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HETEROGENEITY, LIFE CYCLE AND THE POTENTIAL DEMOGRAPHIC IMPACT OF AIDS IN A RURAL AREA OF AFRICA

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INTRODUCTION

In a series of four well documented articles titled "A Continent's Agony", the New York Times (16-19 September, 1990) reviewed the current status of the HIV epidemic in Tropical Africa. The first article bore a frightening title: "AIDS in Africa: a Killer Rages on". Data quoted from the US Bureau of the Census HIV/AIDS Surveillance information base showed the fast progression of the epidemic in many sub-Saharan countries during the late 1980's, "outracing the prevention campaigns that have now been started by every government". In many large cities (e.g. Kampala, Lusaka, Nairobi, Abidjan, Blantyre) 5 to 20 per cent of young adults are HIV positive. The authors note that the epidemic strikes virtually all socio-demographic strata: "men and women, rich and poor, urban and rural".

The rapid spread of the infection in the general population and the very high lethality of the virus raise a fundamental question: What will be the medium and long term demographic consequences of the HIV epidemic ? The aim of this paper is to employ a model to help explore this question in the context of a rural area of West Africa.

MATHEMATICAL MODELS

Many mathematical models have recently been developed to account for the evolution of the epidemic. They are of broadly three kinds: extrapolation, simulation and compartmental models.

EXTRAPOLATION MODELS

The simplest models aim at projecting trends in the number of AIDS cases, or in the number of HIV positive people. They use information for several years and try to project the observed trend using a mathematical function fitting the observed values. The unit of time used is the year, the semester or the trimester.The simplest models project observed trends. More sophisticated versions take into account delays in reporting cases, or try to project trends in HIV infected persons or in the expected number of clinical AIDS cases using a distribution for the incubation period. Various specifications have been used for projections, the two most common being polynomials and log-linear functions, often after a transformation of the dependent variable. For the incubation period a Weibull distribution is commonly assumed.

Curran and colleagues (1985) projected the number of cases using a polynomial model fitted to the adjusted case counts transformed by the Box-Cox method. McEvoy and Tillett (1985) analyzed a log-linear model. Brookmeyer and colleagues (Brookmeyer and Gail, 1986, 1988; Brookmeyer and Damiane, 1989; Gail and Brookmeyer, 1988) assessed the number of AIDS cases likely to arise in the United States of America among the infected population. They estimated the parameters of a Weibull distribution of the incubation period. Karon *et al.*, (1988) extrapolated trends after adjusting for estimated delays in reporting diagnosed cases. They fitted a quadratic polynomial to the adjusted incidence using a weighted least squares procedure. Tennison and Hagard (1988) compared estimates from polynomials and log-linear models.

All these approaches have the same limitations: they project quite accurately the number of cases over a short period of time, but long term predictions are obviously hazardous. Furthermore, they are rarely carried out by age and sex, although they probably could be developed in this way. Therefore they are of little use for estimating long term demographic impact.

SIMULATION MODELS

Bongaarts (1988) has developed a sophisticated Monte Carlo simulation. The basic idea is to detail all possible mechanisms of virus transmission and of the biological effects of infection. Contrary to projection models, simulations can include as many behavioural

parameters as one wishes. The Bongaarts model has some 30 parameters that can be used for fine tuning. The model predicts the number of people infected and mortality and fertility by age and sex at any point in time. It therefore allows one to have accurate medium and long term projections, given prevailing conditions. From the set of parameters that were assumed to represent current conditions of HIV transmission in Tropical Africa, these simulations indicate that the potential demographic impact will largely be offset by the prevailing high rate of population growth. However this model has been shown to be unable to adequately replicate the rapid growth of an outbreak, a situation that has recently been documented for Thailand.

