Finnish Yearbook of Population Research 43 (2007–2008), pp.7–32

HIV and Fertility Decline in North-Central Namibia 1980–2004

RIIKKA SHEMEIKKA, Ph.D., M.Sc., Researcher[1]
VEIJO NOTKOLA, Ph.D., M.Sc., Docent[1], Managing Director[2]
JAN KUHANEN, Ph.D., Researcher[3]
HARRI SIISKONEN, Ph.D., Docent, Professor of General History[3]

[1]Population Research Unit, Department of Sociology, University of Helsinki, Finland
[2]Rehabilitation Foundation, Helsinki, Finland
[3]Department of History, University of Joensuu, Finland

Abstract

The aim of this study was to estimate the development of fertility and the impact of HIV on this development in North-Central Namibia from 1980 to 2004. The main sources of data consisted of parish registers for eight Evangelical Lutheran congregations, the 1992 and 2000 Namibia Demographic and Health Surveys and the 1991 and 2001 population censuses. Developments in fertility were studied using the total fertility rate (TFR), age-specific fertility rates (ASFR), and standardized fertility distributions. The results show that fertility declined from 5.0 in 1980–89 to 4.1 in 1990–99 and to 3.5 in 2000–04. Among women in the 25–29 age group and older, fertility declined, while fertility among adolescents increased. Both age at first marriage and premarital fertility increased during the study period. During the 1990s, HIV infection explained 25–29% of the decline in total fertility. If mortality continues to increase as a result of the HIV epidemic while fertility continues to decline, both because of HIV infection and for other societal reasons, the implications for future population growth rates and the country's demographic structure are pronounced.

Keywords: Africa, Namibia, fertility, HIV, AIDS

Introduction

Fertility transition and the HIV epidemic are the two major demographic issues in sub-Saharan Africa

Southern Africa is a focal point for the two major current demographic issues currently affecting sub-Saharan Africa, fertility transition and the HIV pandemic. Although these two phenomena are independent, they interact.

Fertility transition, i.e. a decline from high to low levels of fertility, combined with a shift from a natural fertility regime in which parents do not consciously attempt to

limit the number of their births or to space them, to fertility controlled by means of contraceptives and abortions (Leridon 1975, for definitions of natural fertility, see also Shemeikka 2006, 16–17), has been the subject of many different explanations. Current explanations for the decline in levels of fertility include, for example, declining mortality levels, changes in the costs and benefits related to having children, the transformation of families towards a nuclear model, improved access to effective methods of fertility regulation, the diffusion of ideas that family size should be limited and methods for achieving this, and government policies which promote the use of family planning techniques (see e.g. Bulatao 2001; Shemeikka 2006).

When sub-Saharan Africa 'joined' the global decline in fertility, it was parts of southern Africa, namely South Africa, Botswana and Zimbabwe, that were the forerunners, together with Kenya from eastern Africa (e.g., Letamo and Letamo 2002; Moultrie and Timæus 2003; Muhwava 2002; White, Hall and Wolf 2007). South Africa entered fertility transition during the 1960s whereas Botswana 'joined' in the late 1970s or early 1980s. In Zimbabwe, fertility declined during the war in the 1970s, remained stable in the post-war period and began to decline again in the 1980s. Among the other countries of southern Africa, sustained fertility decline is also ongoing in Lesotho and Swaziland, while fertility is declining at a slower pace in Mozambique, Zambia and Malawi (Potts and Marks 2001).

A decline in fertility is also ongoing in Namibia (Garenne 2007; Garenne and Joseph 2002; Kirk and Pillet 1998), but the limited availability of data has made it difficult to estimate the onset of fertility decline with any precision. According to estimations by Garenne (2007) based on both census and Namibia Demographic and Health Survey (NDHS) data, fertility decline probably started in the early 1960s in urban areas and in the mid-1970s in rural areas. There are large regional differences in the state of fertility transition within Namibia (Tabutin and Schoumaker 2001). At the beginning of independence, which Namibia gained in 1990, fertility was highest in northern Namibia and other regions which were the so-called "homelands" (Bantustans) during the period of South African colonial rule (Raitis 1995; Shemeikka 2006). One of these regions is the former Ovamboland region, currently known as North-Central Namibia. Earlier research based on parish registers shows that fertility levels began to decline in North-Central in the late 1970s (Notkola and Siiskonen 2000; Shemeikka, Notkola and Siiskonen 2005; Shemeikka 2006).

During the 1990s, in parallel with the strengthening of fertility transition, the focus of the HIV pandemic shifted from central and eastern areas of the continent to southern Africa (Kalipeni, Craddock and Gosh 2004). Currently, 35% of the world's HIV-infected individuals live in southern Africa (UNAIDS and WHO 2007), and in Botswana, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe 15% of adults were HIV-infected in 2007. Namibia belongs to the group of countries affected

most severely by the HIV epidemic. At national level, HIV prevalence among pregnant women increased from 4% to 20% between 1992 and 2006 (GRN/MoHSS 2007).

During the 1990s, the prevalence of HIV infection among pregnant women increased very rapidly in North-Central Namibia, with the rate of increase being higher than the average for the country as a whole. By 2006, average HIV-prevalence at sentinel sites located in North-Central Namibia was 24% (GRN/MoHSS 2007) after reaching 25% in 2002 and declining slightly to 22% in 2004. It seems that after a rapid increase in the 1990s, HIV-prevalence has now stagnated at a high level, with further growth only slow or non-existent. At three out of the five sentinel sites located in North-Central Namibia, HIV-prevalence decreased between 2002 and 2004, at the other two sites it remained unchanged (GRN/MoHSS 2005). Between 2004 and 2006, however, results from HIV sentinel surveillance show an increase in HIV-prevalence at four out of the five sentinel sites.

Earlier research on fertility in Namibia and fertility-HIV-connections in sub-Saharan Africa

Until independence, both reliable data for use in demographic analysis related to Namibia and demographic research focusing on the country were scarce. In the early 1990s, small-scale surveys collected information on contraception in selected regions (Ahrenson-Pandikow 1992; Namibia Development Trust 1994; UNICEF Namibia 1990). The major sources of demographic data that provide information on fertility in Namibia are the 1992 and 2000 NDHS and the 1991 and 2001 Population and Housing Censuses. These data have been used in studying regional and socioeconomic differentials in fertility (Arowolo 2000; Hamata n.d.; Raitis 1995). NDHS data has also been used in some of the comparative studies on fertility transition in sub-Saharan Africa (e.g. Garenne 2007; Garenne and Joseph 2002; Kirk and Pillet 1998; Taboutin and Schoumaker 2001). Teenage pregnancies, premarital fertility and adolescent sexuality have all been studied using the NDHS data and data sets collected specifically for this purpose (Chimere-Dan 1997; Gage 1998; Garenne and Zwang 2006; Hailonga 1993, 2005). The 2006 NDHS, data collection for which was completed in March 2007, will soon provide novel information concerning fertility levels in Namibia and their determinants.

Reliable fertility data dating from the period before independence, which Namibia gained in 1990, is rare. North-Central Namibia is, however, an exception among Namibian regions in the sense that a long-term data set detailing vital events involving the population - parish registers from Evangelical Lutheran congregations – does exist. These parish registers provide an opportunity to study fertility levels in a setting where there is a recent onset of fertility decline and a high prevalence of HIV. This data has been used in research into demographic development in Northern Namibia (e.g. Lemström 1999; Notkola and Siiskonen 2000; Notkola, Timæus and Siiskonen 2000;

Shemeikka et al. 2005) and in studies of the demographic and social consequences of HIV in the region (e.g. Kuhanen et al. 2007; Notkola, Timæus and Siiskonen 2004; Shemeikka and Notkola 2005; Shemeikka et al. 2007).

Until now, connections between fertility levels in Namibia and HIV have only been studied by the authors of the current paper (Shemeikka and Notkola 2005; Shemeikka et al. 2005; Shemeikka 2006). Studies from Namibia and from elsewhere in sub-Saharan Africa show that HIV infection is associated with reduced levels of fertility (e.g. Fabiani et al. 2006; Glynn et al. 2000; Gray et al. 1998; Hunter et al. 2003; Lewis et al. 2004; Ntozi et al. 1997; Shemeikka and Notkola 2005). Lower fertility levels can partly be explained by lower rates of conception and increased rates of foetal loss among HIV-infected women compared to HIV-negative women (Carpenter et al. 1997; Crampin et al. 2003; Gray et al. 1998). The fertility reduction experienced by HIV-infected women starts at the earliest asymptomatic stage of their disease and increases as the HIV disease progresses (Ross et al. 2004; Sedgh et al. 2005). Co-infections with other sexually-transmitted diseases explain a proportion of the reduced levels of fertility among HIV-infected women (Gray et al. 1998; Zaba and Gregson 1998). Possible behavioral changes associated with the HIV epidemic, e.g. the increased use of condoms, can affect fertility levels for the whole population (Kamala et al. 2000; Rotenberg, Biddlecom and Kaona 2000; Terceira et al. 2003).

