

## **Adult Mortality in a Rural Area of Senegal: Trends and Causes of death in Mlomp**

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Adult mortality in developing countries, particularly in sub-Saharan Africa is difficult to estimate because of the lack of reliable data. This is true for the overall level of mortality (Hill and Choi, 2005) and also for mortality due to specific causes of death. In this paper, we provide original estimates of adult mortality in a rural population of Senegal which has been monitored for twenty years. We restrict our study to the mortality of adults between 15 and 60 years old.

### **1. Population and data**

#### *The demographic surveillance system of Mlomp*

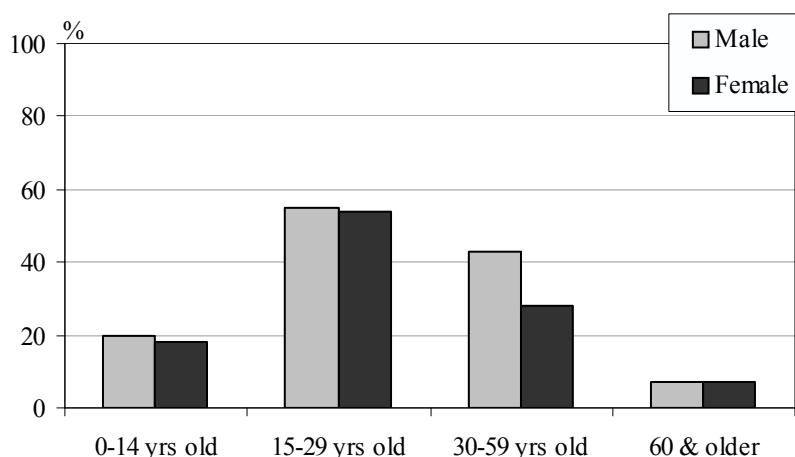
The demographic surveillance system started in 1985 in Mlomp with an initial census listing the inhabitants of the area and recording information on the union and reproductive histories of adult women. The demographic events (births, deaths, migrations and unions) are recorded yearly. Furthermore, for persons who have died, detailed information about symptoms and diseases prior to death are obtained from a close relative through verbal autopsies. On the basis of these reports, completed by medical information provided by local health institutions, physicians establish the cause of the death whenever possible (Pison *et al.*, 2002).

#### *Location of Mlomp and population characteristics*

Mlomp is located in south-west Senegal, in the Casamance area. At the end of 2004, the population totaled 8,000 persons. The population is rural. Most people belong to the Diola ethnic group. They are animist or Catholic. The climate is subtropical with alternating dry and rainy seasons. The local health care system has been functioning since the early 1960s, with a dispensary and a maternity clinic.

#### *Economic resources and migration*

Rice cultivation is the main local economic activity during the rainy season. The majority of male adults migrate during the dry season to earn money through palm wine harvesting or fishing. So, during the dry season, which is a period of low agricultural activity in the area, most people leave Mlomp: almost 60% of the persons aged between 15 and 30, and more than 40% of men older than 30. Migration before age 15 corresponds mostly to family migration (figure 1).

Figure 1. Proportion of persons who are not in Mlomp during the dry season, by age groups (Mlomp, January 1<sup>st</sup> 2005)

Source: Mlomp database, 2005.

## 2. Adult mortality level

### *Relatively low child mortality in Mlomp for a rural area*

During the period 1985-2004, life expectancy at birth reached 57 years for men and 65 years for women (table 1). That is high for a rural area of sub-Saharan Africa. One explanation for this is the relatively low mortality of children aged under 5, whose probability of dying was 100‰ during the period 1985-2004, compared with a risk of more than 170‰ in rural Senegal in 1989-1998 (Sow *et al.*, 1999). This is particularly due to the local health care system (Pison *et al.*, 1993a).

Table 1. Mortality level, by sex (Mlomp, 1985-2004)

Mlomp	Men	Women	Together
Life expectancy at birth (in years)	56.8	64.9	60.5
Uncertainty Interval	55.5-58.2	63.6-66.3	59.6-61.5
${}_5q_0$	0.112	0.089	0.101
Uncertainty Interval	0.098-0.128	0.077-0.104	0.091-0.111
${}_{45}q_{15}$	0.310	0.167	0.244
Uncertainty Interval	0.277-0.346	0.139-0.199	0.222-0.268

Source: Mlomp database, 2005 (p=95%).

