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Successes and failures in the fight against child mortality in Sub-Saharan Africa: Lessons from Senegal, a country with low AIDS prevalence

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Abstract (long)

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INTRODUCTION

Life expectancy at birth worldwide has increased considerably over the last century, due mainly to a marked reduction in child mortality. This has also been the case in sub-Saharan Africa, although this region has the highest mortality rates in the world.

Over the last 60 years, infant mortality (1q0) has declined in sub-Saharan Africa, falling from a level of roughly 180 per 1,000 in 1950-54 to 84 per 1,000 in 2005-2009 as indicated by the United Nations Population Division (2011). According to the UN statistics, the decline occurred at a steady rate until the late 1980s, slowed down and even stagnated during the 1990s, and then resumed during the last decade.

Although the decline in sub-Saharan Africa over these sixty years seems high in absolute figures, it has been considerably slower than in Asia. Infant mortality in 1950-54 was at the same level in Asia as in sub-Saharan Africa (around 180 per thousand according to UN data), but between 2005-2009 it was no more than 41 per thousand there, as against 84 per thousand in Africa. The rate of fall was slower in Africa than in Asia during the entire period.

The mortality decline in Africa since 1950 can doubtlessly be attributed to the same causes as in other parts of the world where mortality was very high. Progress in infrastructure and in health programmes led to the spread of vaccination and effective treatments and to the consequent reduction in the infectious diseases that were chiefly responsible for child deaths. Socio-economic progress, especially in education, played an important part here in enabling all population groups to benefit from progress in health.

It appears that the stagnation of mortality over the 1990s seen in sub-Saharan Africa but not in Asia was due to a phenomenon unique to Africa: the AIDS epidemic being the first to come to mind. The disease is certainly highly prevalent in Sub-Saharan Africa, with important effects on mortality. The development of chloroquine resistance leading to many malaria deaths may also have contributed to the slower mortality decline in Africa at the end of the twentieth century. Substantial efforts have been made over the last decade to fight these two diseases. It appears that the resumption of the child mortality decline at the beginning of the twenty-first century is a consequence of this effort.

The question remains as to whether the principal factor accounting for the halt in the reduction of child mortality and the recent resumption of progress is linked to AIDS and malaria, or whether other diseases or factors are also involved.

To better understand the reasons for the irregular pace of child mortality decline in Sub-Saharan Africa since the mid-twentieth century, particularly the rapid fall in child mortality from the 1950s to 1980s, the subsequent ten-year halt in progress, and the recent resumption of decline, we shall examine in detail the case of Senegal. This country offers the following four advantages:

- child mortality has evolved there in a way that is typical of the whole region, and especially includes a rapid fall followed by a ten to fifteen-year pause and afterwards a return to rapid decline;

- up to the present, the country has not been severely affected by AIDS: the proportion of persons aged 15-49 infected by HIV is estimated at 0.7% and has not changed much between 2005 and 2010 (Ndiaye et Ayad 2006 ; ANSD 2011).

- sources of information there are relatively numerous and the evolution of child mortality on a national scale can be tracked quite accurately;

- the country also possesses three demographic surveillance sites in rural areas that have monitored child mortality and its causes in detail over a long period.

CHILD MORTALITY DECLINE IN SENEGAL SINCE 1945

Ten surveys supply data that can be used to estimate the national level of child mortality in Senegal. We use here as an indicator of child mortality the probability that a newborn will die before the age of 5 (5q0). Figure 1 shows 5q0 estimates for Senegal since 1946. According to these data, in the 60 years following the end of the Second World War, 5q0 decreased nearly six-fold. The decline appears to have occurred rather slowly until the early 1970s, with a 25% drop in 25 years (from 373 per 1,000 in 1946 to 280 per 1,000 in 1970), and to have accelerated thereafter, with 5q0 falling by 75% in 35-40 years (down to 70 per 1,000 in 2008). During this second period of rapid fall, the decline however appears to have halted at the turn of the 1980s and the 1990s, and mortality to have stagnated at the level of 140 per thousand during the 1990s. At the end of the 1990s or the beginning of 2000s, the decline resumed with 5q0 falling rapidly by 50% in the next 10 years (to a level of 70 per 1,000 during the second part of the 2000s).