COMPARTMENTAL MODELS

In a series of recent articles Anderson and colleagues (Anderson *et al.*, 1987 ; Anderson and May, 1988; May and Anderson, 1987; Anderson *et al.*, 1988, 1990) have pioneered a new approach. The idea is to estimate the conditions under which population growth might continue, be stopped or be reversed. The models start from simple differential equations that in the absence of an AIDS epidemic would produce a stable population. The disease is included as a new component of mortality, for both adults and the newborn and as a subgroup of infected persons.

There are several limitations to this model which have already been discussed by the authors. For example, the very strong age pattern of risk of infection and death and their possible effects on outcome constitute one set of limitations. Another is the question of heterogeneity in the risk of contracting the infection.

HETEROGENEITY AND LIFE CYCLE

Sexual behaviour is highly heterogenous among populations, and within populations between individuals. The mathematics of heterogeneity have been investigated by demographers concerned with the study of fecundability (Sheps and Menken, 1973). In the fecundability model, women are assumed to have a constant monthly fecundability, but this probability varies from woman to woman. In this model it can be shown that the observed conditional fecundability decreases with time. This is because more fecundable women tend to conceive earlier and by this selection effect only less fecundable women remain in the pool of susceptibles after a few months. The same effect may well apply to study of the yearly risk of acquisition of AIDS: if one assumes that all people start to be exposed at age 15, then after a few years most high risk persons will be infected and the observed rate of infection will decline, even though behaviour may not change.

Furthermore, sexual behaviour usually has a marked age gradient. The average number of partners per year tends to be higher among young adults especially before marriage, and lower after marriage. Therefore the yearly rate of acquisition of AIDS is expected to decline with age. The possible effects of these factors are investigated below in a case study based on an area or rural West Africa.

A CASE STUDY IN RURAL SENEGAL

The research unit "population et Santé" of ORSTOM, a French Government research institute, has maintained a demographic surveillance of a rural area of Senegal: Niakhar. The population under study was about 25,000 in July 1989.

The study area is populated by Sereer, an ethnic group that came from the Senegal river valley about nine centuries ago. Population density is high by African standards, about 120 inhabitants per square kilometre. Land is scarce and the average level of income is low. As a consequence, there are huge migration flows both towards the cities – in particular towards the capital city of Dakar – and towards the so-called "Terres-Neuves" of Eastern Senegal. Migration flows affect both men and women. Young girls, starting at around ages 8-12, go to large cities during the dry season for a number of years, to work and prepare for their marriage. They usually marry in the villages at about ages 16-22, although some remain on in the cities. Men tend to be employed as herders until around age 15 and then go to the cities or other rural areas until marriage, which occurs at around age 30; they come back to live in the villages only when they can acquire a patch of land. Virtually everyone gets married; divorce is frequent and polygyny is prevalent.

The sexual behaviour of young adults is currently being investigated in the study area. A typical girl would go to Dakar for a few successive dry seasons, between the ages of 10 and 18. During her last years in the city, she will commonly have a relationship with one or several "fiancés" usually from the same ethnic group and from the same urban neighbourhood. She may have sexual intercourse with them, although not necessarily. She may become pregnant and return to the village to get married, although the most frequent pattern is to get married first. Some women stay longer in the cities. The oldest may indulge in sex with several partners, not necessarily for money; a few may practice commercial sex for a while, until marriage occurs or a need to change is felt. After marriage, women may have extramarital sex, but this is usually occasional.

Men have to face celibacy for a longer period of time, since they marry about 10 years later than the women. Men may have a "fiancée" for a long period, but this usually occurs at a later age than for women. Men are likely to have intercourse with free women and commercial sex workers when their income permits. After marriage, men living in the

villages may also have extramarital sex with other women. For such sex men may use the services of commercial sex workers, although this seems not to be a common practice and is highly seasonal: it occurs mainly at the time when income from the harvest is collected. Polygyny is widespread, but happens rather late in men's lives: a second marriage occurs on average around age 47 years, and a third or higher order marriage at about age 57.