Aims of the study

The primary aim of this study is to assess the development of fertility in North-Central Namibia from 1980 to 2004 and to assess the role played by HIV in this development. The detailed aims of the study are: 1) to provide detailed information on developments in fertility levels and the age structure of fertility between 1980 and 2004 – until now, the most up-to-date information relating to fertility has been the 2001 census, 2) to assess the impact of HIV epidemic on fertility both at individual and at population level.

The paper begins with an assessment of changes in fertility levels in the study population in the period 1980–2004. Secondly, estimates are made of the impact of HIV on fertility among infected women and of the contribution of the HIV epidemic to fertility decline at population level. Thirdly, changes in other fertility determinants during the study period are assessed. Finally, the results are discussed.

Data and methods

The primary source of data in this study is the parish registers of eight congregations belonging to the Evangelical Lutheran Church in Namibia (ELCIN). Data from the 1991 and 2001 Population and Housing Censuses is also employed. Information provided by the 1992 and 2000 NDHS is used, for example, when estimating changes in fertility determinants. Estimates of HIV-prevalence are based on the HIV sentinel surveillance of pregnant women. Annual reports by the health authorities and Lutheran medical services are also utilized. Additional information on background factors affecting fertility was obtained from interviews carried out by the research group in the study region in 1994 and 2006.

The study region is North-Central Namibia, the former Ovamboland. Selection of this region for study was based on the fact that ELCIN parish registers, a unique data set, are available for a number of congregations in this region. The time period for the study, which covers both the time before and after the onset of the HIV epidemic, is 1980–2004. At the beginning of the study period, fertility in the study region had recently begun to decline. The first HIV diagnoses in Namibia were made in 1986 (Slotten 1995).

Parish registers of North-Central Namibia

Background information on the study region

The eight congregations included in this study – Elim, Nakayale, Oshigambo, Okahao, Tshandi, Onankali, Oshitutuma and Omulonga (Figure 1) – are located in North-Central Namibia, a region known as Ovamboland during the periods of German and South African colonial rule. Currently, the former Ovamboland region (called North-Central Namibia in this study) is part of four administrative regions, Ohangwena, Omusati, Oshana and Oshikoto, which formed the Northwest Health Directorate until the early 2000s. In 2001, more than 780,000 people, 43% of the Namibian population, lived in these four regions (GRN/NPC 2003). The Ohangwena, Omusati, Oshana and Oshikoto regions are ethnically homogenous, with 87–97% of their populations speaking interillegible Ovambo dialects at home.

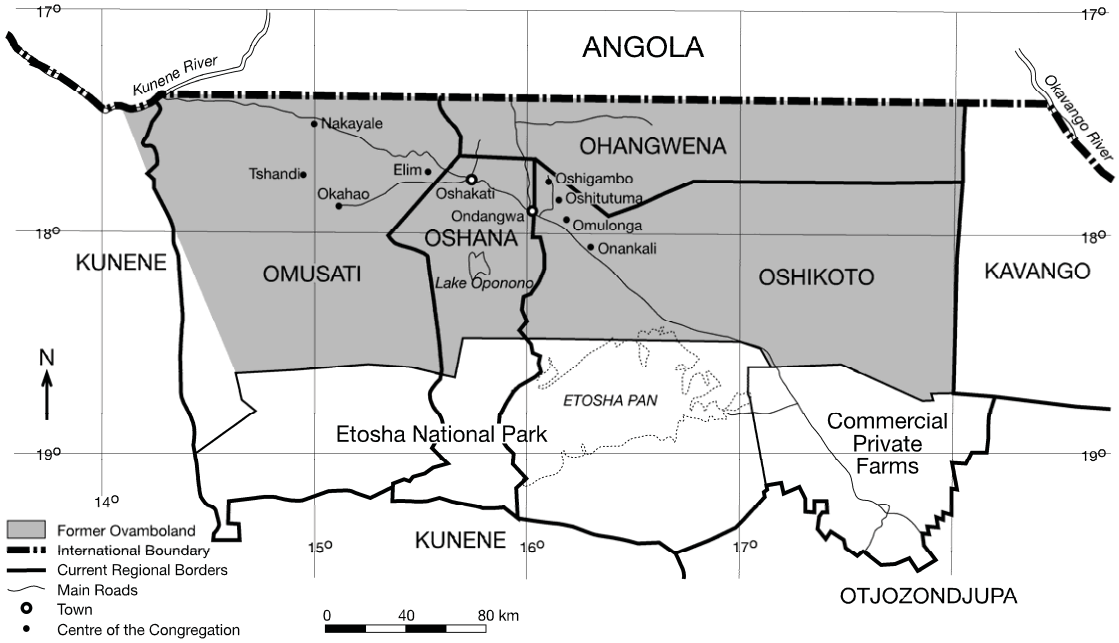

Figure 1. Study region and sample congregations. Source: Shemeikka 2006.

The former Ovamboland was one of the "homelands", or Bantustans, created as a result of the apartheid policy followed by South Africa. The region served as source of labor for farms, mines and enterprises located in southern and central parts of the country. Movement between Ovamboland and other regions was restricted. The migration of male labor through a contract labor system was common. Restricted opportunities to earn income in North-Central Namibia have resulted in labor migration continuing after the abolishment of the contract labor system and during independence up to the present day. The main source of income in North-Central Namibia is subsistence farming (GRN/NPC 2006). While alternative sources of income and opportunities to obtain higher education are limited, their number is growing as a consequence of expanding urban centers, especially in the Oshakati-Ongwediva-Ondangwa area, and by the Northern Campus of the University of Namibia (Phororo and Venditto 2003). The study region was heavily affected by the war of liberation (1966–1989).

Parish registers

The Scandinavian-type parish register system was introduced by Finnish missionaries and has continued with only small modifications until the present day (Siiskonen, Taskinen and Notkola 2005). Parish register systems consist of registers that include, for example, baptisms, deaths and migrations and a family book (also called main book) which aggregate such events at family level. Parishioners thus participate in a vital registration system. Since the 1960s, 60–70% of the population of the study region have been members of ELCIN, while data from the 1992 and 2000 NDHS shows that almost all women aged 15–49 years identified themselves as being either Protestants or Roman Catholics. In 2000, 85% identified themselves as Protestants. (Shemeikka 2006.)

Parish register data has a tendency to omit children who die before baptism, a feature which resulted in a deficiency of 0.2–0.7 children in the total fertility rate in the 1960–2000 period (for details, see Shemeikka 2006). Sex ratio at birth in the period 1980–2004 was 95.4 boys per 100 girls, indicating the modest effect of under-registration of children dying before baptism. According to Garenne (2004), the sex ratio at birth at national level in Namibia was 98.5 in 1992.

Fertility analysis

Registers and main books belonging to the sample congregations were microfilmed or photographed. Information on the marriage cohorts in 1956–2004, i.e. all the couples married in this period, was then collected from these registers. The data set was built using the Family Reconstitution Method (Notkola and Siiskonen 2000; Wrigley 1966). The resulting data includes information about couples and baptisms, deaths, migrations, confirmations and some other family events. The follow-up period continued until early 2005. The number of women included in the 1980–2004 fertility analysis totalled 2,835.

In fertility analysis, follow-up of women began on each individual's fifteenth birthday or, if she was an adult convert, at her baptism. The data therefore also includes information on births occurring before a woman was married. In cases where the date of baptism was unknown, follow-up began from the date of a woman's marriage. Follow-up ceased if a woman was excommunicated from the parish or migrated out of it, and started again when she returned. If the date of woman's migration into a parish was not known, she was not included in the data except in cases where she had migrated before getting married. In such cases, follow-up began from the date of marriage. Follow-up ended when a woman died or when she reached the age of 50.

Parish register data was used to study changes in levels of fertility in the 1980–2004 period. As register-based data allow for direct methods of estimating fertility, this was studied using Age-Specific Fertility Rates (ASFR) and the Total Fertility Rate (TFR). Standardized fertility distributions, which show the age pattern of fertility when the TFR is set to 1 (cf. Moultrie and Timæus 2003) were used when estimating changes in the age structure of fertility.

Analysis of the impact of HIV on fertility

The impact of HIV on fertility was estimated in an indirect way by comparing the fertility histories of women who died at an age of less than 50 years in 1990 and thereafter to the fertility of women who survived until the end of their reproductive period. Chosen because data from parish registers does not include any information on a person's HIV status or their cause of death, this indirect method is based on information from several reports and studies based on both the study region and other regions of southern Africa. These reports and studies state that during the 1990s and

thereafter, a significant proportion of deaths among women of reproductive age was (and continues to be) the result of HIV infection (see e.g. Hosegood, Vanneste and Timæus 2004; Le Coeur et al. 2005; Onandjokwe DDC 2003; Onandjokwe Lutheran Medical Service 1999; van Dillen, Meguid and van Roosmalen 2006). Notkola and his colleagues (2004) found out that during the HIV epidemic, the mortality of women aged between 20 and 64 years was 3.5 times higher than it was before the epidemic. It can therefore be postulated that roughly two out of every three deaths resulted from infection by HIV. To confirm the connection between HIV infection and fertility reduction, a similar comparison was made for a period prior to the HIV epidemic.

