Kinship patterns and co-residence in rural Senegal

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Abstract

Most of the research on kinship patterns in Africa has been conducted through the lens of living arrangements. Changes in living arrangements can be difficult to interpret because they amalgamate two sources of variation. The first is the availability of kins, which is purely a function of mortality, marriage and fertility rates. The second is made of social norms defining the propensity of specific types of kin to co-reside with each other. To be able to tease out the demographic constraints on changes in living arrangements, we combine stochastic micro-simulations with data from one rural area in Western Africa where polygyny is frequent and families are extended: Bandafassi in Senegal. We address the following research questions: (1) How does the availability of kins evolve as people grow in age? (2) Which proportions of kins are co-resident in these areas? (3) What are the effects of demographic changes on kinship networks and living arrangements?

1 INTRODUCTION

Demographic changes occurring in Sub-Saharan Africa (SSA) have the potential to greatly alter the familial environment in which people live, and modifications in familial units can in turn affect demographic behaviors. As an example, the demographic ageing in SSA is taking place in a context of widespread poverty and poor health infrastructure, which could jeopardize the well-being of the elderly. As pension systems cover only a small fraction of the population, older adults are compelled to turn to the extended family as a source of financial and social support. However, the size and composition of this extended family is changing. While the total fertility in SSA was as high as 6.8 children per woman in 1980, it is now around 4.9 and should decline even further in coming decades (United Nations 2013). What will be the size and the composition of kinship networks available for the elderly in SSA in the near future? At the other end of the lifespan, children are also affected by demographic changes. Because of the rapid decline in child mortality, which has not always been paralleled by similar declines in fertility, children are currently facing more competition for resources at the familial level. In countries where the fertility transition is well underway, family sizes have started to decline, but at the population level, children are still growing in larger cohorts as a result of population momentum. As Lam and Marteleto (2008) demonstrated, the demographic transition has been heavily analyzed, but some of the implications of this transition on the dynamics of kinship patterns, as seen from an individual's perspective, are still poorly understood.

Because of a lack of detailed data, most of the research on changes in kinship patterns in Sub-Saharan Africa has been conducted through the lens of living arrangements. This lens is somewhat blurred, however, because living arrangements are determined by two factors. The first is the availability of kins (children, grand-children, siblings, aunts and uncles, etc.), which is purely a function of mortality, marriage and fertility rates. The second is a set of social norms defining the propensity of specific types of kin to co-reside with each other (Merli and Palloni 2006). To be able to tease out the demographic constraints on changes in living arrangements, we combine stochastic micro-simulations with data from Bandafassi, a rural area in Senegal where polygyny is frequent and families are extended. In this area, accurate demographic data have been collected through regular rounds, and mortality, marriage and fertility trends can be retraced over the last 30 to 40 years.

Using a mix of measurements and simulations, we address the following research questions: (1) how does the availability of kins evolve as people grow in age? (2) which proportions of kins are co-resident? (3) what are the effects of demographic changes on kinship networks and living arrangements?

2 DATA AND METHODS

2.1 The study site: Bandafassi

Established in 1970, the Bandafassi Health and Demographic System (HDSS) now covers a population of 13 000 inhabitants in south-eastern Senegal. HDSS are geographically identified populations in which accurate demographic data are collected through regular rounds (Ye et al. 2012). An initial census is conducted and this marks the start of the continuous follow-up of the resident population. New individuals can enter the population by birth or in-migration, and members can exit by out-migration or death. On each study round, interviewers review the composition of all the households, checking the lists of individuals who were present in the households at the last visit and collecting data about vital events, marriages and migrations since the last visit. Causes of deaths are determined through verbal autopsies, in which trained interviewers go back to the relatives of the deceased to elicit information on conditions and symptoms that preceded the death (Adjuik et al. 2006). In Bandafassi, verbal autopsies have been used since 1984.

The Bandafassi HDSS is located in the Departement of Kedougou, in the Tambacounda Region, near the borders with Mali and Guinea (Pison et al. 2014). The area is 700 km