### *Adult mortality: high for men and low for women*

Concerning adults, the probability of dying between age 15 and 60 is near 0.250 for both sexes, but the male mortality level is twice the female one (Table 1). Though infant mortality levels are relatively well documented, even in rural Senegal, that is not true for the adult mortality which is estimated with indirect methods (mostly based on census or DHS data). With the last available census data in 1988<sup>1</sup>, the probability of dying between age 15 and 60

<sup>1</sup> Data from the last census conducted in 2002 are not yet available.

was estimated with the number of deaths in the last year in the households. A probability of 0.300 was obtained for men and 0.170 for women (Pison *et al.*, 1995). We assume that adult mortality is higher in rural areas, as has already been observed for children (Timæus, 1993). In Niakhar and Bandafassi, two other demographic surveillance sites located in rural Senegal, the probability of dying before age 60 for adults older than 15 is respectively 0.291 and 0.236 for men and women in the first site and 0.300 and 0.285 in the second one (Lévi *et al.*, 2004; Guyavarch, 2003). We can conclude that the mortality level is relatively high for men and particularly low for women in Mlomp for a rural area of Senegal.

### *Adult mortality trends*

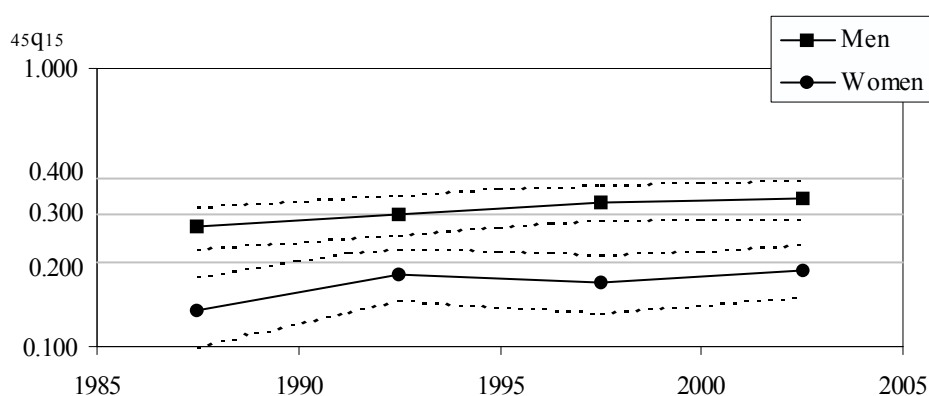
Since the beginning of the demographic surveillance in 1985, the adult mortality level has increased (table 2; figure 2). In the late 1980s, the probability of dying between the ages of 15 and 60 was 0.269 among men, 0.134 among women. In 2000-2004, it was respectively estimated at 0.339 and 0.189. The increase has been continuous in the male population over the twenty years of observation; it became more pronounced in the beginning of the early 1990s for women. Analysis of the causes of death helps to shed light on the reasons for these levels and trends.

Table 2. Mortality level between 15 and 60, by sex and period (Mlomp, 1985-2004)

$_{45}q_{15}$	1985-1989	1990-1994	1995-1999	2000-2004
Men	0.269	0.300	0.329	0.339
Uncertainty Interval	0.226-0.319	0.252-0.355	0.282-0.381	0.289-0.394
Women	0.134	0.182	0.170	0.189
Uncertainty Interval	0.100-0.178	0.146-0.227	0.134-0.215	0.151-0.234

Source: Mlomp database, 2005 (p=95%).

Figure 2. Trends of adult mortality ( $_{45}q_{15}$ ), by sex (Mlomp, 1985-2004)



Source: Mlomp database, 2005 (p=95%).

