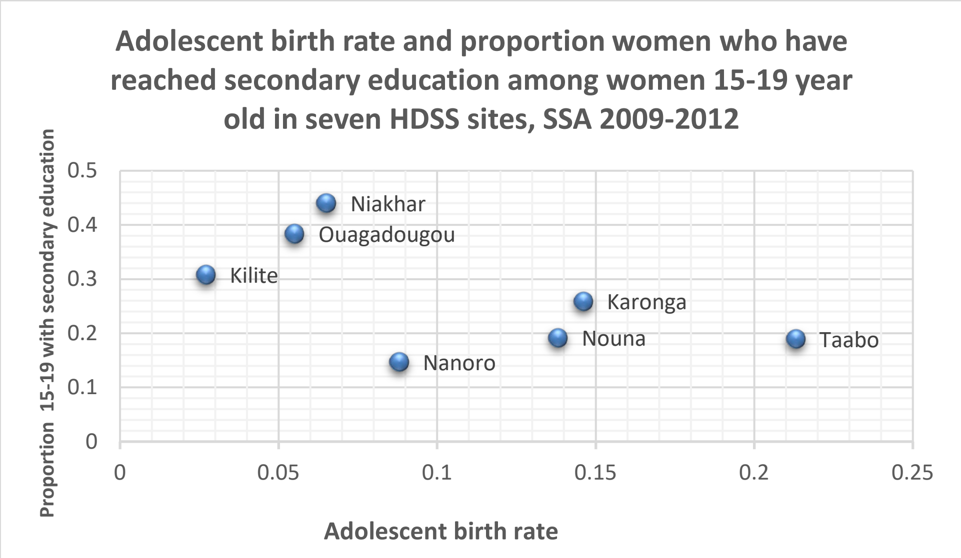

Figure 3

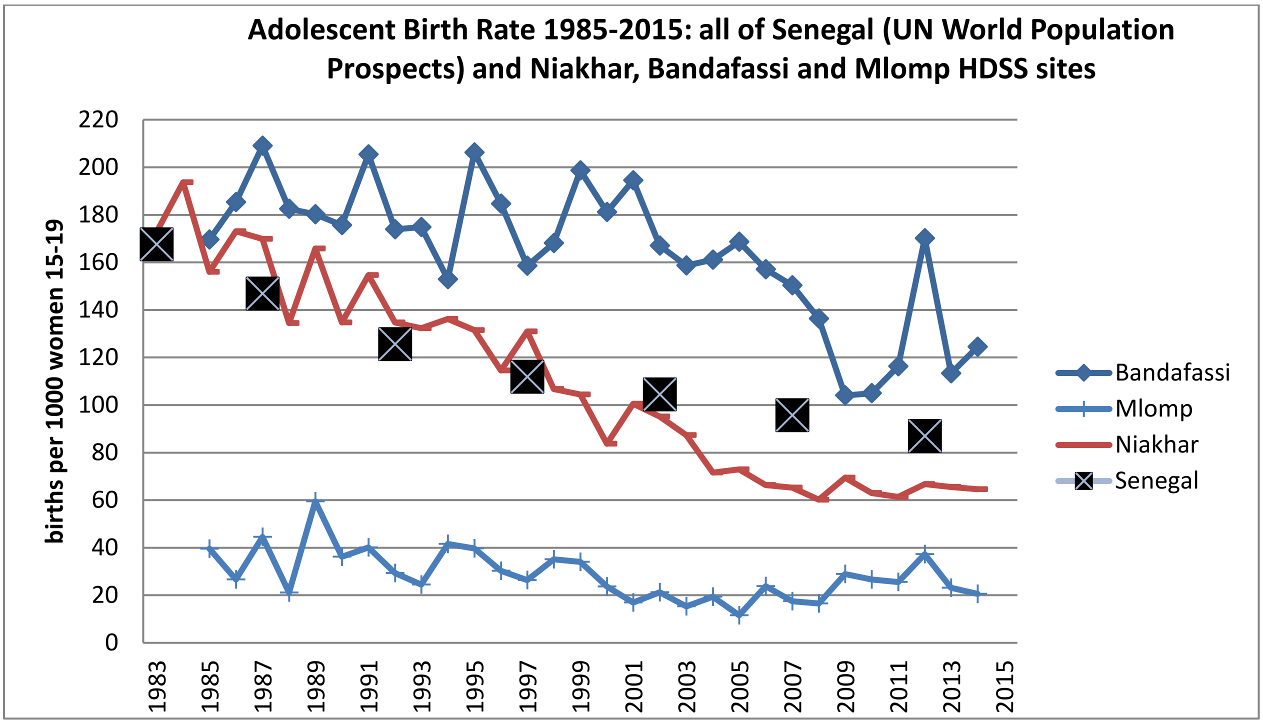

Figure 4

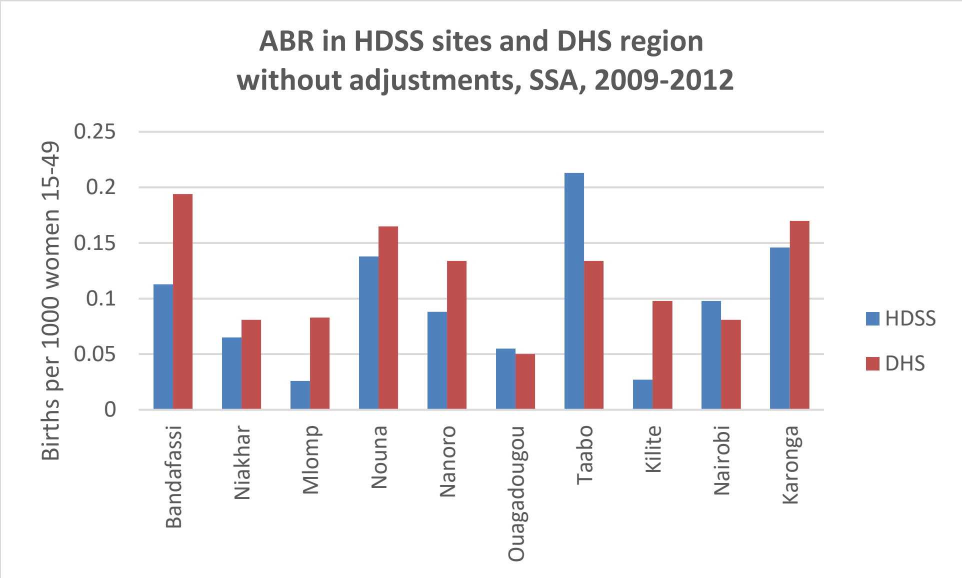

Figure 5