The Demographic Impact of the HIV/AIDS Epidemic in Papua New Guinea, 1990-2030

The scale of the HIV/AIDS epidemic in the country has reached the point where future demographic patterns are likely to be affected, possibly severely.

By Geoffrey Hayes*

The first case of human immunodeficiency virus (HIV) infection in Papua New Guinea was detected in the capital in 1987. After a relatively short period during which the epidemic was concentrated in certain "high-risk" groups, the disease spread throughout the country and by 2005 had become a "generalized epidemic" – with a 1 per cent HIV prevalence rate among adults aged 15-49. The most recent (2007) estimates suggest that the adult prevalence rate has risen to 1.6

* Consultant demographer and a former technical adviser in the UNFPA Country Technical Services Team, Suva, Fiji, e-mail: geoffreyhayes@hotmail.com.

per cent, confirming that the epidemic is continuing to grow rapidly (NACS, 2007).

The scale of the human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) epidemic in the country has reached the point where future demographic patterns are likely to be affected, possibly severely. Among the demographic impacts to be expected based on the experience of other countries with generalized epidemics are an increase in the number of deaths, particularly among young adults leading in turn to reduced life expectancy. The rate of population growth will drop as a higher death rate reduces the rate of natural increase. The number of births can also be expected to decline owing to the impaired fecundity of HIV positive women. Changes to the age structure follow from the concentration of excess AIDS mortality in the young adult age groups.

These demographic changes in turn have social and economic consequences. The number of orphaned children rises as parents succumb to the disease. The quality of the labour force may decline if AIDS deaths are concentrated in professional or more educated groups. Health systems may also come under increasing strain as larger numbers of AIDS sufferers seek hospital care or treatment. This article does not focus on these socio-economic consequences but rather on the more narrowly demographic dimensions, an understanding of which is a precondition for an analysis of such broader socio-economic effects.

Until recently the measurement of the potential impact of the AIDS epidemic in Papua New Guinea was impaired by a very limited surveillance system. While the present scale and quality of surveillance still remains inadequate, the addition of a number of surveillance points throughout the country over the past two years has facilitated a more accurate picture of the past and likely future trends of the AIDS epidemic. Analysis of this richer supply of surveillance data by the National AIDS Council Secretariat and UNAIDS (NACS, 2007) has made it possible to make plausible projections of the future course of the epidemic. The recent development of the AIM computer software (Stover, 2007) that allows epidemiological data to be imported directly into the DemProj population projection program (Stover and Kirmeyer, 2005) further permits the future demographic impact of AIDS to be estimated by combining epidemiological assumptions with demographic ones. This article presents the results of a preliminary study based on these two sets of data.

Data and methods

The methodology employed in this study was to carry out six separate population projections, three of which excluded AIDS-related deaths while three incorporated them. By comparing the results of those two different projections, it is possible to estimate the specific impact of the AIDS epidemic under three sets of demographic assumptions. One limitation of the present analysis is that a single set of HIV/AIDS assumptions has been employed. Those assumptions have been generated by the Estimation and Projections Package (EPP) computer program developed by the World Health Organization (WHO) and the Joint United Nations Programme on HIV/AIDSUNAIDS, employing the most recent HIV/AIDS surveillance data available in Papua New Guinea (NACS, 2007).

All population projections are based on assumptions and are therefore uncertain. This is also true about the HIV/AIDS component. A population projection incorporating the impact of HIV/AIDS consequently makes use of two sets of assumptions – a demographic one and an HIV/AIDS one. This greatly complicates any measure of the impact of HIV/AIDS because demographic processes and the epidemic are mutually interconnected. It is therefore necessary to underscore the normal caveat attached to population projections; they are not predictions. All projections take the logical form of a conditional statement "If x… then y". In other words, if conditions "x" come to pass then consequences "y" will follow. It is the probability of "x" occurring that is uncertain rather than the relationship between "x" and "y", which is basically mathematical.

Demography

To estimate the future demographic impact of the HIV/AIDS epidemic it is first necessary to prepare a population projection (or series of projections) that ignores the epidemic entirely. It is normal demographic practice to base one projection on current population dynamics, the results of which show what would happen if present rates of birth, death and migration were to remain constant. This practice has been followed in this study and these assumptions form the basis for "Projection one". This projection is also referred to below as the "high" projection because it produces the highest growth rate and the largest population by the end of the projection period.

However, such a projection is not realistic because birth, death and migration rates rarely remain constant over a long period of time. Projections that aim for realism (as opposed to "experimental" projections) must be based upon assumptions about future rates of change. Typically, these assumptions are grounded in general (theoretical) knowledge of how population dynamics evolve through time, combined with specific knowledge of past demographic trends and processes in the country under study.