### 3. Causes of death between 15 and 60

#### *Verbal autopsy methodology and diagnosis validity*

The causes of death are assessed through verbal autopsies, which are questionnaires administered to a relative of the dead person, and by an interviewer with no medical education. But this methodology leads to some methodological bias. The registered cause is the main one, although death is usually the result of a complex process (WHO, 1975). Two major errors of diagnosis may occur: a wrong cause of death may be diagnosed (specificity), or the true cause may be missed and the death attributed to a cause other than the real one (sensitivity). The sensitivity and the specificity of the diagnosis depend on the cause. For example, an accident is easy to determine, a cancer may be more difficult. Because the adult mortality structure is due mainly to non-communicable disease<sup>2</sup>, causes of death among adults are generally difficult to study with this method (Chandramohan *et al.*, 1994). In Mlomp, health institutions (dispensary and maternity clinic) may also provide precious medical data to the physician in charge of the diagnosis. That increases the specificity of the diagnosis, but the sensitivity is reduced by the large proportion of deaths whose causes are ill-defined: between age 15 and 40, 18% of deaths have ill-defined causes; and after 40, the proportion is 30% (table 3). Except for one exceptional cause of death which is the consequence of the sinking of the boat “Le Joola” in September 2002<sup>3</sup>, sensitivity is not maximum. So we decided to redistribute the ill-defined deaths across all the other causes, proportionally by sex and age group. In this way, the contribution of the defined causes is not modified.

Table 3. Deaths from ill-defined causes between ages 15 and 60, by sex and age group (Mlomp, 1985-2003)

	Age 15-40	Age 40-60
Proportion of deaths from ill-defined causes (%)	18.0	29.5
General symptoms (fever, coma, convulsions...)	4.3	4.4
Other symptoms (related to a specific organ)	6.2	11.5
Sudden death or unknown cause	7.5	13.7
Number of deaths from ill-defined causes	29	54
Total of deaths	161	183

Source: Mlomp database, 2005.

#### *Distribution of causes of death*

Injuries and poisoning account for a large share of male mortality (drownings, falls and persons killed because of the armed conflict in Casamance region). Excluding the deaths from the sinking of the “Joola”<sup>4</sup>, they represent 37% of male mortality, and only 15% of female mortality. Women are victims of maternal deaths (25% of the mortality rate). Neoplasms, and particularly those of the digestive system<sup>5</sup>, constitute 20% of the deaths in this age group for both women and men. Infectious and parasitical diseases are also important (figure 3).

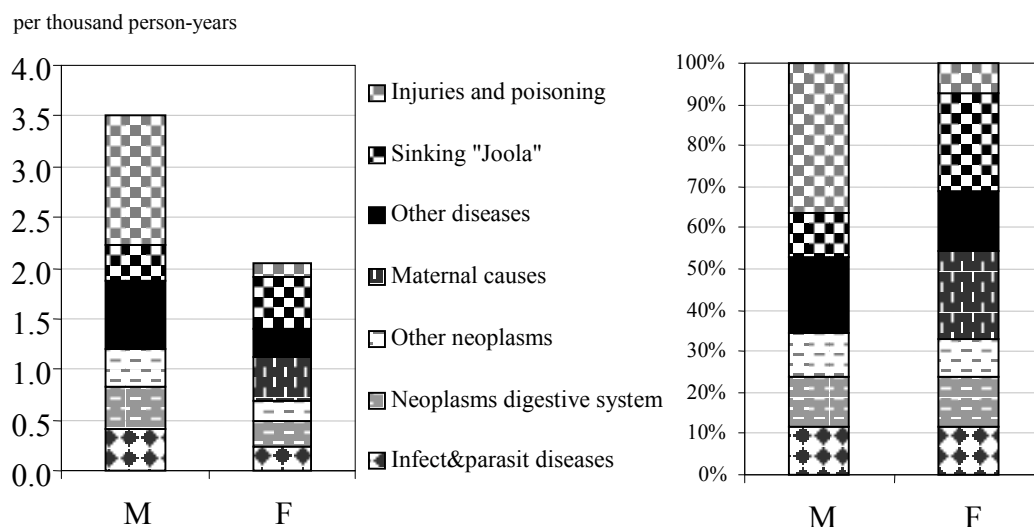
<sup>2</sup> Although, infectious diseases are responsible of many deaths among children in a high mortality context.