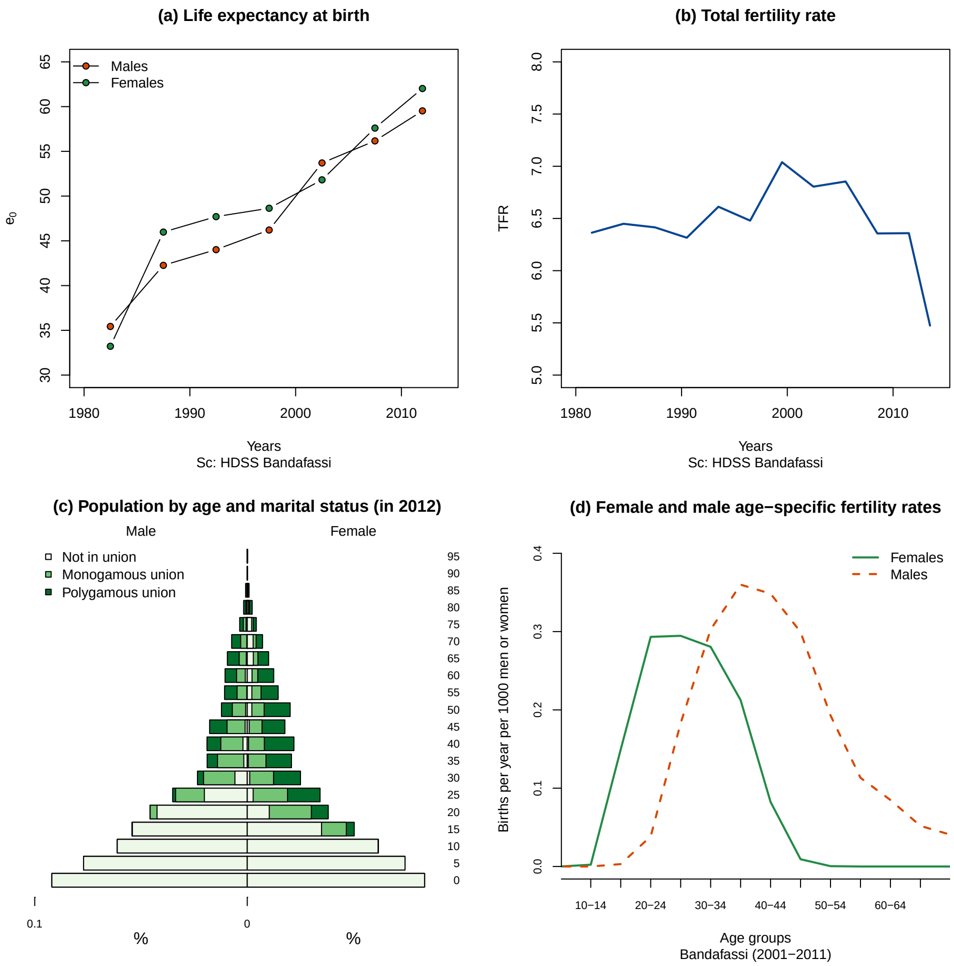

Figure 1 – *(a) Trends in life expectancy at birth, (b) total fertility rate, (c) population by age and marital status, and (d) age-specific fertility rates (males and females) in Bandafassi, Senegal (based on HDSS data)*

from Dakar and 250 km from Tambacounda, the regional capital. The population is split into in 42 small villages (with 300 residents on average). It is also divided into three ethnic groups that live in distinct villages: Bedik (25% of the population), Mandinka (16%) and Fula Bande (59%). When the HDSS was established in 1970 (originally for genetic studies), it covered only 8 villages inhabited by one ethnic group (Mandinka) but it was extended to the other ethnic groups (Fula and Bedik) in 1975 and 1980. The main economic activity is farming, with the cultivation of cereals (such as sorghum, maize and rice), peanuts and cotton, as well as cattle-breeding. Part of the young male population migrates seasonally to cities and other rural areas.

The area has experienced a rapid mortality decline, especially among children. The under-five mortality rate has declined from 400 per thousand in the period 1980-1984 to 111 per thousand in the period 2010-2013. Consequently, the life expectancy has increased from 40 to approximately 55 years in the last three decades (Figure 1). Over the same period, there has been little change in fertility and the total fertility rate is still around 6.5. Polygyny is frequent, with about 160 married women for 100 married men. Women married to the same man usually live together in the same concession. Due to large age differences between spouses, male and female fertility patterns are fundamentally different; fertility rates are both higher and concentrated in older ages among men.

Several additional surveys were conducted during the initial census or soon after to improve or supplement the information. A survey on unions and fertility collected marital and reproductive histories of each adult female. A genealogical survey was also conducted in each concession independently from the census (Pison 1987). This survey allowed to reconstruct the genealogy of the head of the compound and each of the adult women living in the same compound. For each individual, referred to as *ego*, the survey collected :

- the list of his brothers and sisters by birth order, their survival status and address,
- the list of spouses and children of each sibling of *ego*, with their survival status and address,
- then for each child, the same questions regarding spouses and children were repeated, etc.

These questions were later asked about the father and the mother of *ego*, then the father of the father of *ego*, etc., taking care each time to go down to the generation of the surviving kins. These genealogies are more or less complete, because of the variable knowledge of genealogies and omissions. The information collected for the paternal lineages and for males are for example more exhaustive. By contrast, genealogies for migrants are less complete (Pison 1987). As a result, we will observe later some differences with kinship patterns expected based on demographic rates.

