Does pregnancy follow up improve reliability of under five mortality estimates in Health and Demographic Surveillance Systems? Insights from Bandafassi and Niakhar (Senegal)

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Abstract

Pregnancy registration has been part of most HDSSs routine data collection in order to improve estimates of early life mortality. However, little research has investigated the effect of this strategy on mortality estimates. We used logistic regressions and cox models to look at associated factors of pregnancy reporting, and its net effect on the age patterns of under five mortality in Bandafasi and Niakhar HDSSs (Senegal). Reporting of pregnancies depends on frequency of follow up and on maternal factors such as maternal age at birth , ethnic group. In relation to mortality estimates in children, no standard pattern appeared according to the status of pregnancy registration. Particularly, neonatal mortality can be higher (Niakhar) or lower (Bandafassi) for children born from followed up pregnancies. The results suggest that various factors interact with pregnancy follow up so that further investigation is needed to capture its net effect on mortality estimates.

Background

In the absence of functional civil registration systems in low and middle income countries, trends and levels of mortality are mainly derived from censuses and large scale surveys such as Demographic and Health Surveys (DHSs) (Mikkelsen et al., 2015; Moultrie et al., 2013). In children in particular, full birth histories collected in DHSs stand now as the main source of data to track progress made in improvement of child survival. Yet, estimates derived from these data are subject to different erros including omission of past deaths and age heaping around one year (Pullum et al., 2017 ; Masquelier et al., 2013). It is then challenging to look at the variation of under five mortality between 0 and 5 years based on these data. This is however crucial in order to steer efforts towards age ranges that lag behind in terms of progress or that are more responsive to health interventions.

In addition to DHSs, Health and Demographic Surveillance Systems (HDSSs) are alternative source of data on child mortality in low and middle income countries. Most of HDSSs share similarities in terms of methodology (Sankoh et al., 2012). Following an initial census in the area under surveillance, fieldworkers conduct regular household update rounds, and register vital events (births and deaths, migrations and marriages). Because these data are prospectively collected, HDSS are supposed to yield more reliable estimates of mortality compare to full birth histories that are collected retrospectively in DHSs. However, HDSS based estimates cannot be extrapolated beyond the geographic area under surveillance. Instead of providing estimates at the national level, HDSS are mostly used as a "gold standard" to assess the reliability of mortality indicators derived from other sources of data. For example, based on data from three rural HDSSs of Senegal, Masquelier et al. (2016) showed that recent household deaths collected in censuses of the country provided plausible estimates of under five mortality. In Bangladesh, a validation study of full birth histories based on the Matlab HDSS pointed out a moderate underreporting of infant deaths, and a more pronounced underreporting of neonatal deaths (Espeut et al.; 2015). However, a recent study in Guinne-Bissau concluded to upwards biais of neonatal mortality indicators derived from full birth histories because of various reporting errors (Li et al, 2018).

Of particular importance, most HDSS operate pregnancy monitoring to limit the omission of neonatal deaths. At each visit, fieldworkers inquiry on the pregnancy status of women in reproductive age. Pregnant women are then followed up until the end of pregnancy and the outcome is registered. This strategy is supposed to improve estimation of neonatal mortality since women may conceal neonatal deaths because of childbearing norms (Haws et al., 2010). Surprisingly, a comparison of different methods to track pregnant women and pregnancy outcomes in Uganda showed that in the Iganga-Mayuge HDSS less pregnancies and pregnancy outcomes were reported through the routine data collection compared to a pregancy histories survey conducted during the recent period (Kadobera et al., 2017). These results may call into question the reability of mortality estimates derived from HDSSs.

The objective of this paper is twofold. First, we documented the magnitude and factors associated with pregnancy follow up across different HDSSs. Second, we looked at the net effects of this follow up on the measurement of neonatal mortality. The study has several implications in terms of recommendations on the frequency of follow up in HDSSs and most importantly on the accuracy of mortality indicators. Up to now, little research has assessed how pregnancy follow up affects mortality estimates in HDSSs.