<sup>3</sup> In September 2002, the boat “Le Joola” which connected the Casamance region and Dakar, the capital of the Senegal, sanked in the Atlantic Ocean. More than one thousand persons died whose 35 were followed by the demographic surveillance system of Mlomp.

<sup>4</sup> See previous note.

<sup>5</sup> And especially liver cancer for men.

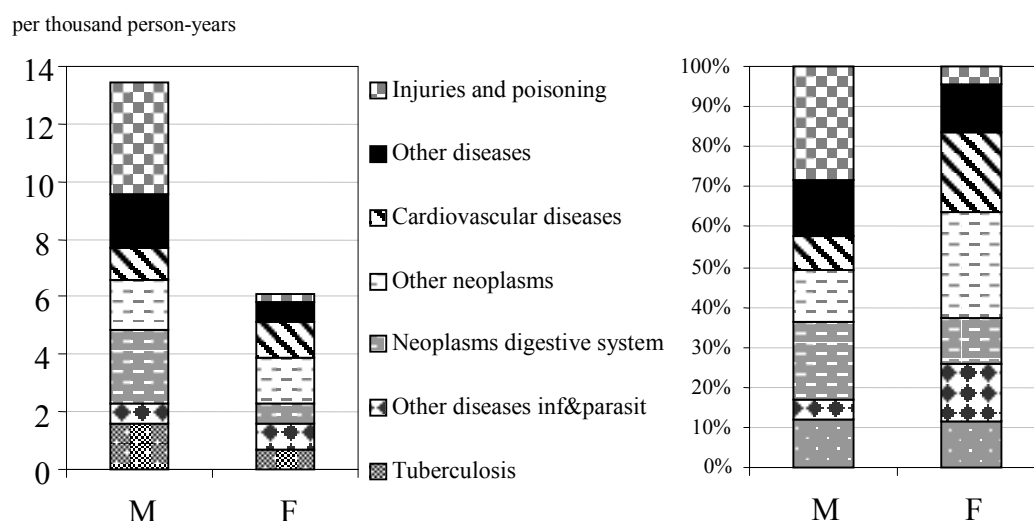
Figure 3. Mortality rate by group of causes between ages 15 and 40, and distribution, for each sex (Mlomp, 1985-2003)



Source: Mlomp database, 2005 (redistribution of deaths from ill-defined causes).

Few cases of tuberculosis are diagnosed before age 40, but this disease becomes relatively important between ages 40 and 60 in Mlomp (12% of mortality). Injuries, and especially, falls from palm trees, account for 30% of male mortality. Neoplasms are the group of causes accounting for the largest share of mortality. All these causes (injuries, neoplasms, and tuberculosis) are responsible for the level that is twice as high among men as women (figure 4).

Figure 4. Mortality rate by group of causes between ages 40 and 60, and distribution, for each sex (Mlomp, 1985-2003)



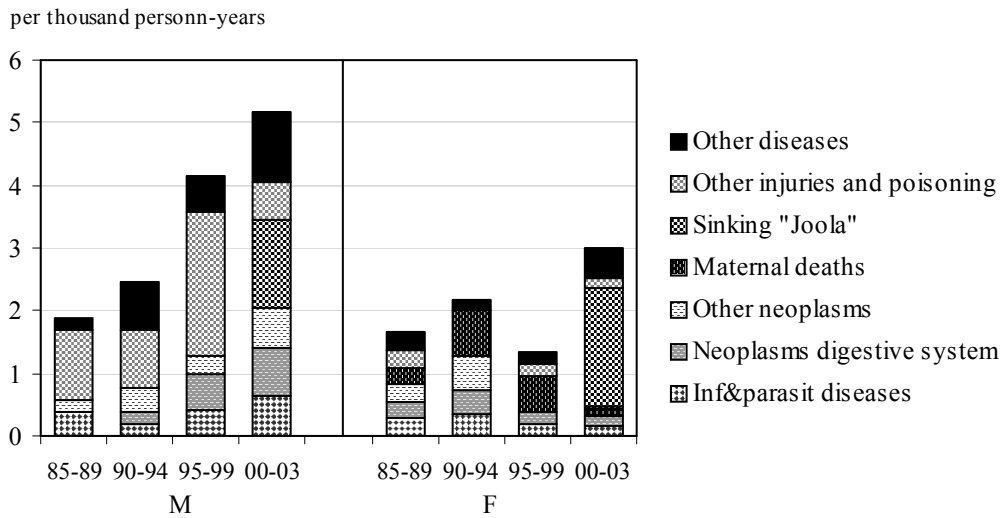
Source: Mlomp database, 2005 (redistribution of deaths from ill-defined causes).