The fertility histories of 'HIV-positive' women (i.e. women who died at an age of 50 or less in 1990 or later) were compared with the histories of 'HIV-negative' women (i.e. women who survived beyond childbearing age) using ASFR and TFR. The fertility of 'HIV-positive' and 'HIV-negative' women in the period 1980–2000, and also the fertility of 'HIV-positive' women in the periods 0–10 years before death and 11–20 years before death were examined. The impact of widowhood on fertility reduction was studied by separately investigating women who had outlived their husbands. A total of 81 women had died at an age of less than 50 in 1990 or later, and of these, 16 were widowed before they died. In three cases the husband and wife died in the same year, and in seven cases the husband died after his wife.

The effect of the HIV epidemic on fertility at population level was estimated by applying the age pattern and magnitude of the HIV-associated fertility reduction found in parish registers to fertility levels in the study region based on the Population and Housing Censuses, and to the female population of the study region after division into sub-populations by HIV status. The most important source of information on the state of the HIV epidemic in Namibia is HIV tests on pregnant women, i.e. HIV sentinel surveillance (for details, see Shemeikka 1999). These tests provide information on HIV-prevalence, i.e. the proportion of pregnant women infected by HIV. Information on new infections occurring among the population, i.e. the incidence of HIV, is limited in Namibia, as it is in most of the countries of sub-Saharan Africa. Information acquired from HIV sentinel surveillance on HIV-prevalence among pregnant women was converted into data for HIV- and AIDS-prevalence in the whole female population using *DemProj* and the *Spectrum System AIDS Impact Model* (*AIM*) software developed by the Futures Group. The influence of HIV infection on fertility was then studied using *PDEPROJ* software developed at the International Institute for Applied Systems Analysis (IIASA).

Population censuses

The first Population and Housing Censuses carried out in independent Namibia were conducted in 1991 and 2001. Information collected in these censuses was published as aggregate-level data tables with several different regional divisions (e.g. GRN/NPC

1994a, 1994b, 2003, 2004a, 2004b, 2005a, 2005b), and the main results were also published as analytical reports (e.g. GRN/NPC 1994b, 2003). Moreover, *Statistics Namibia* produced some extra census tables from the 1991 Population and Housing Census for five out the eight sample congregations (GRN/NPC 1994c). These extra tables were used when estimating fertility in sample congregation areas. Fertility estimations from aggregate-level census tables were made by employing the P/F ratio method (see e.g. United Nations 1983). Data on the size and age structure of the female population required to estimate the impact of the HIV epidemic on fertility was also obtained from census tables.

Interview data

When assessing background factors affecting levels of fertility, interviews conducted in the study region in 1994 and 2006 were utilized (Interview data 1994, 2006). In 1994, using a semi-structured interview method, eleven women aged 18–78 and living in the Oshana and Ohangwena regions were interviewed on topics associated with marriage and reproduction. In 2006, the open-ended interview technique was applied in interviews handling topics connected with the influence of the HIV epidemic on families. A total of 46 interviews were conducted, eight with child or junior-headed households, 13 with single-parent households, 14 with caregiver households, one with a focus group, and 10 with key informants. These interviews were conducted in the Oshana and Oshikoto regions.

Results

Trends in fertility

The study period of 1980–2004 was characterized by a sustained decline in fertility. After being 6.4 children per woman in 1960–69 and 6.5 in 1970–79 (Shemeikka et al. 2005), the TFR fell to 5.0 in 1980–89. The decline continued in the 1990s. In 1990–99, the TFR was 4.1 and in 2000–2004 it was 3.5. Based on yearly estimates using parish register data, the TFR fell from just under six to slightly more than three children per woman between 1980 and 2004 (Figure 2).

Comparison of the age-specific fertility rates in the periods 1980–89 and 1990–2004 shows that during the 1990s and the 2000s, fertility declined in all women aged 25 years and older, but not in the two youngest age groups, i.e. women aged 15–19 and 20–24 (Figure 3). The typical age pattern of fertility for this region, in which peak levels of fertility are found during the central childbearing years (25–39 years), was identified once again in the present study, as it has been in several other studies based on population censuses, NDHS data, and parish register data (e.g. Raitis 1995; Shemeikka 2006). Standardized age-specific fertility rates show that the age distribution of fertility

changed slightly from 1980–1989 to 1990–2004. While the relative contribution of women in their central childbearing years to TFR stayed much the same, the role of younger women (15–24 years) increased while that of older women (40–44 years) was reduced. The TFR for 1990–2004 was 3.9, while for 1980–89 it was 5.0.

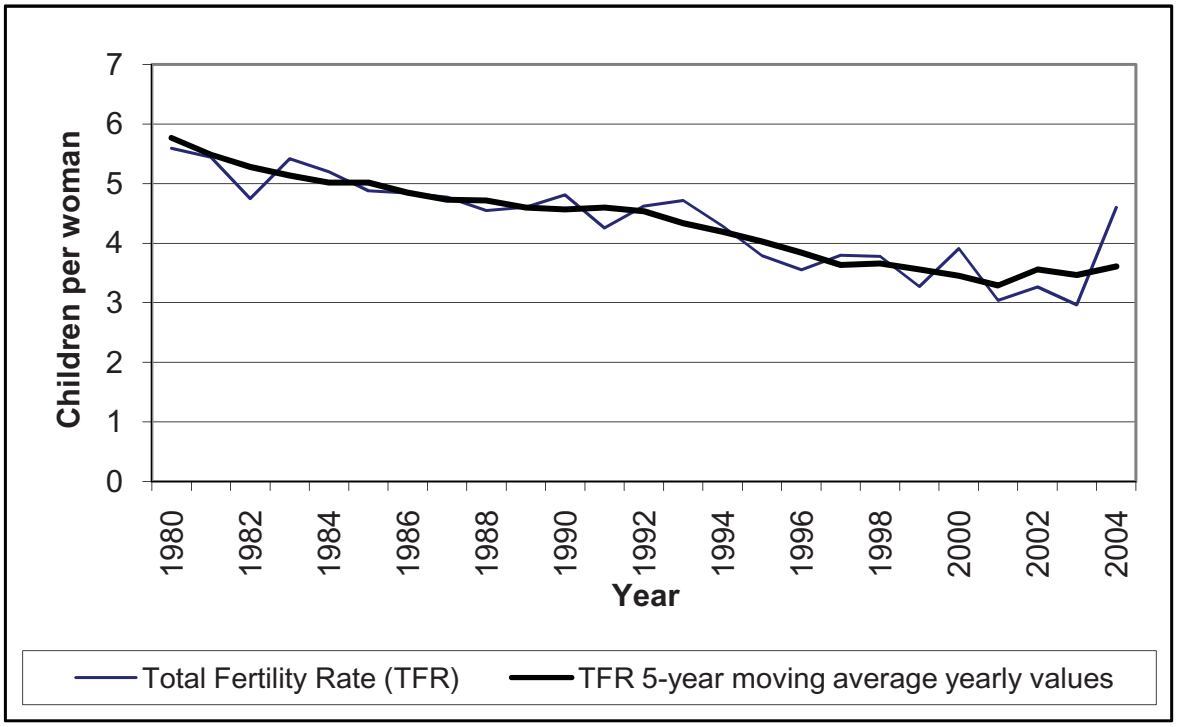

Figure 2. Total fertility rate in North-Central Namibia, 1980–2004.

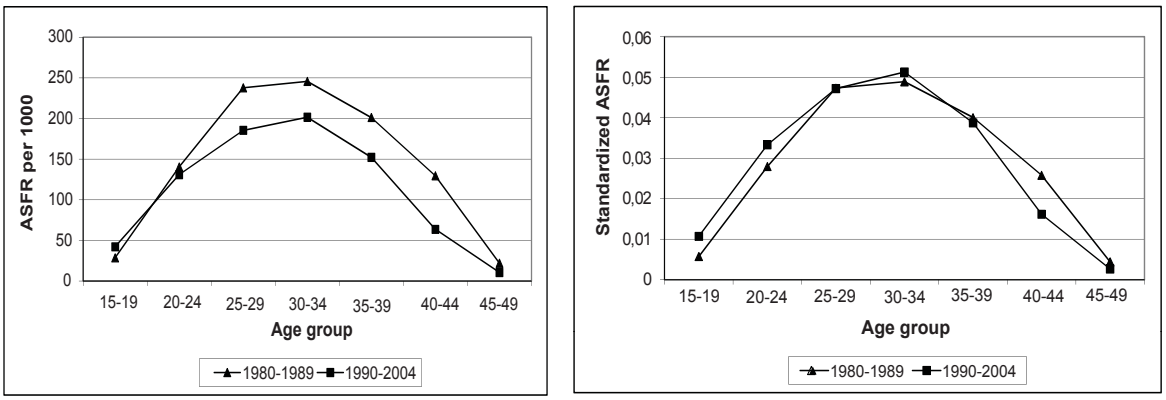

Figure 3. Age-specific fertility rates (ASFR) and the standardized age distribution of fertility in North-Central Namibia, 1980–2004.