Data and methods

Data used in this paper came from the Bandafassi and the Niakhar HDSSs, both located in Senegal (Delaunay et al., 2013; Pison et al., 2014). The Bandafassi HDSS was set up in a rural area of south-eastern Senegal in 1970. The population under surveillance is spread over 42 villages and was around 14,000 inhabitants in 2015. Data have been collected through annual rounds since the inception of the HDSS. The Niakhar HDSS was establised in 1962 in a rural area at 135 km of Dakar, the capital city of Senegal. The followed up population of the HDSS was around 45,000 individuals in 2015 that live in 30 villages. Contrasting with the Bandafassi HDSS, the frequency of follow up has evolved over the years in Niakhar. Vitals events were updated annualy from 1962 to 1987, weekly during the period 1987-1997, every three months from 1997 to 2007, and every four months since then. The two HDSS have been conducting pregnancy monitoring to better capture neonatal mortality. However this information is only available for the periods 1990-2007 and 2011-2013 in Bandafassi, and from 1984 to 2006 in Niakhar.

Under five mortality has decreased over the years in the two HDSSs thanks in part to large-scale immunizations campaigns and the introduction of malaria-control policies in Senegal. However, children living in Bandafassi have been affected by higher mortality compared to Niakhar (Delaunay et al., 2013; Pison et al., 2014). For example, under five mortality was estimated at around 48 per 1000 in Niakhar and 89 per 100 in Bandafassi during the period 2010-2015.

The analyses presented here were restricted to the periods for which data on pregnancies were available for each HDSS. Limiting the analysis on children born under surveillance for data quality issues, we first drawed the age patterns of under five mortaliy rates according to either the child was born from a mother for whom the pregnancy was recorded or not before delivery. Second, to better understand the results we assessed the effects of differents factors that can affect the reporting of pregnancy to fieldworkers. These factors include the frequency of follow up (only for Niakhar), ethnic group and age group of the mother at birth, and geographical place of delivery (within the HDSS or not). Finally, we used a cox model to capture the net effect of pregnancy follow up on neonatal mortality.

Preliminary results

In the Bandafassi HDSS, the proportion of births whose pregnancy was recorded at the previous round has remained stable over the years and was estimated at around 32%. This is likely explained by the fact that since its inception rounds of data collection were conducted annually. Contrasting with Bandafassi, in the Niakhar HDSS the magnitude of pregnancy monitoring raised to 45% at the same frequency of follow up (annual round). This figure increased to 53% when households were visited every three months (1998-2006) and to 90% during weekly visits.

Table 1 shows odds ratios for different variables associated with pregnancy reporting in the two HDSSs. Whatever the HDSS, young mothers were less likely to report their pregnancy compared to older ones. In addition, mothers who delivered within the HDSS were more likely to have their pregnancy registered before giving birth compared to women who deliveded outside the HDSS. The latter women were likely to be absent during household visits. For the particular case of Bandafassi, women of the « Bedik » ethnic group were less likely to report their pregnancy compared to women of the « Malinke » and « Peul » ethnic groups. These

results may be explained by different cultural norms accross ethnic groups. Finally, the case of Niakhar supports the idea that a closer period of visits lead to a better reporting of pregnancy.