In general, the populations of less developed countries experiencing socio-economic development undergo a "demographic transition". The demographic transition model asserts that populations evolve from a situation in which birth and death rates are high, resulting in a low population growth rate, to a situation in which birth and death rates are low, resulting similarly in a low rate of population growth. Rapid population growth takes place during the historical transition between these two fundamentally different situations. The period of rapid growth arises from the fact that historically high death rates tend to decline before high birth rates as public health measures are introduced – often by colonial administrations. Eventually, birth rates will also fall as awareness of the declining death rates spreads and government programmes assist women to reduce their fertility. The length of the period between the falling death rate and the falling birth rate (and hence the period of rapid population growth) varies widely across countries and is difficult to predict – it can last for a 100 years or be as short as 20 years. Country-specific circumstances determine the length of the transition, but it tends to be shortest in countries that are undergoing rapid economic growth and which also have effective family planning programmes.

In Papua New Guinea, the pattern of demographic change over the past four decades since national censuses first commenced follows the broad outline of demographic transition albeit with significant differences owing to the country's particular history. At the national level, birth and death rates have been declining slowly for the past three decades virtually in tandem. Papua New Guinea has not experienced a period during which mortality dropped sharply with economic development and culture change while fertility continued at a high level – leading to the so-called "population explosion". Rather, the trend of both the birth and death rates has been one of slow, steady decline more or less in unison as a result of which the rate of natural increase has remained between 2.0 and 2.5 per cent per year for three decades. The most conservative assumption that could be made about future population patterns in Papua New Guinea, therefore, is that these past trends will continue in the future.

Fertility change

In the case of fertility it is not difficult to identify the scale of the historical trend. As table 1 shows, the total fertility rate (TFR) has declined from 5.4 in 1980, to 4.8 in 1996 and to 4.6 in 2000. The average rate of decline in the TFR over the 20-year period from 1980 to 2000 has been 0.04 per year (0.2 per each five-year period) which is close to the international average for low-income countries with weak family planning programmes – a category that includes Papua New Guinea

(Stover and Kirmeyer, 2005:15-16). On this basis it appears justified to make use of the same, slow rate of decline in fertility for the "middle" or "medium" projection, hereafter referred to as "Projection two".

Table 1. Total fertility rate (TFR), 1980-2000

	1980	1996	2000	1980-2000
TFR	5.4	4.8	4.6	5.4-4.6
Intercensal change	..	-0.6	-0.2	-0.8
Change per year	..	-0.04	-0.05	-0.04

Source: National Statistical Office (2003).

It is also customary, when preparing projections, to base one projection on the goals of the national population policy – or other government policies pertaining to population. Papua New Guinea's National Population Policy 2000-2010 (DNPM, 1999) aims to achieve a TFR of 3.0 by the year 2020. Assuming that the same rate of decline necessary to meet this goal continued through to 2030, the TFR in that year would be 2.2, or close to "replacement fertility". This assumption is the basis for "Projection three". This projection is also described herein as the "low" projection as it produces the lowest rate of population growth. The full set of fertility assumptions for the three projections is shown in table 2.

Table 2. Assumed total fertility rates 2000-2030, Projections one to three

Projection number	2000	2005	2010	2015	2020	2025	2030
Projection one	4.60	4.60	4.60	4.60	4.60	4.60	4.60
Projection two	4.60	4.40	4.20	4.00	3.80	3.60	3.40
Projection three	4.60	4.20	3.80	3.40	3.00	2.60	2.20

Mortality change

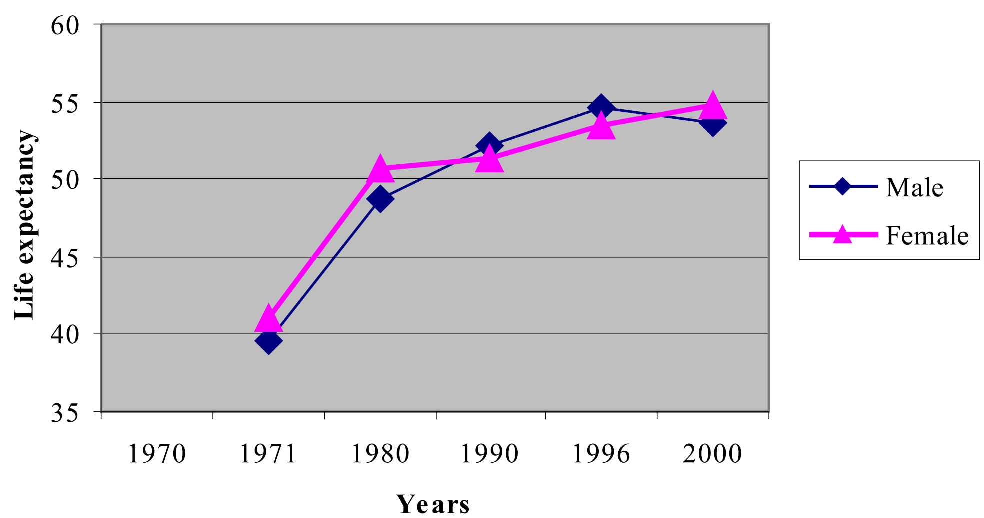
The historical picture is much less clear when it comes to mortality – which is the key variable when assessing the potential impact of HIV/AIDS. The life expectancy estimates from 1971 to 2000 are presented in table 3 and also plotted in figure 1. While the general trend is one of rising life expectancy, the rate of increase and the relationship between male and female life expectancy have been erratic and inconsistent over the years. Between 1971 and 1980, male life expectancy improved rapidly at a rate of about one year added per year. Since 1980, the rate of change has dropped to 0.32 year per year in the 1980-1981 period, 0.48 year in the 1991-1996 period and -0.32 year in the 1996-2000 period. Increases in female life expectancy are consistently upward but also at widely varying rates through time, ranging from 1.1 years per year during the 1970s to 0.06 year per year during the 1980s. It is also apparent that for those years in which sample survey (DHS) data were available (1991 and 1996) estimated male life expectancy was higher than female while the estimates based on census data (1971, 1980 and 2000) showed the opposite.[1]