A first analysis of 1839 retrospective interviews among young adults (1031 males and 808 females) aged 15-39 (Becker, 1991), has given indications of the mean patterns and variations of sexual behaviour (see Table 1 and Figures 1-4).

TABLE 1

SEXUAL BEHAVIOUR OF 1839 ADULTS AGED 15-39, BY SEX, NIAKHAR, 1990

Age	Females			Males		
	Per cent without partner last year	Mean number of partners last year	Cumulated number of partners	Per cent without partner last year	Mean number of partners last year	Cumulated number of partners
<20	30.9	1.12	0.7	59.0	2.24	2.3
20-24	2.9	1.09	1.6	30.6	2.92	9.6
25-29	3.0	1.13	2.3	10.6	1.85	16.3
30-34	1.7	1.10	2.8	6.2	1.36	18.9
35-39	1.2	1.10	3.4	3.2	1.66	21.9

Note: For graphical representations of these distributions see Figures 2-4.

Women enter active sexual lives on average at age 16.0 years. By age 20, virtually all women have regular partners.

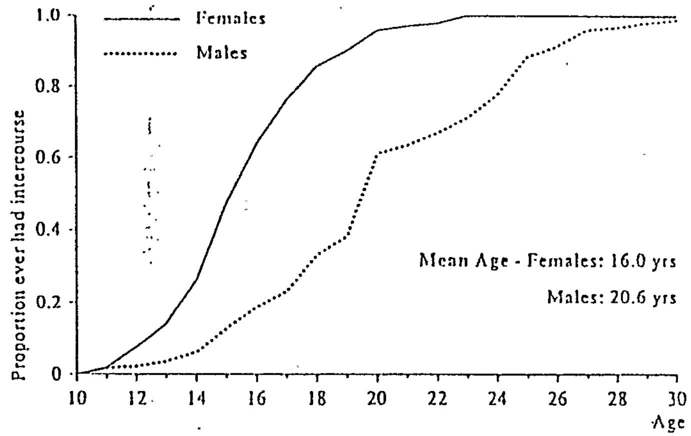

Figure 1 Age at first sexual intercourse, Niakhar, 1990.

When sexually active, the mean number of partners per year is 1.10 and this figure remains fairly constant from ages 15 to 40. By age 40, women have had on average 3.4 partners, a mean rate of partner acquisition of 0.136 per year.

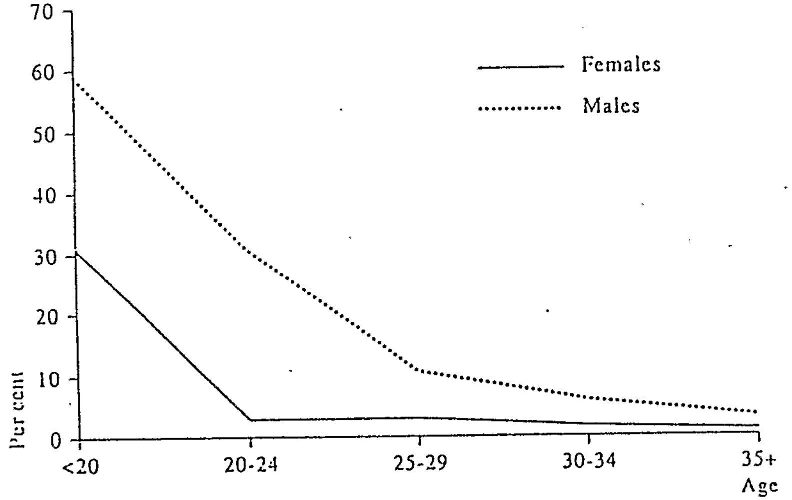

Figure 2 Per cent without sexual partner last year, Niakhar, 1990.