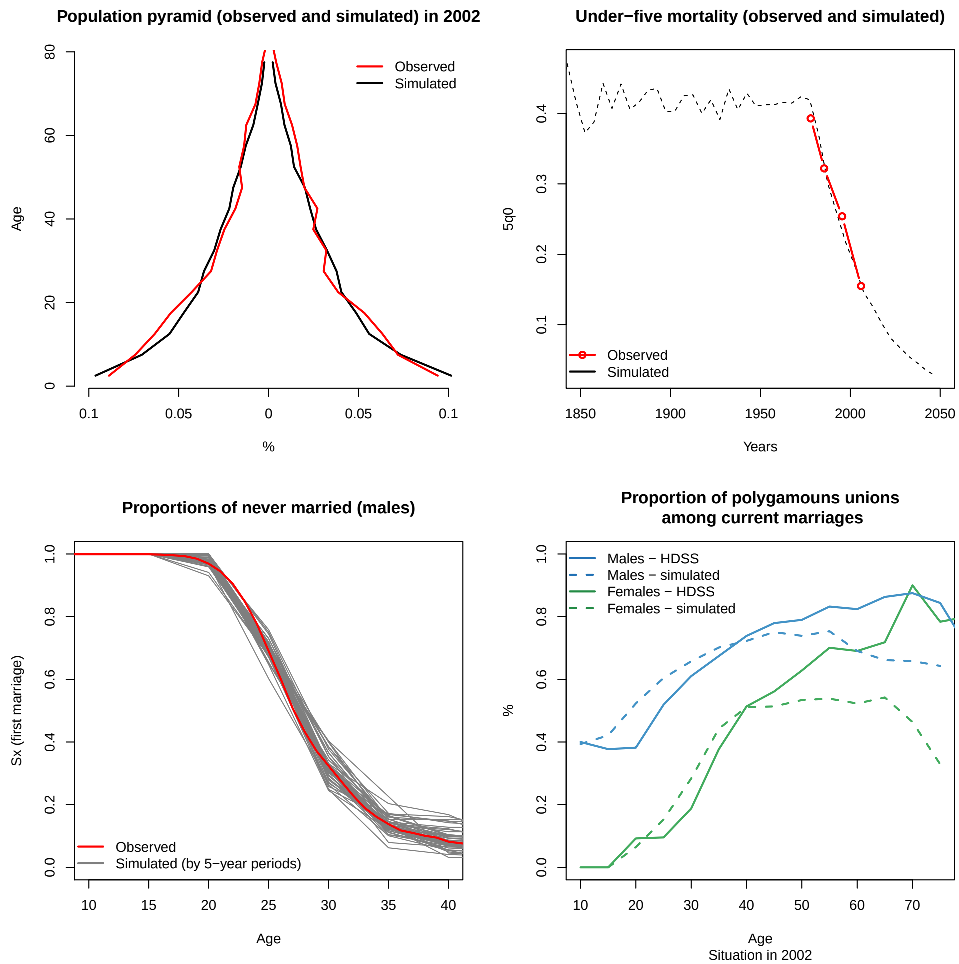

Figure 2 – *Calibration of microsimulation model (based on HDSS data and simulation outputs)*

2.2 The microsimulation model

Microsimulations are stochastic models in which the units of analysis are individuals. For each time step, vital predefined rates are converted into waiting times preceding particular events (e.g., deaths, births, marriages, transitions between groups). These events are assigned to fictitious individuals. Here we use SOCSIM, a program developed in the 1970s at the University of California (Wachter et al. 1997, Murphy 2004, Masquelier 2010). SOCSIM is a closed model, in the sense that no individual joins the population during the population except through birth; this facilitates the tracking of kinship links because all individuals have a mother who is herself identified. In open models, marriage partners are created on an ad hoc basis for each individual in search of a spouse. We generate one populations that advance through time in a way that mirrors demographic trends observed in Bandafassi. This populations is assumed to be stable from 1850 to 1975. Female fertility rates vary by age, parity and marital status; mortality rates and transitions into first marriage vary by age and sex; allowance is made for divorces, re-marriages, and polygyny. Most of demographic rates are obtained directly from the longitudinal data collected in the

HDSS, some are smoothed and a few have to be approximated (ex. the rate of remarriage of men already married). The final populations have about 800 000 persons in the simulations, among which about 400 000 are still surviving in 2012. To ensure that the model reproduces reasonably well the real demographic dynamic from Bandafassi, we compare the simulation outputs with HDSS data for various parameters, such as the age and sex profile, the distribution of women by number of children ever born, or the proportions of polygamous unions among all unions. Some comparisons between observed and simulated parameters are displayed in Figure 2.

3 RESULTS

The expected number of kins (ever born and surviving) can be computed from the simulated populations in 2012. This is presented in Figures 3 to 10. Overall, we observe that differences in the rate and timing of male and female reproduction lead to a definite asymmetry between kinship networks of men and women. For example, men have less children than women until age 40, but then they start having more children on average (about three additional children ever born at age 60) (Fig. 3). Once we skip a generation, this crossover is no longer apparent. At almost all ages, women have more grand-children than men (Fig. 4).

Comparing simulation outputs with HDSS data is useful to evaluate whether the model needs to be further calibrated. In Figure 5, we observe that among older women, simulations generate more children ever born than estimated from the HDSS data. This is presumably because retrospective reports for the periods before the start of the follow-up are incomplete. Such differences between simulated and reported number of kins are observed for the more distant past for all types of kinship links, to a varying degree. This indicates that even among small populations where particular care was taken to collect genealogies, it is very difficult to reconstruct complete genealogies from the data only.