#### *Trends in causes of death*

Between the ages of 15 and 40, the mortality structure has changed differently among men and women (figure 5). The sinking of the “Joola” has strongly marked the most recent period. Among women, the mortality rate due to the sinking of the “Joola” in 2000-2003 (2‰ person-

years) is the total mortality rate observed in the other periods. There is no evidence for trends in female causes of deaths. For men, there was no cancer of the digestive system in late the 1980s, but it increased and the mortality rate due to this category was 0.8‰ in 2000-2003.

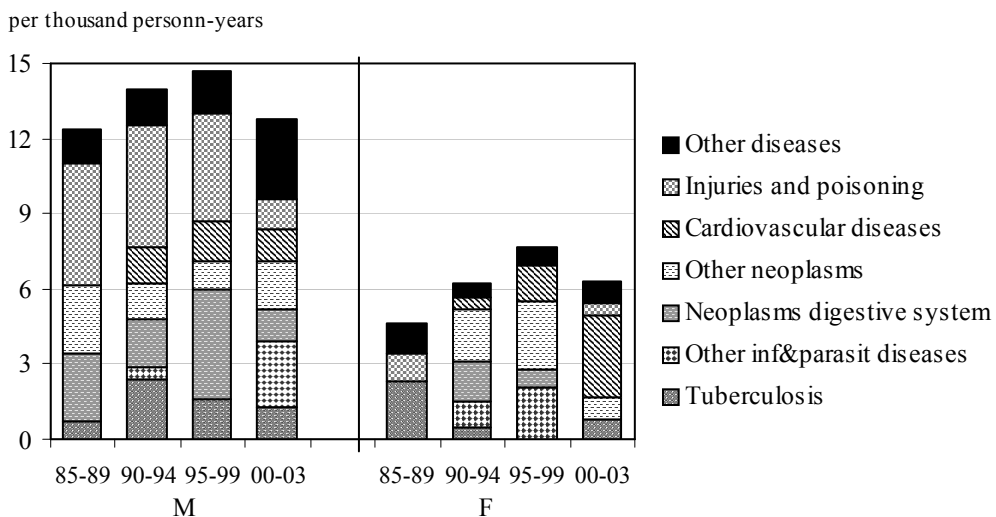
Figure 5. Mortality rate by group of causes between ages 15 and 40, for each sex, by period (Mlomp, 1985-2003)



Source: Mlomp database, 2005 (redistribution of deaths from ill-defined causes).

Concerning mortality after age 40, trends are difficult to discern. The level hasn't changed very much (figure 6). In the last period, there is a reduction of violent mortality in overall male mortality that may be explained by the absence of deaths due to the conflict in Casamance.

Figure 6. Mortality rate by group of causes between ages 40 and 60, for each sex, by period (Mlomp, 1985-2003)



Source: Mlomp database, 2005 (redistribution of deaths from ill-defined causes).