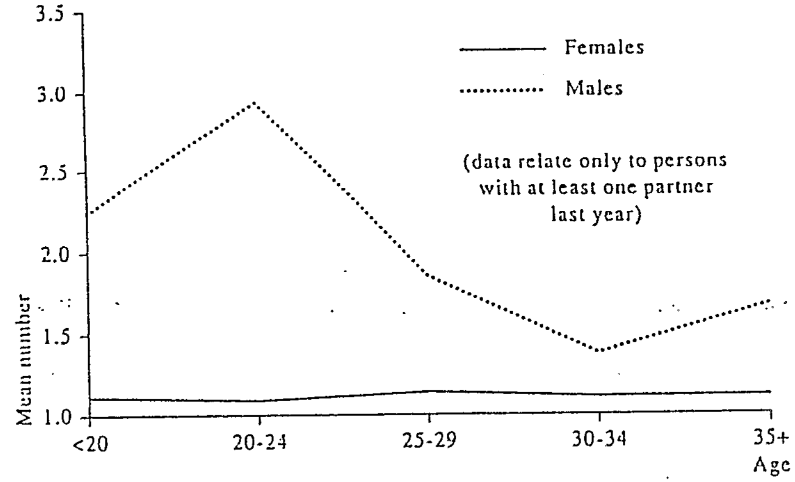

Figure 3 Mean number of sexual partners last year, Niakhar, 1990.

Men display a much wider range of sexual behaviour. They enter active sexual life later, on average at age 20.6 years, and it is only at age 30 that most men have a regular partner. However, they have a much higher mean number of partners per year than do women, with a peak of 2.92 at ages 20-24. By age 40 they have had on average 21.9 partners, a mean rate of partner acquisition of 0.876 per year (see Table 1).

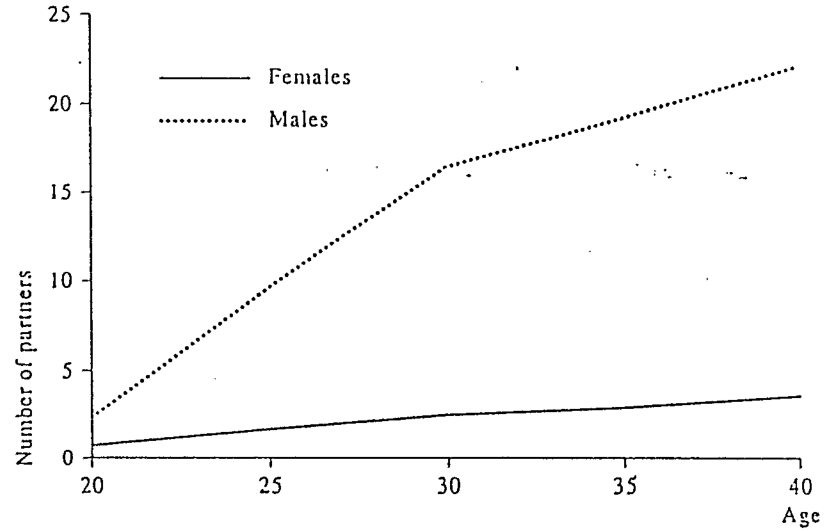

Figure 4 Cumulated number of sexual partners, Niakhar, 1990.

Overall, the sexual behaviour of the Sereer does not seem to be radically different from that of other people, with the exception of the practice of polygyny. Polygyny is perhaps the most distinctive feature of this population with respect to its sexual behaviour. Accurate comparison with other populations of the mean and the distribution of rates of acquiring partners is probably hazardous at this stage, since the Niakhar data were not collected prospectively. We will therefore rely on simulations of various parameters using a compartmental model to infer the potential impact of AIDS in this population. And we will analyze the results in the context of what is known about the people of Niakhar.