Another interesting comparison between HDSS and simulation outputs concerns the survival of parents. Figure 6 presents the proportions of surviving parents by age of *ego*. Because of higher mortality rates among males and later male fertility, the proportion of paternal orphans is always higher than maternal orphans. At age 40-44, 24% of adults have lost their mother, while 48% of adults have lost their father (in 2012). However, when comparing both sets of estimates, we clearly see that our simulated values are below those extracted from the HDSS database. There are at least four potential explanations for this. First, there is an important selection bias since we can only compute the proportion surviving among individuals who have been once resident of the area. Parents who survived longer are more likely to have lived in the area. Second, genealogical data from the HDSS could be incomplete or incorrect. Third, our model could overestimate adult mortality. Finally, there could be some correlation of risks of dying between parents and children, leading to a higher proportion of non-orphans among surviving adults (in the HDSS) than is obtained in simulations where mortality is purely random.

Irrespective of these methodological aspects, it is interesting to note that this gender

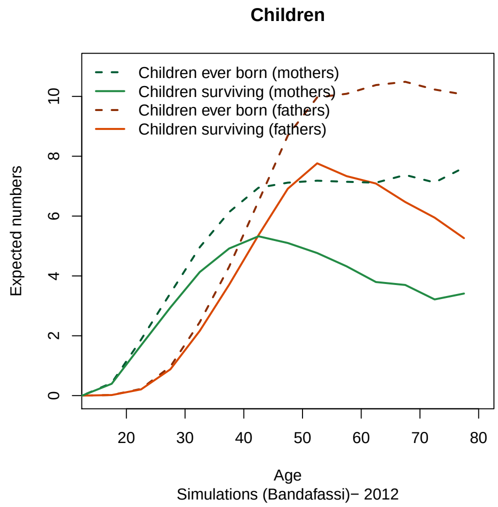

Figure 3 – *Expected number of children ever born and surviving by age and sex*

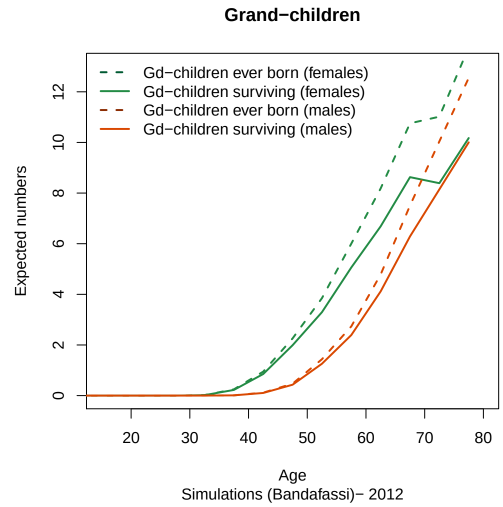

Figure 4 – *Expected number of grand-children ever born and surviving*

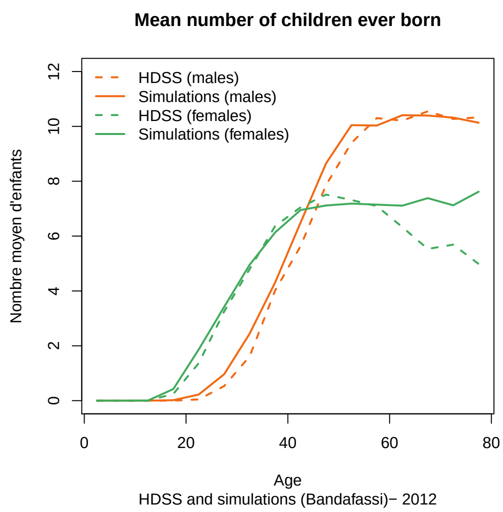

Figure 5 – *Number of children ever born : simulations and HDSS*

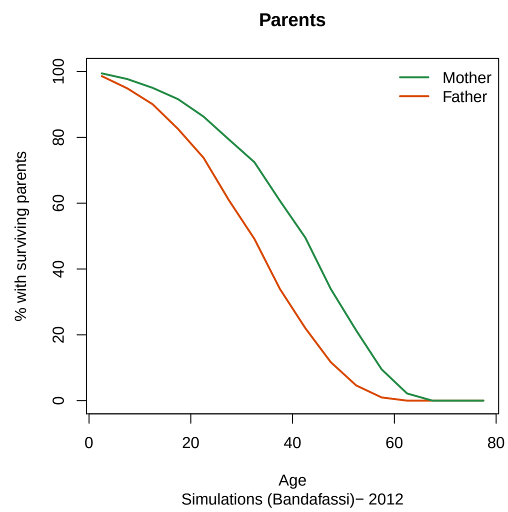

Figure 6 – *Proportions of surviving parents by age of ego and sex of parents*

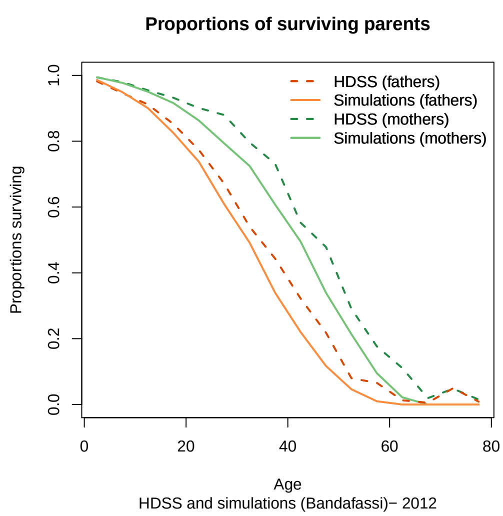