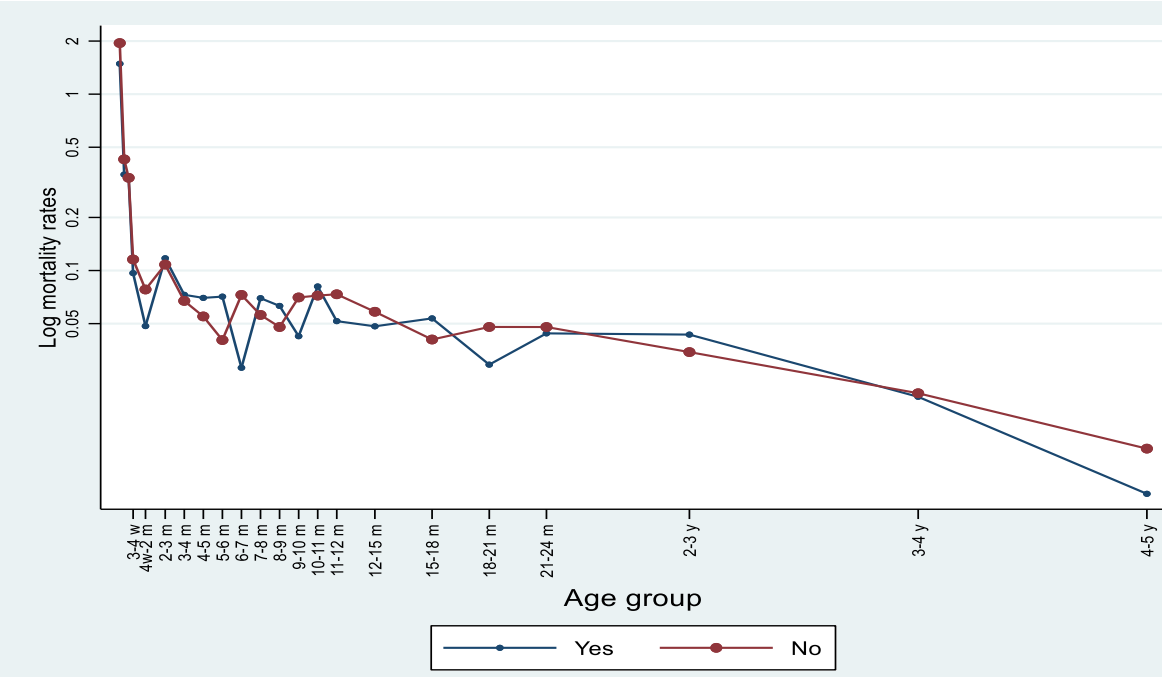
Table 1: Odds ratios of factors associated with pregnancy reporting in Bandafassi (1990-2007; 2011-2013) and Niakhar (1984-2006)

Bandafassi			Niakhar[1]		
Variables		odds ratio	Variables		odds ratio
Place of delivery	Elsewhere	1	Frequency of follow-up	Annualy	1
	Bandafassi	2.1***		Every three months	1.4***
Ethnic group	Bedik	1		Weekly	11.3***
	Malinke	1.2**	Maternal age at birth	15-19 y	1
	Peul	1.2***		20-29 y	1.3***
Maternal age at birth	15-19 y	1		30-39 y	1.7***
	20-29 y	1.1**		40-49 y	1.4***
	30-39 y	1.2**	Constant		0.6
	40-49 y	1.2*			
Constant		0.2***			

*** p<0.01, ** p<0.05, * p<0.1

Figure 1 presented the age patterns of Under five mortality according to whether the child was born from a followed up pregnancy in Bandafassi HDSS. Mortality rates were computed by week until the fourth week, by month until the first anniversary and by year until the fifth anniversary. Overall, the two curves overlap from birth to the fifth anniversary. However, neonatal mortality rate was significantly higher (p.value<0.05) for children born from mothers whom pregnancy was not followed up (table 2). This difference in an unexpected direction is surprising but tend to be less significant with the inclusion of other variables in the model.

Figure 1 : Age patterns of Under five mortality according to whether the child was born from a followed up pregnancy in Bandafassi HDSS (1990-2007 ; 2011-2013)



The age patterns of Under five mortality according to whether the child was born from a followed up pregnancy has evolved over the years in the Niakhar HDSS (Figure 2). In the early periods (1984-1997) there was no significant differences (p.value>0.05) in neonatal and infant mortality rates according to the status of pregnancy monitoring, despite the change in frequency of follow up. But child mortality particularly was significanly lower for children born from followed up pregnancies. In the recent period, however, neonatal mortality was significantly higher (60%) for children born from followed up pregnancies, as we would expect. The siginificant relation between pregnancy follow up and neonatal mortality presented in table 2 came from the recent period. However, the relation became less significant with the inclusion of other variables in the model.