THE MODEL

A compartmental model (Anderson *et al.*, 1988) simulating the long term potential impact of AIDS was applied in the context of this rural population. The two fundamental differential equations of the model are:

$$dN(t)/N(t)dt = (v-u) - (a+(1-e)*v)\ Y(t)N(t) \quad (1)$$

and,

$$dY(t)/Y(t)dt = (bc-u-a) - bc*Y(t)/N(t) \quad (2)$$

where:

- N(t) = the total population at time t
- Y(t) = the infected population at time t
- y(t) = the proportion infected in the population = Y(t)/N(t)
- v = the crude birth rate
- u = the crude death rate
- a = the AIDS related death rate
- 1–e = the proportion of infected newborn born to infected mothers
- b = the probability of acquiring infection from an infected partner
- and, c = the average rate of acquiring partners

Under certain conditions, the population can either continue to grow, become stationary, or decline until it completely disappears. The key parameter of the model is "bc", which we will call the conditional risk of contracting infection. The product "bc*y(t)" is the rate at which adults acquire infection when a proportion of the population is already infected. Attrition of the population over the long run can only occur when:

(I) $R_0 = bc/(u+a) > 1$, that is when the reproductive rate of infection is greater than 1

and, (II) $(u+a)*(bc-v-a)/(bc-u-a) > ev$

When the population continues to grow, the prevalence of infection tends towards a limit, y*, and the rate of population growth tends towards r*. When population growth is halted by AIDS, there is a time, Tc, at which attrition starts. All these values can be computed analytically from the prevailing set of parameters and the initial proportion of people infected.

Values of the parameters that were used are displayed in Table 2. The birth rate, death rate and per cent infected at time 0 were those observed in the Niakhar population. Values of the crude AIDS death rate, mean length of incubation period (10 years) and proportion of infected newborn born to infected mothers (30 per cent) were taken from the literature. The key parameter, bc, was allowed to vary over a wide range of values from .05 to .80 to suit virtually any plausible situation.

TABLE 2

BASIC PARAMETERS OF THE DEMO-EPIDEMIOLOGIC MODEL

Initial conditions:		
Niakhar data		
v =	0.050	crude birth rate
u =	0.020	crude death rate
dt =	0.005	proportion infected at time t=0
Published data		
al =	0.100	crude AIDS related death rate
ip =	10.00	mean incubation period (1/al), years
1-ep =	0.300	proportion of infected newborn born to infected mothers
Variable		
bc =	0.163	value given is the critical conditional risk of infection
Consequences		
r =	0.030	rate of population growth (without AIDS)
lb =	0.043	rate of growth of infected population
tt =	0.115	AIDS death rate (adults + children)
aa =	0.013	difference between growth rates
bb =	0.048	a+ev
R_0 =	1.358	basic reproductive rate
r/tt =	0.261	ratio of population growth rate/AIDS death rate
lb/bc =	0.264	ratio of infected growth rate/risk of infection

RESULTS

HOMOGENEITY

Assuming first homogeneity of sexual behaviour, the model was run with these parameters. The results are shown in Table 3. When bc is lower than .120, the basic reproductive rate is lower than 1; when bc is between 1.20 and 1.63 the population continues to grow despite the persistence of the epidemic. However, when bc is higher than 1.63 population growth will eventually become negative. This may take 82.4 years when bc=.20 or only 6.5 years when bc is 0.80. The critical value appears to be bc=.163.

TABLE 3

RESULTS OF SIMULATIONS ACCORDING TO VARIOUS VALUES OF BC (HOMOGENOUS POPULATION)

Risk of acquiring infection	Doubling time of infected population	Basic reproductive rate	Population growth positive/negative	Time at which growth becomes negative
bc	T_2	R_0	r	Tc
0.050	NA	0.42	+	NA
0.100	NA	0.83	+	NA
0.120	NA	1.00	+	NA
0.150	NA	1.25	+	NA
0.163	76.9	1.36	0	NA
0.200	20.0	1.67	–	82.4
0.250	10.0	2.08	–	41.7
0.300	6.7	2.50	–	27.9
0.400	4.0	3.33	–	16.8
0.500	2.8	4.17	–	12.1
0.600	2.2	5.00	–	9.4
0.700	1.8	5.83	–	7.7
0.800	1.5	6.67	–	6.5

Note: NA = Not applicable.