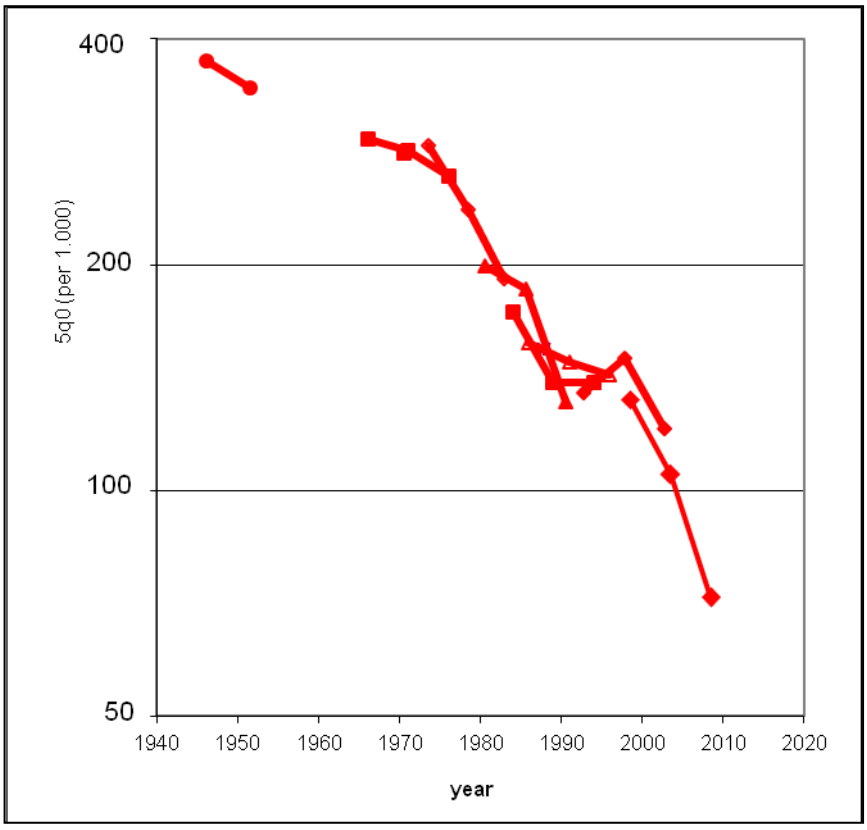
The trend shown by figure 1 raises several questions that are addressed in the paper:

1 – are the trends shown by figure 1 real or artefacts ? In particular, did mortality decline really level off during the 1990s ? The type and quality of data gathered varies across the surveys, as do the methodologies employed. However we chose to focus on a simple, robust indicator of child mortality, 5q0. The different measurements are fairly consistent. And a similar halt is also observed at the same period in the three demographic surveillance sites in rural areas (see below).

2 – what are the factors behind the decline in child mortality in Senegal ? In this country, as in most other countries, it is probably related to economic development and the improvement in health conditions which took place after the end of the Second World War. In the paper we try to determine more precisely what has been the contribution of different factors: (1) changes in the epidemiological context (with new or resurgent infections), (2) the development of health infrastructures (number of hospitals, maternity clinics, health personnel, etc.) and their distribution across the country, (3) health programmes (vaccinations, programmes to control particular diseases – HIV infection, malaria, etc..). We examine in

particular whether the changes in the pace of child mortality decline (acceleration, or slowing down, stagnation or reversal) are concomitant with changes in the epidemiological context or in health infrastructures and programmes.