The impact of HIV on fertility

Comparison of the fertility histories of women who died at an age of less than 50 years (classified as presumably HIV-positive) to the fertility of other women (classified as presumably HIV-negative) showed a clear reduction in fertility among the the presumably HIV-positive women. When comparing levels of fertility among these two groups

in 1980–2000, the reduction of fertility among 'HIV-positive women' was detectable in the 25–29 age group, whose fertility was 81% of that of 'HIV-negative women'. The difference between the two groups was, however, most pronounced in the 30–34, 35–39 and 40–44 age groups. In these age groups, the fertility of 'HIV-positive women' was 63–64% of that of 'HIV-negative women'. In the 1980–2000 period, the TFR of 'HIV-positive women' was 74% of that of 'HIV-negative women', being 79% during the 1980s and only 61% during the 1990s. Although HIV infection was not as common in the 1980s as it was in the 1990s, some of the women who died in the 1990s had become infected during the 1980s. An examination of the fertility histories of women who died at an age of 50 years or less before the HIV epidemic, i.e. in 1966–79, did not show any reduction in fertility before death. The situation was in fact quite the opposite, since their fertility was slightly higher than that of other women. This finding is likely to verify the link between HIV infection and the lower levels of fertility now identified.

Comparison of 'HIV-positive women' and 'HIV-negative women' showed that the reduction in fertility among the former is concentrated mostly in the period 0–10 years before death (Figure 4). There is also, however, a small decline in fertility in the period 11–20 years before death. Closer examination of this reduction in fertility revealed that a substantial part of this reduction can probably be explained by the death of spouse – by only including those women who outlived their husbands in the analysis, the reduction in fertility only occurred in the 30–34 age group and cumulative fertility until the age of 39 (i.e. the sum of age-specific fertility rates until age 39) was almost the same as that among 'HIV-negative women' in 1980–2000. In the period 0–10 years before their death, the TFR of 'HIV-positive women' was not related to the survival status of the husband, as a reduction in fertility levels was identified both among women who outlived their husbands and among women who were widowed.

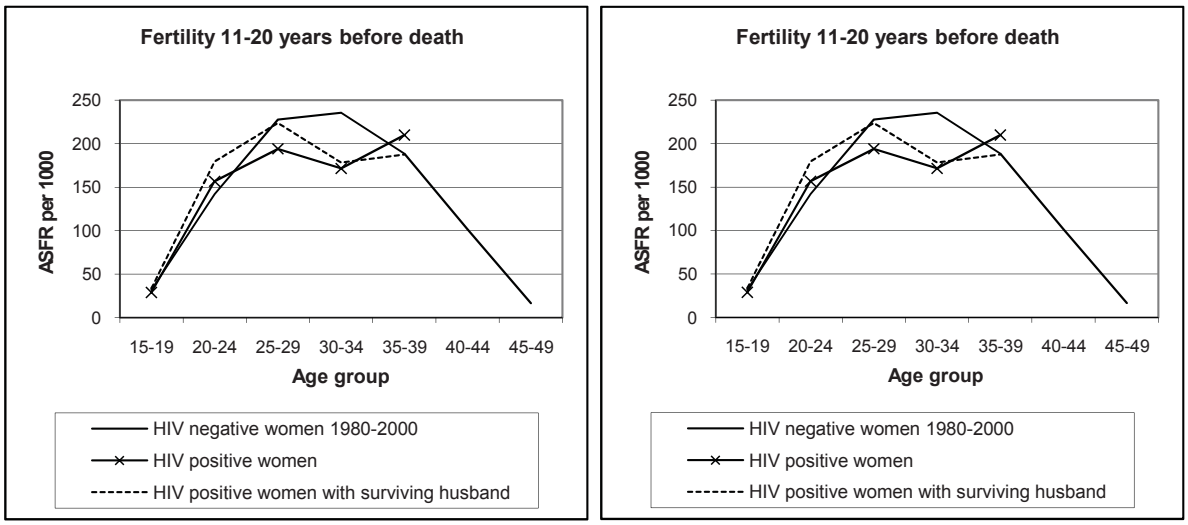

Figure 4. Age-specific fertility rates for periods 0–10 and 11–20 years before death, all 'HIV positive' women and 'HIV positive' women who have not been widowed.

The combination of the substantial fertility-reducing effect of HIV infection and the high level of HIV prevalence in the study region is resulting in a situation where the HIV epidemic is contributing to fertility decline at population level, i.e. in the average fertility of all women, not only those infected by HIV. The magnitude of this effect was estimated by combining the age pattern and size of the HIV-associated fertility reduction found in parish registers to the level and age structure of fertility in the study region based on population census data, and to the population of the study region after its division into sub-populations by HIV status. Based on census data, the TFR of the whole population was 4.4 children per woman. This was found to consist of a TFR of 4.8 among 'HIV-negative women' and a TFR of 3.7 among 'HIV-positive women'. In other words, the fertility of 'HIV-infected women' was 1.1 children lower than that of women not infected by HIV. At population level, the HIV epidemic resulted, on average, in a fertility reduction of approximately 0.4 children per woman.

On the basis of these fertility rates, the number of children born in the region in 2001 was 24,100. If fertility rates had not varied according to HIV status, i.e. if the TFR of the entire population had been 4.8, the number of children born would have been 25,900. Lower fertility among HIV-positive women thus resulted in some 1,800 (7%) fewer children being born than would have been the case if fertility did not vary according to HIV status.

According to the estimates from 1991 and 2001 census data (calculations based on data tables from GRN/NPC 1994a, 2003) and the results of the 1996 Intercensal Demographic Survey (GRN/NPC n.d.), the TFR the former Northwest Health Directorate fell from 6.8 in 1991 to 5.3 in 1996, and then to 4.4 in 2001. Census-based estimates from the sub-regions in which the sample congregations are located show somewhat lower fertility levels in both 1991 and 2001, i.e. 5.7 and 4.0, respectively (calculations based on data tables from GRN/NPC 1994c, 2004a, 2004b, 2005a, 2005b). On average, the census-based estimations of TFR for congregation regions in 1991 and 2001 were 0.7 children lower than those based on parish register data. The age-pattern of fertility in the congregation regions was very similar in parish register-based and census-based estimates (for more-detailed comparisons of census- and parish register-based estimates, see Shemeikka 2006).

Over the same period, the prevalence of HIV among pregnant women increased from 4% in 1992 to 24% in 2000. In their research based on several regions in eastern and central Africa, Zaba and Gregson (1998) determined that a one percent increase in female HIV-prevalence was associated with a 0.4% decline in total fertility at population level, a finding which is in line with the results of the present study based on parish registers. Estimated in this way, the reduction in TFR at population level resulting from the HIV epidemic would have been less than 2% at the beginning of the 1990s

and almost 10% in 2000. This equates to a reduction of 0.1 children per woman in the TFR in the early 1990s and 0.4–0.5 children per woman in the TFR in 1996–2000.

When the reduction in fertility levels caused by HIV infection is considered in the context of the general fertility decline in the study region, the HIV epidemic would appear to have been one important factor in the process. In Figure 5, the magnitude of the fertility reduction resulting from HIV infection is illustrated in the context of levels of total fertility and also compared to the level of total fertility in the former Northwest Health Directorate based on data from the 1991 Population and Housing Census. The first year for which HIV sentinel results exist is 1992. HIV infection explained more than a quarter (25–29%) of the decline in TFR during most of the 1990s. The absolute reduction in total fertility was at its highest level (0.52 children) in 1998.

In this comparison, the estimate of HIV prevalence is based directly on the prevalence of HIV among pregnant women. This could somewhat underestimate the real level of HIV prevalence among all women. According to calculations by Heuveline (2003), this underestimation increases as the duration of the epidemic increases and after 15 years of the epidemic, HIV prevalence among pregnant women is 90% of that among all women. In the study region, this would mean that in 2001, the reduction in the number of births that can be attributed to HIV infection would be 0.54 children rather than the 0.48 children presented in Figure 5.