Values of bc = .163 cannot be achieved in the female population of Niakhar, since c=.136 and b<1. But they can be achieved by the male population, since c=.876, that is as soon as b>.186. A high value of b is possible in stable relationships, but is probably unrealistic in occasional sexual relationships. In any case, the AIDS epidemic is more likely to be spread by men than by women in this situation. And the high risk population seems to be young unmarried men aged 20-29 years.

HETEROGENEITY

The effect of heterogeneity in sexual behaviour on the conditional risk of acquiring the infection over time was also investigated through simulation. Cut-off points were taken after 5, 15, 25 and 35 years of exposure. The effect of heterogeneity was simulated by employing various β functions, with a mean bc varying from .100 to .800 and a standard deviation range of .075 to.100. The results in Table 4 show that heterogeneity will compensate to a large extent for high values of the mean. For instance, with bc=.200, whereas in a homogenous population the growth rate will tend to be negative, in a

heterogenous population the value of the risk of infection will fall below the critical value of .163 after just 5 years of exposure. Only at high values of bc will the effect of heterogeneity be insufficient to prevent population attrition.

TABLE 4

EFFECT OF TIME ON THE CONDITIONAL RISK OF INFECTION IN A HETEROGENOUS POPULATION (MODEL IS A β FUNCTION)

Parameters of the β function	Value of conditional risk of infection, bc Number of years after beginning of exposure: 0	5	15	25	35
1.5,13.5	0.100	0.072	0.057	0.047	0.040
1.8,10	0.150	0.103	0.079	0.064	0.054
3,12	0.200	0.149	0.119	0.099	0.085
6,14	0.300	0.240	0.200	0.171	0.150
9.2,13.8	0.400	0.329	0.279	0.242	0.214
12,12	0.500	0.414	0.353	0.308	0.273
13.8,9.2	0.600	0.493	0.418	0.363	0.321
14,6	0.700	0.559	0.466	0.400	0.350
12,3	0.800	0.600	0.480	0.400	0.343

The effect of variance, that is of the intensity of heterogeneity, was also simulated by taking β distributions with the same mean and different standard deviations.

TABLE 5

EFFECT OF VARIANCE ON THE CONDITIONAL RISK OF INFECTION IN A HETEROGENOUS POPULATION (MODEL IS A β FUNCTION)

Standard deviation of the risk	Value of conditional risk of infection, bc Number of years after beginning of exposure: 0	5	15	25	35
0.01	0.200	0.197	0.197	0.197	0.197
0.02	0.200	0.191	0.189	0.187	0.186
0.03	0.200	0.186	0.182	0.178	0.175
0.04	0.200	0.180	0.172	0.166	0.161
0.05	0.200	0.172	0.162	0.153	0.146
0.06	0.200	0.164	0.151	0.140	0.131
0.07	0.200	0.155	0.139	0.127	0.117
0.08	0.200	0.145	0.127	0.114	0.104
0.09	0.200	0.134	0.115	0.101	0.091
0.10	0.200	0.123	0.103	0.090	0.080
0.15	0.200	0.052	0.038	0.032	0.029

A lower standard deviation implies more homogeneity in the risk of acquiring infection while a higher standard deviation implies the reverse. The results in Table 5 show that for a mean value of bc=.200, values of standard deviation of .05 are sufficient to compensate for attrition and convert population growth to positive.

Sexual behaviour is certainly heterogenous, especially for men in Niakhar. This heterogeneity will probably play a moderating role in the spread of the epidemic. It will tend to reduce the long term demographic impact below that which would be expected in the case of homogenous behaviour.