Figure 2 : Age patterns of Under five mortality according to whether the child was born from a followed up pregnancy and by period in Niakhar HDSS (1984-2006)

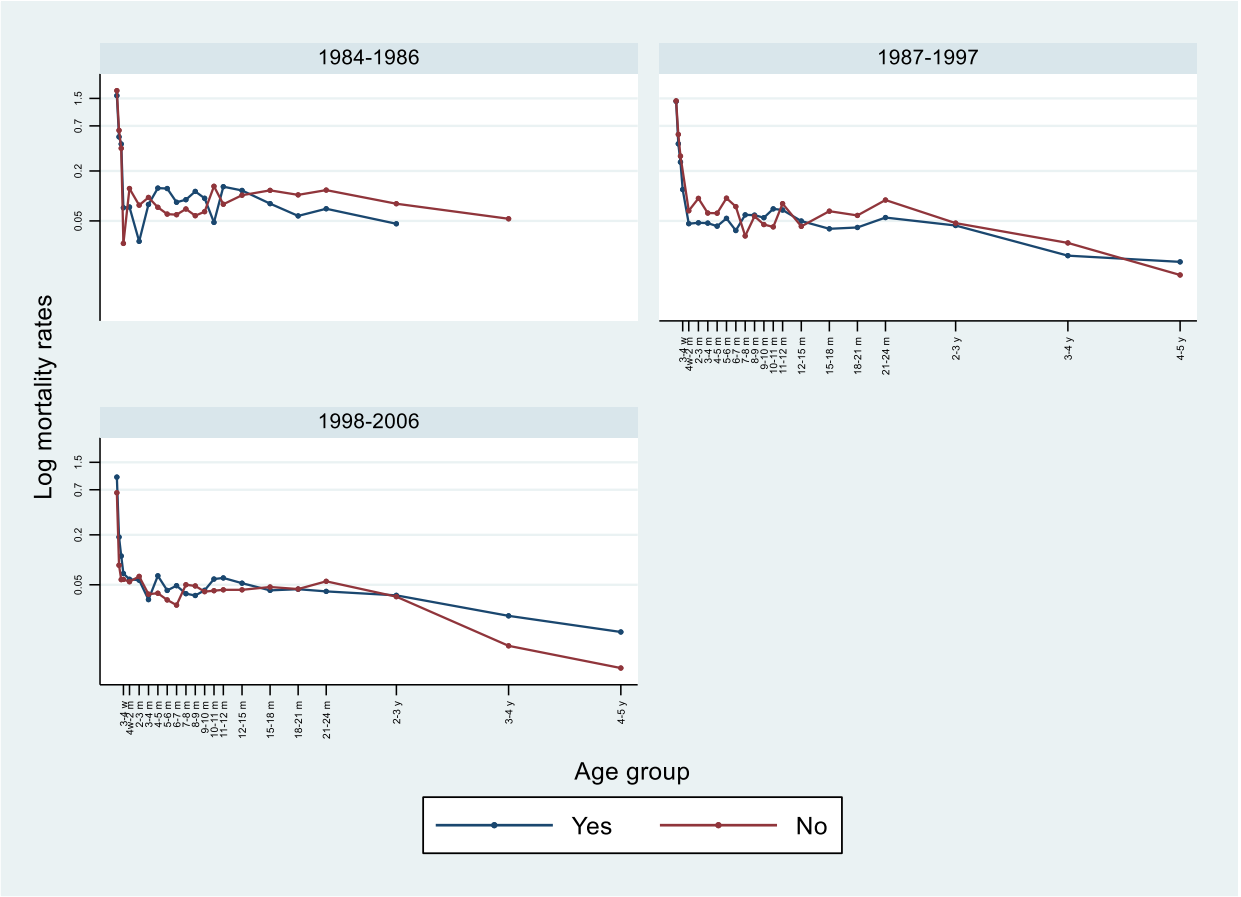


Table 2 : Net effect of pregnancy follow up on mortality in Bandafassi and Niakahar (Hazard ratios)

Bandafassi				Niakhar			
Variables		Unadjusted	Adjusted	Variables		Unadjusted	Adjusted
Pregnancy follow up	No	1	1	Pregnancy follow up	No	1	1
	Yes	0.8**	0.8*		Yes	1.3***	1.2*
	Elsewhere		1		Annualy		1
Place of delivery	Bandafassi		0.7	Frequency of follow up	Every three months		0.3***
	Bedik		1		Weekly		0.5**
Ethnic group	Malinke		0.8		15-19 y		1
	Peul		1	Maternal age at birth	20-29 y		0.6***
	15-19 y		1		30-39 y		0.6***
Maternal age at birth	20-29 y		0.6***		40-49 y		0.8
	30-39 y		0.6***				
	40-49 y		0.7				

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