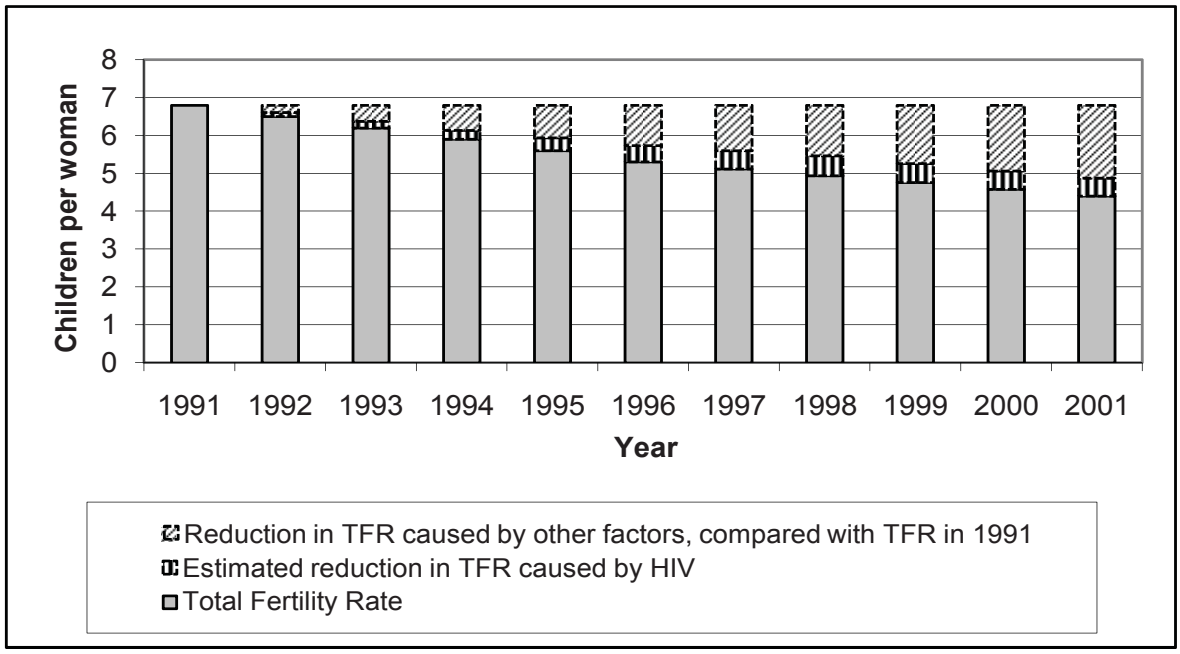

Figure 5. Total fertility rate (TFR) in the Northwest Health Directorate in 1991–2001 and the reduction in fertility resulting from HIV infection and other factors. Source: Shemeikka 2006, based on 1991 and 2001 Population and Housing Census data, results of Inter-censal Demographic Survey, and results of HIV sentinel surveillance 1992–2002.

The interviews conducted in 2006 included women who had lost their husbands because of HIV infection. These women reported that the stigma connected with HIV infection is less than it was in earlier phases of HIV epidemic in their region because almost every family now has experience of HIV. For this reason, they reported, their position in community did not change after they became widows. They also reported having told some relatives about the cause of their spouse's death. In contrast to this openness, some women admitted to not having sufficient courage to tell their husbands of their own infection. Widowed women and other single parents said they were not willing to marry again or have more children. Reasons given for this included 1) that they did not want any additional problems, 2) that they could not take proper care of the existing children, 3) that they were already adults (and did not therefore need to marry to obtain a senior position in the community), or 4) that they were too old. (Interview data 2006.)

Other fertility determinants

Even though HIV had a substantial effect in reducing fertility at population level, the majority of the decline in fertility between 1980 and 2004 was caused by factors other than HIV. Some determinants of fertility levels are now examined.

Marital pattern

Women's age at first marriage increased significantly during the study period. Earlier studies show that in the 1960s, both the mean and median age for a woman's first marriage was 23 years, and 24 years in the 1970s (Shemeikka 2006). In the 1980s and thereafter, the increase in a woman's age at first marriage accelerated, with the median age being 26 years in the 1980s, 29 years in the 1990s and 30 years in 2000–2004. Between 1980 and 2004, the mean age for a woman's first marriage rose from 25 to 32 years. On average during the study period, the mean age at first marriage for men was almost five years higher than that of women.

As the start of marital life was postponed, its connection with the beginning of motherhood became weaker and premarital fertility increased, i.e. a growing proportion of women bore children before their first marriage. In the 1960s and 1970s, among women who married before the age of 30, the proportion of women who gave birth to a child before marriage was 10–11%. In the 1980s this figure increased to 18% and in the 1990s it rose to 29% (Shemeikka 2006). Interview data shows that entering into a formal marital union was not always an obvious aim of either never-married (Interview data 1994) or widowed women (Interview data 2006). Marital life was feared as a source of possible problems such as a bullying husband (1994) or too many children to be cared for (2006).

Post-partum infecundity

Post-partum infecundity is primarily dependent on the period of breastfeeding but parish-register data provides no information on breastfeeding practices. NDHS data shows that in the Northwest Region, the median period for breastfeeding increased from 17.5 months to 19.4 months between 1992 and 2000 (GRN/MoHSS 2003; GRN/MoHSS and Macro International 1993). The combined effects of post-partum infecundity and post-partum abstinence meant that after delivering a child, women were not susceptible to pregnancy for a period of 15 months in 1992 and 20 months in 2000.

Contraception and abortions

The use of contraceptives increased significantly during the study period (1980-2004). Records from hospitals administrated by the colonial government show that contraceptives, especially contraceptive injections, were dispensed in North-Central Namibia during the 1980s (Notkola and Siiskonen 2000; Shemeikka 2006). The use of contraceptives, however, was still very limited in the early 1990s. According to the 1992 NDHS, contraceptive prevalence was only 7% in the study region (GRN/MoHSS and Macro International 1993). The importance of contraception as an agent in fertility decline increased during the 1990s. In 2000, 26% of then-married women were using some modern method of contraception (GRN/MoHSS 2003). The methods most commonly used were injections, condoms, the Pill and female sterilization. Both the use of condoms and injections increased considerably between 1992 and 2000.

Abortions were prohibited by the country's South African colonial rulers, and the government of independent Namibia continued the same policy (Lucas 1992; United Nations 2002). At independence, Namibia inherited the 1975 Abortion and Sterilization Act of South Africa. Under this act, abortion is permitted to save a woman's life, to preserve her physical or mental health, and in cases of rape, incest or foetal impairment. According to estimates by the United Nations, abortion is not practized widely in Namibia and even unwanted pregnancies are carried to term in most cases.

Other fertility determinants

Fertility is also affected by permanent sterility, i.e. the primary and secondary sterility that results from, for example, sexually-transmitted diseases. Levels of primary infertility do not seem to have increased during the study period (1980–2004). The proportion of women married before the age of 30 who remained childless at an age of 45 was 3–5% among the 1956–1989 marriage cohorts. The average figure for primary sterility in sub-Saharan Africa is around 3%, with the highest levels (6%) being found in Cameroon and in the Central African Republic (Larsen 2000).

Information concerning intrauterine mortality in the study region is very limited, but it appears possible that levels have increased during the latter half of the study period.

According to statistics from the Lutheran Medical Mission, the rate of stillbirths among deliveries in Onandjokwe hospital fell from the early 1980s to 1990 (Lutheran Medical Mission 1985, 1986, 1988, 1991). As a comparison, the number of stillbirths in this hospital in 1987 totalled 44, while the number of women treated for spontaneous abortion was 334, but these statistics include only a fraction of the total number of stillbirths and spontaneous abortions in the study region. It seems that the proportion of stillbirths among deliveries increased between 1990 and 2003 (GRN/MoHSS 2004).

Fecundity is directly dependent on frequency of intercourse. In North-Central Namibia, long-standing traditions of temporary labor migration have resulted in prolonged periods of spousal separation, which obviously affects the probability of conceiving. During the 1980s, the war of independence resulted in both spousal separation and the postponement of marriages. Interview data from 1994 showed that even after Namibia became independent, when formal restrictions on trips to home regions had been abolished, husbands who worked in other parts of the country often visited their wife and children only once or twice a year (Interview data 1994).

Conclusions

Fertility in North-Central Namibia has been subject to considerable variation from the 1920s onwards, with the highest levels being found in the 1930s (Notkola and Siiskonen 2000). Before the period dealt with in this study (1980–2004), TFR and total marital fertility rate increased in the 1950s, were high throughout the 1960s and most of the 1970s, and began to decline in the late 1970s. During the study period, a sustained decline in fertility from just under six children per woman to slightly more than three children per woman has taken place. The decline in fertility was concentrated among women aged 25 and above. In parallel with the decline in TFR and total marital fertility there was, however, an increase in premarital fertility and fertility among women aged 15–19, the youngest age group, which is in line with findings made by Garenne and Zwang (2006).

Data from parish registers show that HIV infection reduces fertility among infected women in the study region. Because of the high prevalence of HIV in the study region, the HIV epidemic also contributes to declining fertility at population level. For most of the 1990s, HIV infection explains more than one fourth of the decline in fertility. For the whole population of the study region, the TFR in 2001 was almost half a child less than it would have been without the HIV epidemic, and total fertility among HIV-infected women was about one child less than that of women not infected by HIV. The true decrease in fertility may be even greater, since the group of 'HIV-positive' women includes women who actually died of other causes, while the group of 'HIV-negative' women includes women who actually are HIV-positive but who are still alive.

Discussion

The decline in fertility in North-Central Namibia has similarities with the situation in rural South Africa (e.g. Garenne, Tollman and Kahn 2000; Garenne et al. 2007), with increasing age at first marriage and high levels of premarital fertility. There is also a likeness with neighboring Botswana (e.g. Letamo and Letamo 2002), as both regions are sources of migratory labor. Despite the differences in timing and magnitude, shifts in fertility in the study region bear some resemblance to the changes in Zimbabwe (Muhwava 2002): in both countries, fertility decline started during a period of conflict, halted for a short post-war period, and continued thereafter. In both North-Central Namibia and Zimbabwe, a major element in the causes of declining levels of fertility during the periods of conflict was probably spousal separation.