DISCUSSION

The ultimate impact of the HIV epidemic on demographic growth is debatable and we do not have all the parameters required to make a reasonable assessment of the outlook for Niakhar. The rapid spread of the epidemic in some areas is frightening. But it may be primarily due to a selection of high risk people, that is those who because of their behaviour are most likely to become infected. The size of the susceptible population in a probabilistic perspective, that is the proportion of the population likely to eventually be infected, may well be much lower than 1, except in extreme cases. Heterogeneity of sexual behaviour may indeed play a more important role than has hitherto been assumed.

Furthermore, health education campaigns have been started in virtually all African countries. These may have an impact on sexual behaviour, at least as regards use of condoms and the reduction of high risk behaviour. The discovery of a vaccine or efficient treatment could also radically change the picture.

The fact that HIV is spreading rapidly in many African countries is partly due to local patterns of sexual networking and partly due to cofactors of infection, e.g. the sometimes widespread existence of other sexually transmitted diseases. In other words, the "b" component of the "bc" parameter (the risk of acquiring infection from an infected partner) may play a relatively large role compared to the "c" component (the rate of acquiring partners). Too little attention seems to have been devoted to this first parameter. Systematic screening of sexually transmitted diseases and their treatment may be a powerful means of controlling the growth of the infected population.

Very fast growth rates of the infected population have been documented in certain high risk groups: for instance 68.1 per cent per year among prostitutes in Nigeria (Anderson *et al.*, 1988). Similar values were found recently in Chieng Mai, Northern Thailand, where the proportion of infected prostitutes rose from 0.98 per cent in October 1988 to 64.0 per cent in June 1990 (Thai Ministry of Public Health, 1990). A key factor of the growth rate of

infection in the general population may be the annual contact rate with high risk groups, rather than the rate of acquiring partners in the general population. Current models could be improved to better reflect variation in such conditions.

Finally, little attention has been devoted to the health education of young migrant workers. They are a very mobile category, usually with little or no modern education and are difficult to reach. However they may be one high risk category which may play a major role in the spread of the disease. So far, the prevalence of HIV infection has been low in Niakhar as in the general population of Senegal, about 0.5 per cent from various estimates. There is still time to tackle these issues with appropriate means.

REFERENCES

Anderson, R.M., G.F. Medley, S.P. Blythe and A.M. Johnson. 1987. Is it Possible to Predict the Minimum Size of the AIDS Epidemic in the UK ? *Lancet*: 1073-1075.

Anderson, R.M. and R.M. May. 1988. Epidemiological Parameters of HIV Transmission, *Nature*, 333 (9 June): 514-519.

Anderson, R.M., R.M. May and A.R. McLean. 1988. Possible Demographic Consequences of AIDS in Developing Countries, *Nature*, 332, (17 March): 228-234.

Anderson, R.M., S. Gupta and T.W. Ng. 1990. The Significance of Sexual Partner Contact Networks for the Transmission Dynamics of HIV, *J. AIDS*, 3:417-429.

Becker, C. 1991. Etude anthropologique sur les migrations, la nuptialité et les comportements sexuels chez les Sereer du Senegal, Rapport ANRS, Paris.

Bongaarts, J. 1988. A model of the spread of HIV infection and the demographic impact of AIDS, Population Council, New York.

Brookmeyer, R. and M.H. Gail. 1986. Minimum Size of the AIDS Epidemic in the United States, *Lancet* (6 December): 1320-1322.

Brookmeyer, R. and M.H. Gail. 1988. A Method for Obtaining Short-term Projections and Lower Bounds on the Size of the AIDS Epidemic, *JASA*, 83(402): 301-308.

Brookmeyer, R. and A. Damiane. 1989. Statistical Methods for Short Term Projections of AIDS Incidence, *Statistics in Medicine*, 8:23-32.

Curran, J.W., *et al.* 1985. The Epidemiology of AIDS: Current Status and Future Prospects, *Science*, 229:1352-1357.

Gail, M.H. and R. Brookmeyer. 1988. Methods for Projecting the Course of the AIDS Epidemic, *Journal of the National Cancer Institute*, 80 (12):900-911.