Figure 1. Child mortality (5q0) trends in Senegal between 1945 and the period 2006-2010 (5q0: probability for a new-born child of dying before age 5)



Sources :

- Hill, 1989
- Sénégal, 1971.
- Rutstein, 1984
- Ndiaye et al., 1988 (Enquête démographique et de santé, 1986)
- Pison et al., 1994
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- Ndiaye et al.,1997 (Enquête démographique et de santé III, 1997)
- Sow et al.,2000 (Enquête sénégalaise sur les indicateurs de santé, 1999)
- Ndiaye et al.,2006 (Enquête démographique et de santé IV, 2005)
- ANRS, 2011 (Enquête démographique et de santé à indicateurs multiples, 2010-2011)

3 – to better understand the reasons for the successes and failures of efforts to lower child mortality in Senegal, we examine in detail the changes in causes of death. As there are no sufficiently reliable statistics on causes of death at the national level, we examine changes in three Senegalese rural areas: Bandafassi, Mlomp and Niakhar. The populations of these areas have been monitored for more than twenty five years (Pison et al, 1993 ; Pison et al., 1997, Delaunay et al., 2001). Causes of death have been determined using verbal autopsy method. Changes in child mortality and causes of child death have been documented precisely in these populations. As these demographic surveillance sites are located in very different areas of the country, the mortality differences between them give an idea of the total geographic variations across the country.

In the following part of this abstract, we focus on some of the results of our study.

SPREAD OF VACCINATION, ONE MAJOR CAUSE OF THE DECLINE IN CHILD MORTALITY

Initiated in Senegal in 1981, the Expanded Programme for Immunization (EPI) was designed to extend vaccination coverage to rural areas, which were at that time not well served, and to improve coverage in urban areas. Its objective was to protect children against seven diseases: tuberculosis, diphtheria, tetanus, pertussis, polio, measles and yellow fever.

Since the EPI first began, its activities have varied in intensity, with periods of accelerated efforts followed by periods of lesser activity. Each acceleration led to the training and mobilization of administrative and health personnel, media information campaigns (especially by radio), and the provision of new equipment for dispensaries.

The fluctuation of vaccination efforts is reflected by the changing levels of vaccine coverage. The percentage of children aged 12-23 months who were fully vaccinated[1] increased considerably in the second part of the 1980s. Based on data from demographic and health surveys and multiple indicator surveys, it progressed from 21% in 1986 to 49% in 1992. Complete vaccination coverage increased 1.2-fold in the Region of Dakar between 1984 and 1987, and 1.5-fold in the other urban areas (Pison et al., 1995). The impact of the acceleration of the EPI in 1987 was therefore relatively small in the towns. In rural areas, on the other hand, where coverage was particularly low in 1984, there was a threefold increase in 1987, so that the gap in coverage levels compared to the towns was almost closed in one go.

Vaccination coverage diminished rather than continuing to increase in the 1990s. The proportion of children between the ages of 12 and 23 months who were fully vaccinated

[1] That is, vaccinated against seven diseases: tuberculosis, diphtheria, tetanus, pertussis, polio, measles and yellow fever.

decreased from 49% in 1992 to 42% in 1999. Subsequent to the resumption of vaccination efforts that year and in the 2000s, vaccination coverage rose again, with respectively 59% and 63% of children between the ages of 12 and 23 months who were fully vaccinated in 2005 and 2010 (Ndiaye et Ayad 2006 ; ANSD 2011).

Child mortality, as we have seen above, declined continuously in Senegal between World War II and the late 1980s. In 45 years, from 1945 to 1990, the probability of dying before the age of 5 was reduced by two thirds, from approximately 400 per 1,000 to 140 per 1,000. The decline accelerated in the late 1970s and early 1980s, when a new health policy oriented towards primary health care was initiated. The implementation of the Expanded Programme for Immunization (EPI) probably contributed significantly to the accelerated decline along with the development of health infrastructures in the various regions (Pison et al., 1995). The cessation of the fall in child mortality at the watershed between 1980 and 1990 coincided with a pause in improvements to the health infrastructures and programmes. In particular, the EPI, which had greatly advanced during the 1980s, then marked time, with a decrease in vaccination coverage during the 1990s.