The background to fertility decline in North-Central Namibia lies both in the region's history and the social, cultural and economic changes that have taken place. Among fertility determinants, the increasing use of contraceptives is one of the major mechanisms contributing to fertility decline. Hospital reports reveal that contraceptives, primarily injectibles, were being dispensed in hospitals administered by the colonial government during the 1980s. Before Namibia's independence, in colonial South-West Africa, family-planning services were however segmented along the lines of apartheid policy, services provided to the colored population and in "homelands" were weak and restricted in scope. Among hospitals managed by the Lutheran Mission, contraceptives were available to some degree, but the systematic provision of family planning services only started during the 1990s when the availability and prevalence of contraceptive methods increased significantly.

Age at first marriage continued to rise during the study period (1980–2004). The influence of this increase in marital age was moderated, however, by the fact that a growing proportion of children were born out of wedlock. Spousal separation has probably played a significant role in fertility decline during the study period for two main reasons: the war of independence during the 1980s and the migrant labor system. Although there is no precise information concerning the number of men expatriated during the war, more than 43,000 registered exiles returned to the country during the eight months period before independence in 1990, 80% of them to their homes in the study region (Tapscott and Mulongeni 1990; Webb and Simon 1995). The war of independence was probably one of the factors contributing to the increase in age at first marriage during the 1980s, even though this continued to increase after the conflict had ended and independence had been achieved. The war may have also contributed to fertility decline as a result of insecurity and the suspension of normal life.

Labor migration results in long periods of spousal separation and the absence of males from the study region. During the time of the colonial contract labor system, return trips to their home areas by male migrants were governed by strict rules. Even after independence,

when these formal restrictions no longer exist, migrant laborers continue to spend long periods in other regions of Namibia, returning only occasionally to their families. Currently, migration in search of work involves not only men, but also women.

Fertility has also been affected by increasing levels of formal education. Educational work by missionaries and churches was important because it brought access to formal education to broad population groups in the early colonial period (Lehtonen 1999). In the 1960s, basic education in the study region was placed under the authority of the colonial administration. During the period of apartheid, the high school managed by church administration was a source of high-quality education in the study region.

On the other hand, ELCIN has maintained a negative attitude towards sex education in its schools and towards promoting the use of contraceptives, especially among adolescents. These attitudes may have been a contributory factor in teenage pregnancies and dropping out of school in the study region. In regard to the HIV epidemic, ELCIN and other mainline churches were also committed to traditional Christian moral discourse until the late 1990s, which may have promoted the stigmatization of HIV-positive people and discrimination against them (Siiskonen 2008). Since the late 1990s, churches have become more active and open-minded in their response to the epidemic in terms of preventing HIV infection, and especially by enacting measures to relieve the social consequences affecting communities.

There is little information concerning the mechanisms through which infection by HIV affects fertility in Namibia. One possible link is marital breakdown, while widowhood appears to make some contribution to reductions in fertility. There are several ways in which the illness and/or death of a husband may reduce fertility among these women who later also died. In cases where the husband died after a period of illness, as a result of HIV infection and its opportunistic diseases for example, coital frequency may have been reduced before his death. HIV infection is also associated with reduced semen quality, which reduces the probability of conception (e.g. Dulioust et al. 2002). In cases where the husband's death was the result of HIV infection, the wife may also have been infected, with the reduction in levels of fertility being a result of that infection. When a husband dies, marital collapse will reduce the widow's fertility because she has lost both her spouse and her sexual partner. Interviews indicate that the motivation of widowed women to remarry is relatively weak (Interview data 2006). It is also possible that after being widowed, a woman is infected by her new sexual partners.

The majority of women in the study region do not usually know their own HIV status, and in 2000, only 17% of women aged 15–49 reported that they had been tested for HIV (GRN/MoHSS 2003). It is therefore probable that the fertility-reducing effect of HIV is mostly the result of biological factors and behavioral factors which affect all women, regardless of their actual HIV status. Also, a proportion of the observed reduction in

fertility is quite probably the result of co-infections by other sexually transmitted diseases. Reductions in fertility identified as occurring in the 1980s and during the period 11–20 years before a woman's death might indicate subfertility prior to HIV infection.

Research carried out in other countries in sub-Saharan Africa indicates that menstrual abnormalities, spontaneous abortions and stillbirths are all associated with HIV infection, and that periods of sickness reduce fecundity by reducing coital frequency among HIV infected persons (e.g. Gray et al. 1998). Even though information concerning intrauterine mortality is scarce, there is some evidence of a possible increase in stillbirths in the study region during the HIV epidemic. The number of stillbirths among deliveries in Onandjokwe hospital varied from 12 to 25 per 1,000 in 1984–87 and was 9 per 1,000 in 1990, while the annual health report on the Oshana Region shows that the rate of stillbirths in 2003–2004 was 32 per 1,000 deliveries (GRN/MoHSS 2004; Lutheran Medical Mission 1985, 1986, 1988, 1991). It appears that primary sterility did not increase in the study region in the 1990s, but HIV infection probably has a greater influence on secondary than primary sterility as it is more likely to affect women who already have started bearing children.

There is evidence of some behavioral changes in the study region which may be linked to the HIV epidemic and the preventive campaigns waged against it. The increase in levels of condom use was substantial between 1992 and 2000, and 17% of sexually-active women have reported using condoms as their current contraceptive method (GRN/MoHSS 2003). The increased use of condoms, especially with non-regular sexual partners, as a result of HIV-prevention programs has also been reported elsewhere in sub-Saharan Africa (World Bank 2007).

Fertility rates in the study region declined significantly in 1980–2004. During the 1990s, HIV infections explained approximately one fourth of this decline. In 2001, lower fertility among HIV-positive women resulted in 7% fewer children being born than would have been the case if fertility had not been affected by HIV status. In addition to the fertility-reducing effect of HIV, the HIV epidemic reduces the number of children born through increased levels of mortality, thus reducing the number of potential mothers. In the future, the decline in the number of potential mothers will have a greater negative effect on the total number of children born in the study region than the fertility-reducing effect associated with HIV infection (see Shemeikka and Notkola 2005).

If mortality continues to increase because of the HIV epidemic while fertility continues to decline, both as a result of HIV infection and for other societal reasons, the implications for future population growth rates and Namibia's demographic structure are pronounced. Such development could, however, be mitigated by further improvements in the delivery of antiretroviral treatment, as this would slow the progress of the HIV disease and associated ailments among HIV-infected people in North-Central Namibia.

References

Ahrensen-Pandikow, Helena. 1992. Survey of attitudes towards the use of contraceptives in Namibia. NISER Research Report, No. 15. Windhoek, Namibia: Namibian Institute for Social and Economic Research.

Arowolo, O.O. 2000. Fertility in Namibia. In: *Population-development-environment: background readings on Namibia*, edited by Ben Fuller, Isolde Prommer, and Wolfgang Lutz, pp. 253–271. International Institute for Applied Systems Analysis (IIASA) Interim Report IR-00-031. Laxenburg, Austria: IIASA.

Bulatao, Rodolfo A. 2001. Introduction. *Population and Development Review* 27 Supplement: Global fertility transition: 1–14.

Carpenter, Lucy M., Jessica S. Nakiyingi, Anthony Ruberantwari, Samuel S. Malamba, Anatoli Kamali, and James A.G. Whitworth. 1997. Estimates of the impact of HIV infection on fertility in a rural Ugandan population cohort. *Health Transition Review* 7 (Suppl. 2): S113–S126.

Chimere-Dan, Orieji. 1997. Non-marital teenage childbearing in southern Africa: the case of Namibia. *African Population Studies* 12(2): 87–95.

Crampin, Amelia C., Judith R. Glynn, Bagrey M.M. Ngwira, Frank D. Mwaungulu, Jörg M. Pönnighaus, David K. Warndorff, and Paul E.M. Fine. 2003. Trends and measurement of HIV prevalence in northern Malawi. *AIDS* 17(12): 1817–25.

Dulioust, E., A. Le Du, D. Costagliola, J. Guibert, J.-M. Kunstmann, I. Heard, J.-C.Juillard, D. Salmon, M. Leruez-Ville, L. Mandelbrot, C. Rouzioux, D. Sicard, J.-R. Zorn, P. Jouannet, and M. De Almeida. 2002. Semen alterations in HIV-1 infected men. *Human Reproduction* 17(8): 2112–8.

Fabiani, Massimo, Barbara Nattabi, Emingtone O. Ayella, Martin Ogwang, and Silvia Declich. 2006. Differences in fertility by HIV serostatus and adjusted HIV prevalence data from antenatal clinic in northern Uganda. *Tropical Medicine & International Health* 11(2): 182–7.

Gage, Anastasia J. 1998. Premarital childbearing, unwanted fertility and maternity care in Kenya and Namibia. *Population Studies* 52(1): 21–34.

Garenne, Michel. 2004. Sex ratios at birth in populations of Eastern and Southern Africa. *Southern African Journal of Demography* 9(1): 91–6.

—. 2007. Fertility changes in Africa. Manuscript.

Garenne, Michel and Veronique Joseph. 2002. The timing of fertility transition in sub-Saharan Africa. *World Development* 30(10): 1835–43.

Garenne, Michel, Stephen Tollman, and Kathleen Kahn. 2000. Premarital fertility in rural South Africa: a challenge to existing population policy. *Studies in Family Planning* 31(1): 47–54.