Karon, J.M., T.J. Dondero and J.W. Curran. 1988. The Projected Incidence of AIDS and Estimated Prevalence of HIV Infection in the United States, *J. AIDS*, 1:542-550.

May, R.M. and R.M. Anderson. 1987. Transmission Dynamics of HIV Infection, *Nature*, 326:137-142.

McEvoy, M.and H.E. Tillett. 1985. Some Problems in the Prediction of Future Number of Cases of AIDS in the UK, *Lancet*:541-542.

Sheps, M.C. and J.A. Menken. 1973. Mathematical Models of Conception and Birth, University of Chicago Press, Chicago.

Tennison, B.R. and S. Hagard. 1988. AIDS: Predicting Cases Nationally and Locally, *British Medical Journal*, 297:711-713.

Thai Ministry of Public Health. 1990. HIV/AIDS situation and surveillance in Thailand, (September), Bangkok.

SEXUAL NETWORKING AND THE RISK OI AIDS IN SOUTHWEST NIGERIA

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INTRODUCTION

Sexual networking, defined as the number of different sexual partners of eac individual, is believed to be at levels in southwest Nigeria at least as high as those found i those parts of East and Southern Africa acutely affected by AIDS. The research outline here was designed to test this belief. It is associated with other research in southern Niger and Ghana with parallel aims (Orubuloye, 1990a; Bakare, 1990).

The research described in this paper, The Ekiti Study, consists of two parts: (I) Tl Ekiti Survey which was carried out in 1989-90 as an in-depth demographic survey, aimir at defining the present situation (Orubuloye, Caldwell and Caldwell, 1990), and (II) number of focused anthropological studies and associated library research aiming examining changes over time (Caldwell, Orubuloye and Caldwell, 1990; Caldwel Caldwell and Orubuloye, 1990).

Ekiti is the far northeastern corner of the Yoruba culture area of southwest Nigeria. forms the northernmost District of Ondo State. Like the rest of Yorubaland, it is, by Afric: standards and in terms of its per capita income, highly urbanized – a fact of son

PREFACE

This book contains a selection of the papers which were presented at the Seminar on Anthropological Studies Relevant to the Sexual Transmission of HIV held in Sonderborg, Denmark, from the 19th to the 22nd of November 1990. The meeting was organized under the auspices of the IUSSP Committee on Anthropological Demography whose members were Gilles Pison (Chair), Peter Aaby, Caroline Bledsoe, Monica Das Gupta, Tim Dyson and Valerie Hull.

The seminar and this volume would not have occurred without the assistance of several institutions and many individuals. Most important was the generous backing provided by the Danish Department of International Development Cooperation (DANIDA). DANIDA's support and foresight were vital to the seminar's success. We are also extremely grateful for additional assistance from the International Development Research Centre (IDRC) Canada, The Norwegian Agency for International Development (NORAD) and the Swedish International Development Agency (SIDA), as well as the very generous support of the United Nations Population Fund (UNFPA) and of the Hewlett Foundation.

All members of the Committee on Anthropological Demography helped in drawing up the agenda and list of participants for the seminar. But particular mention must be made of Peter Aaby's enthusiasm and enterprise which resulted in our meeting in Denmark. Invaluable assistance and advice as regards the seminar's organization were provided by the IUSSP secretariat in Liège, especially Bruno Remiche, the Union's Executive Secretary, and Irène Grignac and Joseph Leynen. I owe a special debt of gratitude to Marilyn Hynes in London, who has worked unflaggingly both as regards preparations for the seminar and apropos the production of this book. At various times help and useful counsel has come from many other people including Richard Atkins, Jette Bukh, Michel Caraël, François

SEXUAL BEHAVIOUR AND NETWORKING: ANTHROPOLOGICAL AND SOCIO-CULTURAL STUDIES ON THE TRANSMISSION OF HIV

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