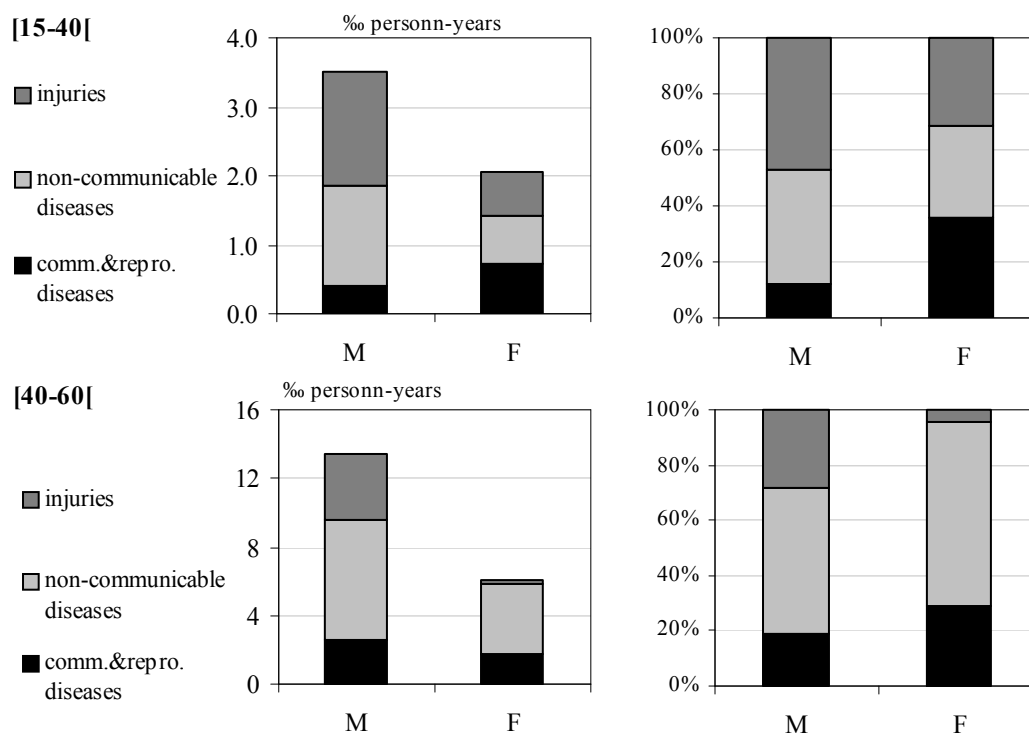
#### 4. Communicable and reproductive diseases, non-communicable diseases and injuries

##### *Three groups of causes*

To give an overall picture of the mortality structure, we can group causes of death into three categories: communicable and reproductive diseases (infectious and parasitical diseases, maternal causes, perinatal causes...); non-communicable diseases (neoplasms, cardiovascular diseases, chronic respiratory diseases, nervous system disorders...); and injuries (violent deaths). This makes possible to see schematically what kind of causes of deaths are “avoidable” relative to other industrialized populations (Bourgeois-Pichat, 1952). This approach has been used by Christopher Murray *et al.* to study adult mortality in developing countries (1992). We adopt it to study the mortality observed in Mlomp, with a minor difference, in that we redistribute proportionally the deaths from ill-defined causes that we assume can be included in the three groups, and not restricted to the non-communicable diseases group (Duthé, 2006).

Except for young men, communicable and reproductive diseases account for more than 20% of mortality, and the level is close to 40% among women (figure 7). Before age 40, non-communicable diseases are the second group and after age 40 they are the first (52% and 66% of male and female mortality between ages 40 and 60). Violent mortality represents a very large share of the mortality of young adults and men older than 40.

Figure 7. Mortality rate by group of causes between ages 15-40 and 40-60, for each sex (Mlomp, 1985-2003)



Source: Mlomp database, 2005 (redistribution of deaths from ill-defined causes).