Figure 7 – *Proportions of surviving parents (simulations and HDSS data)*

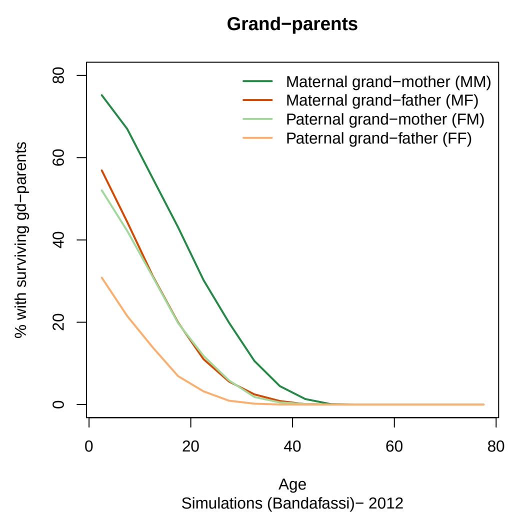

Figure 8 – *Proportions of surviving grand-parents*

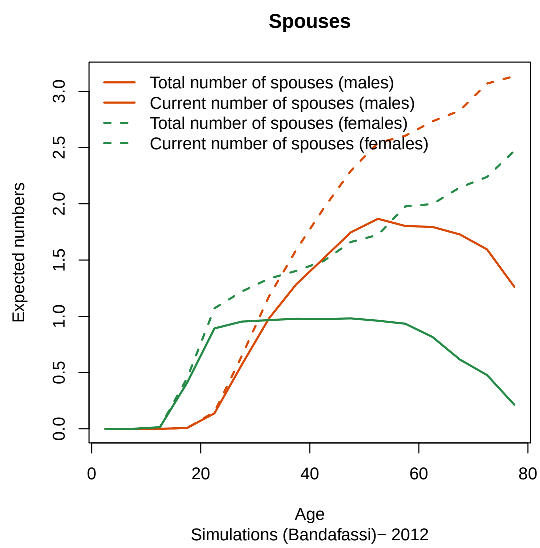

Figure 9 – *Expected number of spouses (current and total)*

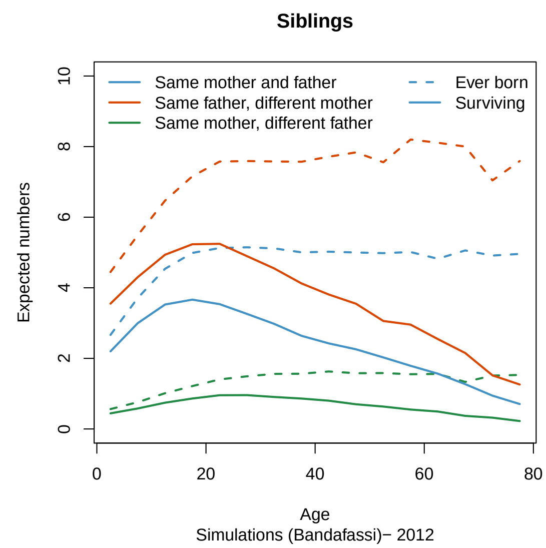

Figure 10 – *Expected number of siblings (ever born and surviving) by type*

imbalance is even larger for grand-parents. From simulations only, one can estimate that 76% of children aged less than 1 still have their maternal grand-mother, while only 31% of these children still have their paternal grand-father (in 2012). Apart from the maternal grand-mother, less than 20% of other types of grand-parents are alive when ego reaches 20 (Figure 8).

Finally, we present the expected number of partners (current and total) in Figure 9, along with the expected number of siblings (ever born and surviving) in Figure 10. Because of high rates of divorce, widowhood and remarriage, adults will have more than two spouses on average in their lifetime. The age and sex patterns of fertility and marriage also result in a very large proportions of brothers and sisters being half-siblings born from the same father. These half-siblings are even more numerous than full siblings from the same mother and father.

The number of surviving kins (obtained from simulations) can now be compared with the numbers of co-resident kins (as observed in the HDSS), in order to evaluate the propensity of various types of kins to co-reside with each other. This is presented in Figures 11 to 13 (in 2012). The residential unit considered here is the compound, in which reside the members of the extended patrilineal family (on average 15 people). In a polygamous society, this unit seems more relevant than the household for our purposes.