The development of health infrastructures and programmes have been essential for reducing child mortality, especially in rural areas. The timing of this reduction suggests that the immunization programme played a leading role in the acceleration of the decline in the 1970s and 1980s. The decrease of vaccination coverage is probably one factor explaining why the decline in child mortality ceased thereafter in the 1990s. And the renewal of vaccination efforts at the end of the 1990s and the beginning of the 2000s, one of the reasons for the renewed mortality decline thereafter.

MALARIA CONTROL PROGRAMMES

Malaria is endemic in Senegal and is one of the major causes of child mortality. Antimalaria programmes have for long been based on prevention using chloroquine-based chemoprophylaxis (called ‘chloroquinization’), and treatment also based on chloroquine, which was the cheapest antimalarial drug. This policy was brought into question following the emergence of chloroquine-resistant strains of the parasite at the end of the 1980s and their rapid transmission across the country in the years after. It is only in 2003 that a new treatment combining amodiaquine + sulfadoxine/pyrimetamine was introduced as a replacement for chloroquine for the first-line treatment of malaria in all health facilities in Senegal. In 2006, this treatment was replaced by another one combining artesunate + amodiaquine, known as ACT (Artemisinin-based Combination Therapy). A program of mass distribution of insecticide-treated nets was also launched in 2008 throughout Senegal.

Trends in the proportion of children benefiting from these new malaria control methods can be retraced using the national surveys conducted since 2005 ((Ndiaye et Ayad 2006 ; Ndiaye et Ayad 2007 ; Ndiaye et Ayad 2009 ; ANSD 2011). According to the declarations of the persons interviewed, the proportion of household which had at least one mosquito net increased from 38% to 72% from 2005 to 2010-2011, and the proportion of those who had at least one insecticide-treated nets, from 27% to 63%. The proportion of children under age 5

who slept under an ITN the night preceding the survey increased from 10% in 2005 to 35% in 2010-2011.

The treatments received by the children also changed. Among those who had a fever during the two weeks preceding the survey, in 2005, 12% took antimalarial drugs rapidly, the same day or the next day (6% in 2010-2011). The use of chloroquine was still frequent in 2005 (two thirds of treatments the same day or next day), this drug is much less frequently used in 2010-2011 (in less than one sixth of cases). In 2011-2011, children who had antimalarial drugs rapidly received ACT in half of the cases.

The new malaria control policy has changed progressively the behaviours and the treatments and this had probably an important impact on child mortality in the country, as shown by changes observed in the three rural demographic surveillance sites.

CHANGES IN CHILD MORTALITY AND CAUSES OF DEATH RECORDED IN THE THREE RURAL DEMOGRAPHIC SURVEILLANCE SITES OF SENEGAL

The paper will provide detailed estimates of mortality rates by age, sex, cause of death, and period, in the three Senegalese demographic surveillance sites, and will comment on the evolution over the last 25 years. In this abstract we comment rapidly some results.

In the three Senegalese demographic surveillance sites, child mortality declined rapidly in the 1980s. In all of them the fall was interrupted in a similar fashion in the late 1980s, and child mortality then remained at about the same level during the 1990s (250 per thousand) at Bandafassi and Niakhar, and even rose slightly in Mlomp, from 88 per thousand in 1985-89 to 111 per thousand in 1995-99. Afterwards, mortality started to decline again rapidly. The pause therefore occurred on the three sites as it did in the country as a whole.

The analysis of trends in causes of death provides some insights into the factors behind theses changes. In this abstract, we provide some results on two major killers of children : measles, a rapidly declining cause of death, and malaria, a cause which rose at the turn of the 1990s and the 2000s, before decreasing thereafter.