Garenne, Michel, Stephen M. Tollman, Kathleen Kahn, and Mark Collinson. 2007. Fertility trends and net reproduction in Agincourt, Rural South Africa: 1992–2004. *Scandinavian Journal of Public Health*. 35(Suppl. 69): 68–76.

Garenne, Michel and Julien Zwang. 2006. Premarital fertility in Namibia: trends, factors and consequences. *Journal of Biosocial Science* 38(2): 145–67.

Glynn, Judith R., Anne Buvé, Michel Garaël, Maina Kahindo, Isaac B. Macauley,

Rosemary M. Musonda, Eva Jungmann, Francis Tembo, and Leopold Zekeng. 2000. Decreased fertility among HIV-1-infected women attending antenatal clinics in three African cities. *Journal of Acquired Immune Deficiency Syndromes* 25(4): 345–52.

Gray, Ronald H., Maria J. Wawer, David Serwadda, Nelson Sewankambo, Chuanjun Li, Frederick Wabwire-Mangen, Lynn Paxton, Noah Kiwanuka, Godfrey Kigozi, Joseph Konde-Lule, Thomas C. Quinn, Charlotte A. Gaydos, and Denise McNairn. 1998. Population-based study of fertility in Women with HIV-1 infection in Uganda. *Lancet* 351(9096): 98–103.

GRN/MoHSS (= Government of the Republic of Namibia/Ministry of Health and Social Services). 2003. *Namibia Demographic and Health Survey 2000*. Windhoek, Namibia: Ministry of Health and Social Services.

—. 2004. *Oshana region annual report 2003/2004*. Windhoek, Namibia: Ministry of Health and Social Services.

—. 2005. *Report of the 2004 national HIV sentinel survey*. Windhoek, Namibia: Ministry of Health and Social Services.

—. 2007. *Report of the 2006 National HIV Sentinel Survey,* Windhoek, Namibia: Ministry of Health and Social Services.

GRN/MoHSS (= Government of the Republic of Namibia/Ministry of Health and Social Services) and Macro International Inc. 1993. *Namibia Demographic and Health Survey 1992*. Windhoek, Namibia: Ministry of Health and Social Services and Macro International Inc.

GRN/NPC (= Government of the Republic of Namibia/National Planning Commission). 1994a. *1991 Population and housing census.* Report B. Statistical tables. (Tables for 13 administrative regions). National Planning Commission, Central Statistics Office. Windhoek, Namibia: National Planning Commission.

—. 1994b. 1991 *Population and housing census: basic analysis with highlights*. National Planning Commission, Central Statistics Office. Windhoek, Namibia: National Planning Commission.

—. 1994c. *Population and housing census. Statistical tables for sub-regions of Elim, Nakayale, Oshigambo, Okahao, and Tshandi congregations*. Unpublished statistical tables. National Planning Commission, Central Statistics Office. Windhoek, Namibia: National Planning Commission.

—. 2003. *2001 Population and Housing Census National Report: Basic Analysis with Highlights.* Government of the Republic of Namibia, Central Bureau of Statistics, National Planning Commission. Windhoek, Namibia.

—. 2004a. *2001 Population and Housing Census*. Oshikoto region: basic analysis with highlights. National Planning Commission, Central Bureau of Statistics. Windhoek, Namibia: National Planning Commission.

—. 2004b. *2001 Population and Housing Census*. Oshana region: basic analysis with highlights. National Planning Commission, Central Bureau of Statistics. Windhoek, Namibia: National Planning Commission.

—. 2005a. *2001 Population and Housing Census*. Omusati region: basic analysis with highlights. National Planning Commission, Central Bureau of Statistics. Windhoek, Namibia: National Planning Commission.

—. 2005b. *2001 Population and Housing Census*. Ohangwena region: basic analysis with highlights. National Planning Commission, Central Bureau of Statistics. Windhoek, Namibia: National Planning Commission.

—.2006. Namibia Household Income & Expenditure Survey 2003/2004. Main report. National Planning Commission, Central Bureau of Statistics. Windhoek, Namibia, National Planning Commission.

—. n.d. (no date). Printout of selected results from the 1996 Intercensal Demographic Survey. National Planning Commission, Central Bureau of Statistics. Windhoek, Namibia: National Planning Commission. Undated.

Hailonga, Panduleni. 1993. *A study to identify the knowledge, attitudes and behaviours of adolescents with regard of teenage pregnancy in Katutura*. Windhoek, Namibia: Ministry of Health and Social Services.

—. 2005. *Adolescent sexuality and reproductive behaviour*. A socio-historical analysis. Maastricht, the Netherlands: Shaker Publishing.

Hamata, Sylvia Amanda. (n.d.). Fertility determinants in Namibia. Unpublished and undated manuscript. Windhoek, Namibia.

Heuveline, Patrick. 2003. HIV and population dynamics: a general model and maximum-likelihood standards for East Africa. *Demography* 40(2): 217–45.

Hosegood, Victoria, Anna-Maria Vanneste, and Ian M. Timæus. 2004. Levels and causes of adult mortality in rural South Africa: the impact of AIDS. *AIDS* 18(4): 663–71.

Hunter, Susan-Catherine, Raphael Isingo, J. Ties Boerma, Mark Urassa, Gabriel M.P. Mwaluko, and Basia Zaba. 2003. The association between HIV and fertility in a cohort study in rural Tanzania. *Journal of Biosocial Science* 35 (2):189–99.

Interview data 1994. 11 interviews conducted in Oshana and Ohangwena regions in North-Central Namibia.

—. 2006. 46 interviews conducted in Oshana and Oshikoto regions in North-Central Namibia.

Kalipeni, Ezekiel, Susan Craddock, and Jayati Ghosh. 2004. Mapping the AIDS pandemic in Eastern and Southern Africa: a critical overview. In: HIV & AIDS in Africa: Beyond Epidemiology, edited by Ezekiel Kalipeni, Susan Craddock, Joseph R. Oppong and Jayati Ghosh, pp. 58–69. Oxford: Blackwell Publishing.

Kamali, Anatoli, Lucy Mary Carpenter, James Alexander Grover Whitworth, Robert Pool, Anthony Ruberantwari, and Amato Ojwiya. 2000. Seven-year trends in HIV-1 infection rates, and changes in sexual behaviour, among adults in rural Uganda. *AIDS* 14(4): 427–34.

Kirk, Dudley and Bernard Pillet. 1998. Fertility levels, trends, and differentials in sub-Saharan Africa in the 1980s and 1990s. *Studies in Family Planning* 29(1): 1–22.

Kuhanen, Jan, Riikka Shemeikka, Veijo Notkola, and Margareth N. O. Nghixulifwa. 2007. Are junior-headed households a possible strategy for coping with the growing orphan crisis in Northern Namibia? *African Journal of AIDS Research*, in Print.

Larsen, Ulla. 2000. Primary and secondary infertility in sub-Saharan Africa. *International Journal of Epidemiology* 29: 258–91.

Le Coeur, Sophie, Gaston Halembokaka, Myriam Khlat, Nicolas Brouard, France Purhuence, Pierre M´Pelè, Gaelle Baty, Francis Barin, and Marc Lallemant. 2005.

Impact of AIDS on adult mortality: a morgue-based study in Pointe Noire, Republic of Congo. *AIDS* 19(15):1683–87.

Lehtonen, Lahja. 1999. *Schools in Ovamboland from 1870 to 1970*. Helsinki, Finland: Finnish Evangelical Lutheran Mission.

Lemström, Ossi. 1999. *Hedelmällisyys ja kuolleisuus Kavangossa 1950-1996 verrattuna Ambomaahan* [Fertility and mortality in Kavango 1950-1996 compared to Ovamboland]. Master's thesis. Department of Sociology, University of Helsinki, Finland.

Leridon, Henri. 1975. Biostatistics of human reproduction. In: *Measuring the effect of family planning programs on fertility*, edited by Chandrasekaran, C. and Albert I. Hermalin, pp. 93–131. International Union for Scientific Study of Population. Liége, Belgium: Ordina Editions.

Letamo, Gobopamang and Halima N. Letamo. 2002. The role of proximate determinants in fertility transition: a comparative study of Botswana, Zambia and Zimbabwe. *Southern African Journal of Demography* 8(1): 29–35.

Lewis, James J.C., Carine Ronsmans, Alex Ezeh, and Simon Gregson. 2004. The population impact of HIV on fertility in sub-Saharan Africa. *AIDS* 18 (Suppl. 2): S35–S43.

Lucas, David. 1992. Fertility and family planning in southern and central Africa. *Studies in Family Planning* 23(3): 145-58.

Lutheran Medical Mission. 1985. *Annual report of Lutheran Medical Mission of the Evangelical Lutheran Owambo Kavango Church 1984*. English Version. Onandjokwe, Namibia.

—. 1986. *Annual report of Lutheran Medical Mission of the Evangelical Lutheran Owambo Kavango Church 1985*. Onandjokwe, Namibia: Lutheran Medical Mission.

—. 1988. *Lutheran Medical Mission: annual report 1987*. Ondangua, Namibia: Lutheran Medical Mission.