The co-residence of parents with their children is frequent, even at the adult ages (Fig. 11). As expected, the frequency of co-residence tends to decline gradually between the ages 40 to 70 for mothers. One way to express this is the ratio of the mean number of coresiding child to surviving child, equaling 0.83 in the age group 40-44, and declining steadily to 0.30 at age group 70-74. This decline is not so apparent for fathers. The corresponding ratio

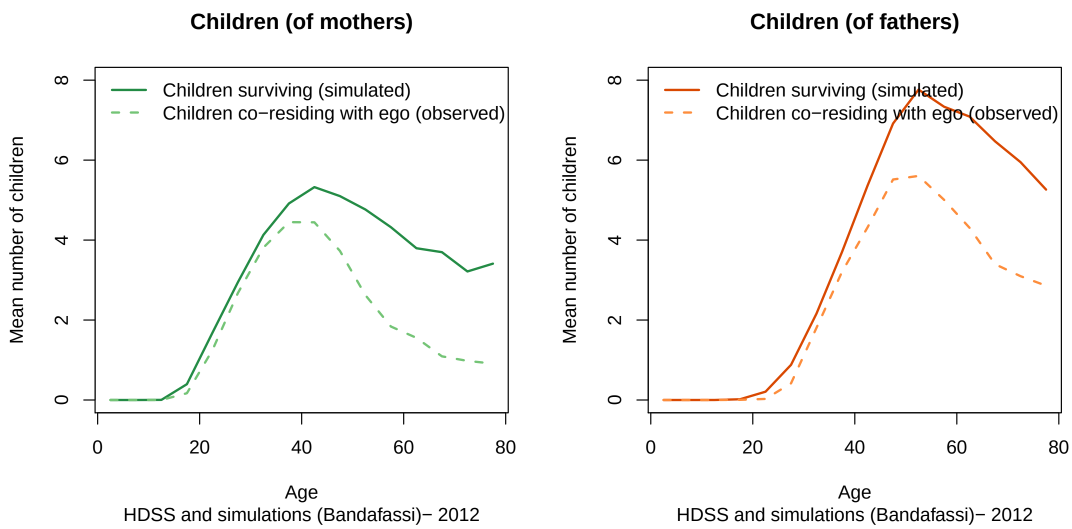

Figure 11 – *Mean number of children surviving (simulated) and co-residing with ego (HDSS) - Bandafassi, 2012*

declines from 0.81 (in the age group 40-44) to 0.52 only. In other words, men reside with a diminishing number of children once they reach 50, but this is mainly explained by the fact that they have fewer surviving children to live with. Older women have a much smaller number of co-residing children (about one at age 70-74, against 3.1 for men), and this is due both to a smaller pool of potential children, and a smaller chance that these children will stay with their mother.

We can also compare these estimates for 2012 with similar values for 1982 (Table 1). Over the last 30 years, HDSS data indicate that the mean number of co-resident children has increased for both mothers and fathers. For example, women aged 50-54 had 1.35 co-resident child in 1982, and this number increased to 2.62 in 2012. Over the same period, men aged 50-54 gained more than three additional co-resident children (from 2.54 to 5.61). Without detailed information on changes in the total number of children ever born, or in the presence of reporting errors, it would be difficult to tease out the effect of the decline in mortality (resulting in larger family sizes) and of social changes. However, this is feasible based on simulations. When looking at the changes in the ratios of co-residing children (observed) to surviving children (simulated), one can clearly conclude that these have also increased over the period, and for both sexes. This indicates that there have been changes in the propensity of children to co-reside with their parents as well.

Now viewed from the child's perspective, one can see in Figure 12 that the co-residence of children with their parents is systematic for sons, even when they advance in age. This is true for both their mothers and fathers (here displayed for 2012). Of course, we consider only individuals residing in the area here; all those in migration (and most likely not living with their parents) are not considered. By contrast, co-residence is rare for daughters after age 20, typically because they will move away after their marriage. These observations are

	Mean number of co-resident children		Expected number of surviving children		Ratio of co-residing to surviving children	
	1982	2012	1982	2012	1982	2012
	(1)	(2)	(3)	(4)	(1/3)	(2/4)
			Women			
30-34	2.14	3.81	2.89	4.13	0.74	0.92
40-44	2.04	4.44	3.70	5.32	0.55	0.83
50-54	1.35	2.62	3.64	4.76	0.37	0.55
60-64	1.03	1.55	3.17	3.80	0.32	0.41
70-74	0.72	0.98	2.94	3.22	0.24	0.30
			Men			
30-34	0.86	1.81	1.61	2.16	0.54	0.84
40-44	2.39	4.32	3.65	5.36	0.65	0.81
50-54	2.54	5.61	4.90	7.76	0.52	0.72
60-64	2.43	4.31	4.63	7.09	0.53	0.61
70-74	2.00	3.10	5.80	5.95	0.34	0.52

Table 1 – *Mean number of co-resident children (from HDSS) and surviving children (from simulations), by age and sex, and ratio of co-residing to surviving children*

expected in a society where marriage is virilocal, but we did not expect to see this as so systematic. Also surprising is the fact that the co-residence of children with parents seem to be more frequent at the adult ages than in childhood, once we consider the survival of parents.