Measles is a disease rather easy to diagnose in rural Senegal using verbal autopsy. Deaths from measles declined sharply in the 1980s in the sites, and this marked regression of one of the main causes of child mortality was the most spectacular consequence of introducing vaccinations in these populations. In Bandafassi for example, vaccinations were introduced in 1987 and they had a major impact. Before then, measles was responsible for a high proportion of deaths. Among children from 1 to 20 months old it accounted for about 1 out of every 7 deaths (14% in 1970-1979 and 15% in 1980-1986), and of 1 out of every 3 (35% and 30% respectively) among children aged 21 to 59 months, thus making it the primary cause of death. From 1987, over the period 1987-1993, measles was however responsible for only 3% and 5% of deaths at these ages (Pison et al., 1995 ; Desgrées du Loû et al. 1996). The lessening of vaccination coverage in the 1990s led to a slight rise in deaths

from measles in Bandafassi, but this was far from the extremely high pre-vaccination levels. In Niakhar, it remained at the same level in the 1990s without further decreasing.

Deaths from malaria are more difficult to diagnose than those from measles. This disease cannot be identified with any certainty through the verbal autopsy method, because of the difficulty in distinguishing it from other diseases that also cause fever. So here, “malaria” is a broad category that includes “true malaria” but also “unspecified fever”. In Mlomp, however, malaria-related mortality could be retraced with some accuracy, because many of the children who died following bouts of fever had sought advice from the local health centre, where biological tests (using thick blood films) were made in order to ascertain whether the malaria diagnosis should be confirmed.

In Mlomp, malaria-related mortality was relatively low until 1991 (five times lower than Bandafassi and eight times lower than Niakhar); a sign that the fight against malaria organized by the health centre in the 1970s and 1980s was successful. Malaria-related mortality rose sharply between 1991 and 1993, and has subsequently remained at higher levels. During the periods 1985-1991 and 1993-2000, malaria increased 7-fold in Mlomp, 2.5-fold in Bandafassi and 2-fold in Niakhar. This rise was largely attributable to the appearance and spread of malaria strains in the late 1980s and early 1990s that were resistant to chloroquine, the anti-malarial widely used in Senegal both preventively and curatively up to the present day (Trape et al., 1998), and which had enabled malaria-related mortality to be drastically reduced in Mlomp from 1975 onwards. This unfavourable trend in deaths from malaria is one of the reasons why overall child mortality stagnated in Bandafassi and Niakhar in the 1990s and rose again in Mlomp.

Following the change in malaria control policy in the country in 2003, malaria-related mortality declined in the three areas as this will be shown in the paper.

LESSONS FROM SENEGAL

Mortality has declined in Sub-Saharan Africa over the last 60 years but the decrease has not been regular. It has accelerated over some periods, as during the last decade, and slowed down during others. Mortality has even increased during some periods, as in the 1990s. This was not solely attributable to AIDS. In order to determine any other diseases or factors that also played a part, Senegal was chosen for study – a country with very low AIDS prevalence but where trends in child mortality have closely resembled those of the whole region. In addition, Senegal has the advantage of possessing relatively numerous information sources available for tracing the evolution of child mortality on a national scale, as well as three demographic surveillance sites in a rural area where child mortality could be followed and the causes of deaths studied in detail over almost 25 years.

The decline in child mortality in the 1970s and 1980s was attributable to the reduction in deaths from infectious diseases, thanks largely to vaccinations. The situation reversed in the 1990s due to a combination of several factors: the development of chloroquine resistance leading to many malaria deaths; inefficiencies in the health services leading to failures in

basic services, including vaccination; and an adverse economic climate. Mortality decline resumed rapidly in the 2000s due also to a combination of factors, among which the renewal of vaccination efforts and investments in anti-malaria programs played an important role. These factors are common to many countries in Sub-Saharan Africa and explain why many of them experienced the health crisis in the 1990s and the renewal of progress in the 2000s, irrespective of whether or not they were hit by the AIDS epidemic. Child mortality will continue to decline rapidly in the coming years if there is an increased attention to diseases and conditions responsible for early deaths, in particular those in the neonatal period, and if special efforts are made to reduce these causes of death.

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