—. 1991. *Lutheran Medical Mission: annual report 1990*. Ondangua, Namibia: Lutheran Medical Mission.

Moultrie, Tom A. and Ian M. Timæus. 2003. The South African fertility decline: evidence from two censuses and a demographic and health survey. *Population Studies* 57(3): 265–84.

Muhwava, William. 2002. The onset of fertility transition in Zimbabwe: a re-analysis of census and survey data using robust demographic techniques. *African Population Studies* 17(1): 1–17.

Namibia Development Trust. 1994. *Improving the legal and socio-economic situation of women in Namibia*. Uukwambi, Ombalantu and Uukwanyama integrated report. Volume 1. Namibia Development Trust (NDT) with assistance from the Social Impact Assessment and Policy Analysis Corporation (SIAPAC), the Friedrich Ebert Foundation (FES), and the Centre for Applied Social Sciences (CASS). Windhoek, Namibia: NDT.

NDHS 1992 (= Namibia Demographic and Health Survey 1992). Individual Data Files NMIQ23RT.DAT, obtained from Macro International Inc. in 1993, and NMIR21RT.SAV, available from Macro International Inc. <http://www.measuredhs.com/start.cfm>

NDHS 2000 (= Namibia Demographic and Health Survey 2000). Individual Recode Data File (NMIR41RT.SAV). Available from Macro International Inc. <http://www.measuredhs.com/start.cfm>

Notkola, Veijo and Harri Siiskonen. 2000. *Fertility, mortality and migration in subSaharan Africa: the case of Ovamboland in North Namibia, 1925–90*. Basingstoke, Great Britain: Macmillan Press.

Notkola, Veijo, Ian M Timæus, and Harri Siiskonen. 2000. Mortality transition in the Ovamboland region of Namibia, 1930-1990. *Population Studies* 54:153–67.

—. 2004. Impact on mortality of the AIDS epidemic in northern Namibia assessed using parish registers. *AIDS* 18(7): 1061–5.

Ntozi, James P.M., Immaculate M. Nakanaabi, and Yovani A.M. Lubaale. 1997. Fertility levels and trends in the face of the AIDS epidemic in Uganda. *Health Transition Review* 7 (Suppl. 2): S145–S155.

Onandjokwe DDC (District Development Committee). 2003. *Onandjokwe district: annual report for the year 2002/2003*. Prepared by the Onandjokwe District DDC Members. Onandjokwe Lutheran Hospital. Ondangwa, Namibia: Onandjokwe DDC.

Onandjokwe Lutheran Medical Service. 1999. *Annual report for Onadjokwe district for the year 1998/9*. Onandjokwe Lutheran Medical Service, Onandjokwe Lutheran Hospital. Ondangwa, Namibia: Onandjokwe Lutheran Medical Service.

Phororo, Hopolang and Bruno Venditto. 2003. *The economic effects of HIV/AIDS on 4 O's regions of Namibia*. Namibian Economic Policy Research Unit (NEPRU) Research Report. Windhoek, Namibia: NEPRU.

Potts, Deborah and Shula Marks. 2001. Fertility in southern Africa: the quiet revolution. *Journal of Southern African Studies* 27(2): 189–205.

Raitis, Riikka. 1995. Fertility in the Northwest region of Namibia. *Yearbook of Population Research in Finland* 32: 106–17.

Ross, Amanda, Lieve Van der Paal, Rosemary Lubega, Billy N. Mayanja, Leigh Anne Shafer, and Jimmy Whitworth. 2004. HIV-1 disease progression and fertility: the incidence of recognized pregnancy and pregnancy outcome in Uganda. *AIDS* 18(5): 799–804.

Rutenberg, Naomi, Ann E. Biddlecom, and Frederick A.D. Kaona. 2000. Reproductive decision-making in the context of HIV and AIDS: a qualitative study in Ndola, Zambia. *International Family Planning Perspectives* 26(3):124–30.

Sedgh, Gilda, Ulla Larsen, Donna Spiegelman, Gernard Msamanga, and Wafaie W. Fawzi. 2005. HIV-1 disease progression and fertility in Dar es Salaam, Tanzania. *Epidemiology and Social Science* 39(4): 439–45.

Shemeikka, Riikka. 1999. HIV/AIDS: the major demographic challenge of Namibia. *Yearbook of Population Research in Finland* 35: 65–81.

—. 2006. Fertility in Namibia: Changes in fertility levels in North-Central Namibia 1960-2001, including an assessment of the impact of HIV. *Yearbook of Population Research in Finland* XLII. Supplement. Helsinki: The Population Research Institute of the Family Federation of Finland.

Shemeikka, Riikka and Veijo Notkola. 2005. Fertility reduction caused by HIV/AIDS

and its demographic impact in northern Namibia. In: *What are we doing there? Experiences and lessons learned from development cooperation in health care and social welfare (1990-2005)*, edited by Ursula Aaltonen and Simo Mannila, pp. 207–26. Saarijärvi, Finland: National Research and Development Centre for Welfare and Health (STAKES).

Shemeikka, Riikka, Veijo Notkola, and Harri Siiskonen. 2005. Fertility decline in North-Central Namibia: an assessment of fertility in the period 1960–2000 based on parish registers. *Demographic Research* [Online]. 30 August 2005, Volume 13, Article 4, Pages 83–116.

Shemeikka, Riikka, Jan Kuhanen, Veijo Notkola, and Harri Siiskonen. 2007. HIV-epidemia ja sosiaalinen ja taloudellinen tuki eteläisessä Afrikassa: Tuen tarve Pohjois-Namibiassa [The HIV epidemic and social and economic support in southern Africa: the need for assistance in North-Central Namibia. In Finnish]. *Kuntoutus* 1/2007, 16–36.

Siiskonen, Harri. 2007. The Namibian Mainline Churches and HIV/AIDS. In Bollig, Michael, Bubenzer, Olaf, Vogelsang Ralf, and Wotska, Hans-Peter (Eds.): *Aridity, Change and Conflict in Africa*. Colloquim Africanum 2, 441-469. Cologne: Heinrich-Barth-Institut.

Siiskonen, Harri, Anssi Taskinen, and Veijo Notkola. 2005. Parish registers: a challenge for African historical demography. *History in Africa* 32: 385–402.

Slotten, R.A. 1995. AIDS in Namibia. *Social Science & Medicine* 41: 277–84.

Tabutin, Dominique and Bruno Schoumaker. 2001. *Une Analyse Régionale des Transitions de Féconité en Afrique Sub-Saharienne*. Paper presented at XXIV IUSSP General Population Conference, Salvador, Brazil on 18 – 24 August 2001. [Cited 30 May 2005]. Available from: <http://www.iussp.org/Brazil2001/s40/S43_02_Tabutin.pdf>

Tapscott, Chris and Ben Mulongeni. 1990. *An evaluation of the welfare and future prospect of repatriated Namibians in Northern Namibia*. Namibian Institute for Social and Economic Research, Research Report 3. Windhoek, Namibia: University of Namibia.

Terceira, Nicola, Simon Gregson, Basia Zaba, and Peter R Mason. 2003. The contribution of HIV to fertility decline in rural Zimbabwe, 1985-2000. *Population Studies* 57(2): 149–64.

UNAIDS and WHO. 2007. AIDS Epidemic Update: December 2007. Geneva, Switzerland: UNAIDS and WHO. < http://www.unaids.org/en/HIV_data/2007EpiUpdate/default.asp>. Accessed in December 2007.

UNICEF (= United Nations Children's Fund) Namibia. 1990. *Household health and nutrition survey*. Report on a survey in Katutura and selected northern areas of Namibia in April-May 1990. UNICEF Namibia, Ministry of Health and Social Services, and Food Studies Group, University of Oxford. Windhoek, Namibia: UNICEF.

United Nations. 1983. *Manual X: indirect techniques for demographic estimation*. Population Studies 81. United Nations, Department of International Economic and Social Affairs. New York, NY: United Nations.

United Nations. 2002. *Abortion policies: a global review*. United Nations Population Division, Department of Economic and Social Affairs. New York, NY: United Nations.

Van Dillen, Jeroen, Tarek Meguid, and Jos van Roosmalen. 2006. *Acta Obstetricia et Gynecologia* 85: 499–500.

Webb, Douglas and David Simon. 1995. *Migrants, money and the military: the social epidemiology of HIV/AIDS in Owambo, northern Namibia*. The Namibian Economic Policy Research Unit (NEPRU), Occasional Paper No. 4. Windhoek, Namibia: NEPRU.

White, R.G, C. Hall, and B. Wolf. 2007. Period and cohort dynamics in fertility norms at the onset of the demographic transition in Kenya 1978-1998. *Journal of Biosocial Science* 39(3): 443–54.

World Bank. 2007. The Africa Multi-Country AIDS Program 2000-2006: Results of the World Bank Programme to a Development Crisis. Washington, DC: World Bank.

Wrigley, E.A. (Editor). 1966. *An introduction to English historical demography*. London, Great Britain: Weidenfeld and Nicolson.

Zaba, Basia and Simon Gregson. 1998. Measuring the impact of HIV on fertility in Africa. *AIDS*, 12 (Suppl. 1): S41–S50.