Finally, we clearly see in Figure 13 the implications of the rule of virilocal residence on the coresidence with siblings. After their marriage, women have practically no co-resident sibling. Men have slightly more co-resident sisters, and they tend to live with most of their brothers. However, the propensity to co-reside with a brother declines with the age of *ego*. Comparing simulations and co-resident siblings also suggest that our microsimulation model result in a larger number of siblings born to the same father than we would expect based on the HDSS data. This is especially egregious in childhood, and calls for further calibration of the model.

We present in Table 2 the ratios of the mean number of co-residing siblings (as estimated from HDSS data) to the mean number of surviving siblings, for 1982 and 2012, by sex of *ego*, and separating siblings born to the same mother and siblings born to the same father. These ratios indicate that the propensity to co-reside with a sibling declines with the age of *ego*, irrespective of his/her gender and the types of siblings. In terms of changes over time, there is little variation between 1982 and 2012 in the ratios, although they tend to increase sightly. Again, this would suggest that *ego* has a larger number of siblings in the same compound, mainly because of the larger family sizes, and to a lower extend because of a more frequent tendency to co-reside with each other.

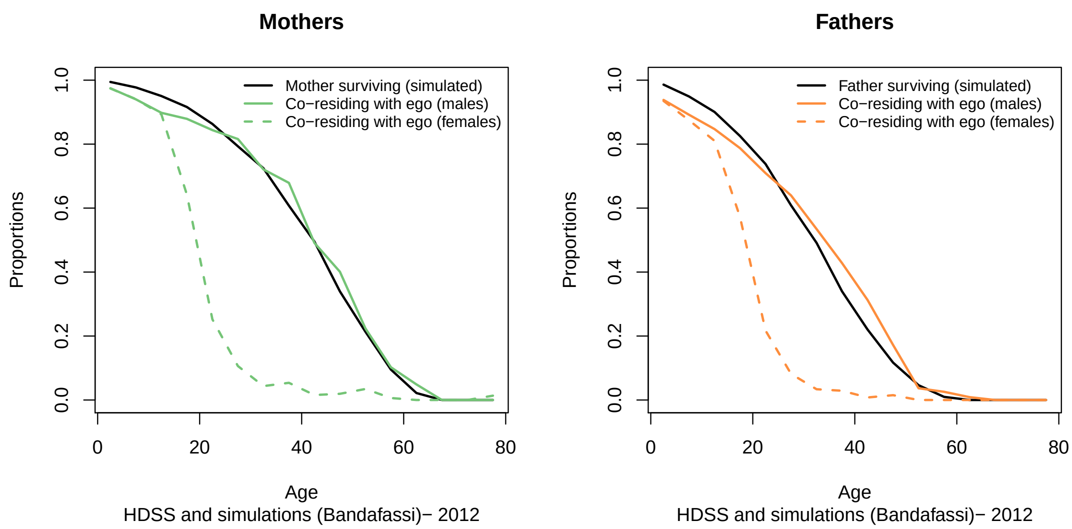

Figure 12 – *Mean number of parents surviving (simulated) and co-residing with ego (HDSS) - Bandafassi, 2012*

4 DISCUSSION

In this paper, we used micro-simulations combined with longitudinal data to describe kinship patterns and co-residence in a rural area of Senegal. Our model assumes away some complexities. For example, there is not inter-generational correlation of fertility or mortality. However, the model seems to faithfully reproduce the kinship networks in the HDSS. Based on these simulations, our first objective is descriptive and seeks to investigate, how, in a given demographic context, the "availability of kin" evolves over the life span of one person. Our results not only show the very marked variations with age in the size and composition of kinship networks, but also an asymmetry between the paternal and maternal sides, due to the importance of polygyny and differences in the age pattern of male and female fertility. As observed by Howell (2008) with the !Kung population, "there are systematic differences between the genders in their place in the kinship system over their life spans, with women becoming socially central at an earlier stage of their lives than their brothers, but with men tending to hold the central positions in old age (p. xxi)." This asymmetry between males and females affects the entire kin group: patrilateral kins outnumber matrilateral kins (Pison 1986). Our second objective is to confront the potential number of close relatives with the observed household structures. This work is still in progress, especially as far as changes over time are concerned. However, our preliminary results confirm that changes in living arrangements should not be evaluated without a reference providing the "supply of kins".