### Communicable and reproductive diseases

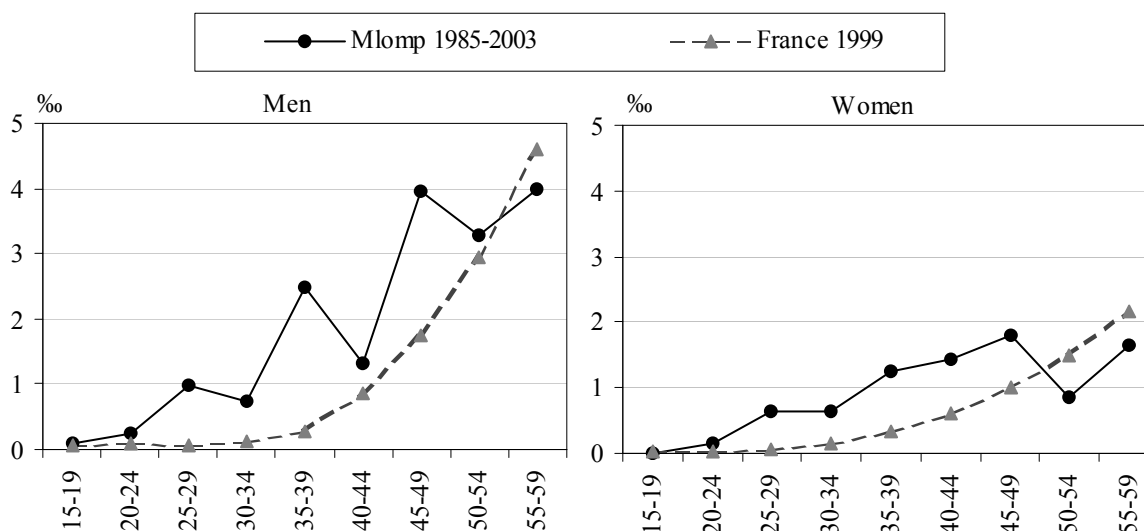
Respiratory infectious and tuberculosis are the most important causes in the communicable and reproductive diseases group. Tuberculosis is not associated with AIDS whose prevalence is relatively low in Mlomp. The incidence was 0.8 in 1990-1995 (Pison *et al.*, 1993b; Diop *et al.*, 2000). Since 1985, AIDS has killed 12 persons according to the diagnoses, but the first case occurred in 1990. Then, intestinal infectious and maternal causes for women are the next most common causes. Cholera is mostly an epidemic disease. Maternal mortality was estimated at 319 per 100,000 live births<sup>6</sup> in 1985-2003, a lower level than observed in the two other rural sites Niakhar and Bandafassi and usually in rural Africa (Pison *et al.*, 2000).

### Non-communicable diseases

Neoplasms and cardiovascular diseases are the two major causes included in the non-communicable diseases group. The three causes recorded most often are cancer of the digestive system, cardiopathy, and cerebral haemorrhage.

The comparison of mortality rate by age group and sex between Mlomp and those observed in France in 1999 shows that the rate in Mlomp, although low, is always higher than the French one between the ages of 25 and 50 (figure 8).

Figure 8. Mortality rate for a neoplasm by age group between ages 15 and 60 for each sex, in Mlomp (1985-2003) and France (1999)



Source: Mlomp database, 2005; Meslé and Vallin, no date.

### Injuries

Except for deaths due to the sinking of the “Joola” in 2002 and the conflict in Casamance, falls and drownings are the most frequent cause of violent death: working activities are strongly involved in violent mortality among men who are harvesting palm wine and fishing. Domestic activities also present risks of mortality from falling into wells.

Concerning indirect causes of injuries, half of the men who died by drowning were epileptic. We don't know if the persons died during a fit but we may suppose so. Otherwise, alcohol consumption which is common in Mlomp may have contributed to increasing the number of violent deaths (Kjellstrom *et al.*, 1992; Ezzati *et al.*, 2002).

<sup>6</sup> Uncertainty interval  $_{95\%} = [111-528]$ .



## 5. Conclusion

Although they are very different, the three groups of causes are connected if we consider the morbidity aspect: infectious diseases are involved in the apparition of non-communicable ones, and the example of the epilepsy shows that a violent death may occur because of a chronic disease.

Despite an increase in the adult mortality level, there is no evidence of structural trends since 1985. The only causes which have changed constantly are neoplasms. Intestinal infections may be responsible for deaths due to a digestive dysfunction (liver cancer, cirrhosis). Differences between men and women appear to indicate that day-to-day behaviors are also involved.

Few deaths are due to AIDS, but the incidence seems to be increasing (Diop *et al.*, 2000). Nevertheless, communicable and reproductive diseases still have a major impact on adult mortality in Mlomp. Adults accumulate two types of diseases and a high level of violent mortality. The health transition in Mlomp does not correspond to an epidemiological transition described by Abdel Omran with a substitution of the different groups of causes (1982) but is a local observation of a double burden of those two types of disease among adults (WHO, 2003).

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