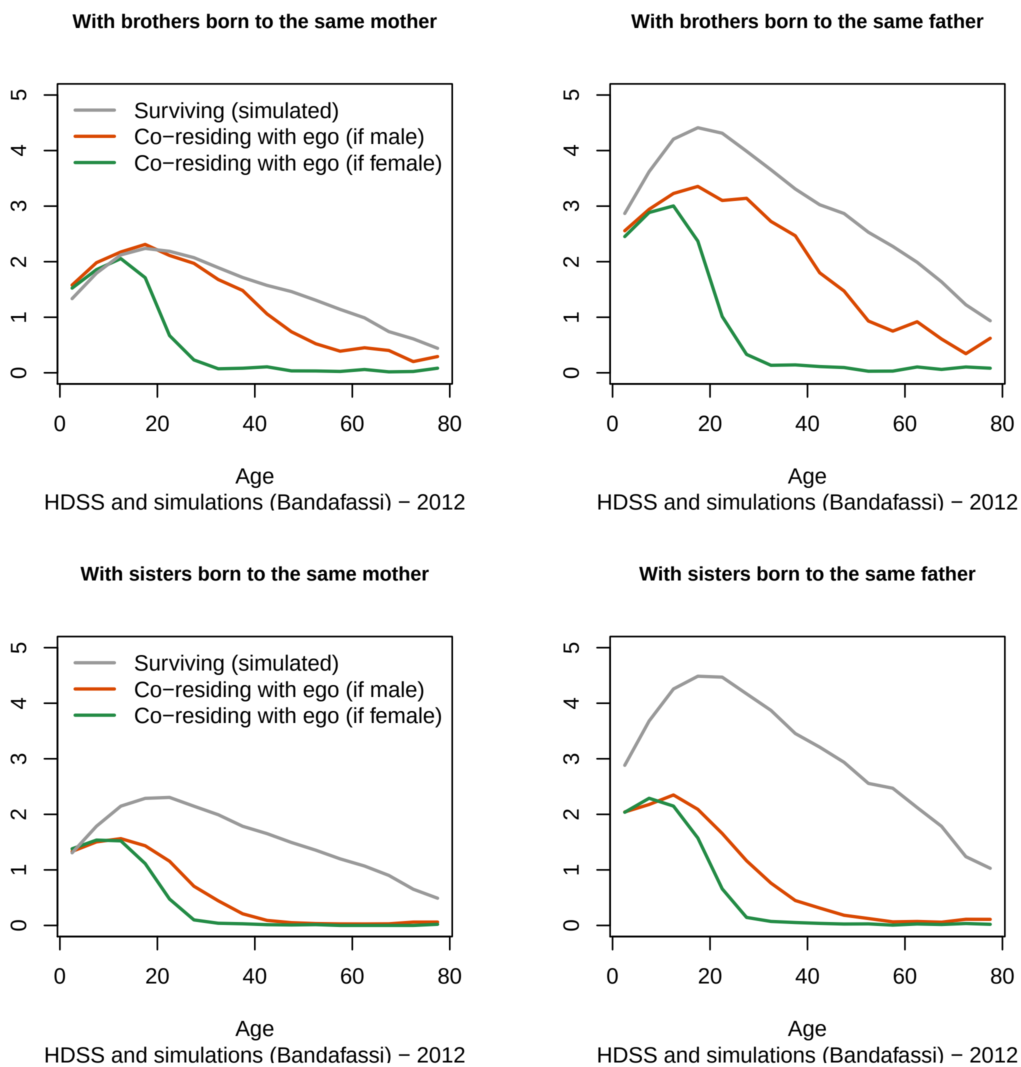

Figure 13 – *Mean number of siblings surviving (simulated) and co-residing (HDSS) - Bandafassi, 2012*

	Same mother & ego male		Same mother & ego female		Same father & ego male		Same father & ego female	
	1982	2012	1982	2012	1982	2012	1982	2012
	Brothers							
5-9	0.97	1.06	0.91	1.00	0.81	0.79	0.75	0.75
15-19	0.88	1.00	0.45	0.72	0.72	0.74	0.39	0.53
25-29	0.86	0.89	0.21	0.11	0.76	0.72	0.17	0.09
35-39	0.71	0.77	0.06	0.08	0.59	0.70	0.07	0.05
45-49	0.44	0.44	0.01	0.02	0.44	0.43	0.03	0.02
55-59	0.42	0.37	0.03	0.04	0.33	0.33	0.03	0.03
65-69	0.19	0.38	0.08	0.07	0.29	0.29	0.05	0.08
	Sisters							
5-9	0.85	0.81	0.85	0.87	0.68	0.57	0.61	0.60
15-19	0.58	0.64	0.34	0.46	0.47	0.47	0.25	0.33
25-29	0.28	0.34	0.17	0.06	0.27	0.29	0.14	0.05
35-39	0.12	0.11	0.02	0.03	0.17	0.15	0.03	0.02
45-49	0.05	0.05	0.03	0.01	0.06	0.07	0.01	0.01
55-59	0.01	0.02	0.01	0.01	0.03	0.02	0.01	0.01
65-69	0.08	0.04	0.00	0.00	0.05	0.05	0.03	0.01

Table 2 – *Ratios of co-residing sibling (observed in HDSS) to surviving sibling (simulated) according to sex of ego, sex of sibling, and period*

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