Table 3. Life expectancy at birth in Papua New Guinea, 1971-2000

	Year of estimate				
	1971	**1980**	**1991**	**1996**	**2000**
Male	39.6	48.7	52.2	54.6	53.7
Annual change (years)	..	1.01	0.32	0.48	-0.23
Female	41.1	50.7	51.4	53.5	54.8
Annual change	..	1.10	0.06	0.42	0.32
Data source	Census	Census	Survey	Survey	Census

Sources: National Statistical Office (2003), Hayes (1996).

Figure 1. Life expectancy trends, 1971-2000



These inconsistencies make it difficult to identify a clear trend for the period from 1991 to 2000 – especially for females. From a methodological point of view the survey data should give a more correct picture of the relationship between male and female life expectancy. This is because the surveys asked direct questions on both male and female adult mortality ("Is your own father still alive" and "Is your own mother still alive") whereas the census only asked about the survival status of mothers[2] and the analysis proceeded on the assumption that male life expectancy would be lower than female – as is the normal pattern in almost all countries. However, if female life expectancy is higher than male, it follows that sex ratios will tend to fall in older ages – a function of excess male mortality. In Papua New Guinea, however, the sex ratio increases with age so that above the age of 45 there is a substantial surplus of males, thus indicating either higher female mortality or an undercount of older females (or both). It is therefore plausible that in this country, female life expectancy is in fact lower than that of male and that the survey data give a more accurate picture of female life expectancy than the census data.

If this is the case then a simple extrapolation of the historical rate of change in life expectancy from the past into the future is problematic because it would reproduce the historical inconsistencies existing between years and sexes. There is little doubt that the normal pattern is for female life expectancy to be higher than that of male and therefore the pattern in Papua New Guinea can be described as an anomaly which can probably be explained by the particularly low social status accorded to women and girls. Whether social and cultural change will bring about a correction of this situation, and if so how soon, is an open question, yet it is not inappropriate to assume that this Pacific country will eventually conform to the usual pattern. If this assumption is accepted then a statistical means must be found to "normalize" the relationship between male and female life expectancy while also assuming that both would increase through time.

The approach taken in this study was to accept the 1991 life expectancy levels (Hayes, 1996), as well as the 1991 relationship between male and female life expectancy, and to progressively assume a faster rate of improvement in female life expectancy than for males such that the life expectancy of females would overtake that of males around 2010. This date is somewhat arbitrary, but an earlier date would not be consistent with the fairly slow pace of economic development during the 1990s and the persistence of gender inequality. This is the mortality assumption underlying "Projection two".

Because the pattern of life expectancy improvement in Papua New Guinea has been so erratic over the past many years, the rates of change generated by the United Nations model life tables have been used in this study rather than one from any intercensal period based on empirical data. For countries with life expectancy ranging from 55 to 65 years, the United Nations model life tables indicate that life expectancy has historically increased by 2.0 to 2.5 years every five years, or by 0.4

to 0.5 year per year (Stover and Kirmeyer, 2005). This is a pattern of change similar to those observed in many developing countries. In Papua New Guinea the rate of change between the 1991 and 1996 Demographic and Health Surveys fits within this range, but is either higher or lower in other periods. The long-run rate of increase in life expectancy (1971-2000) also falls within this range (0.486 for males and 0.472 for females). A case can therefore be made for employing the model life table rate of change to project life expectancy into the future.

Thus, "Projection two" assumes that male life expectancy will increase at the rate of 0.4 year per year from 2000 to 2030 and female life expectancy would increase by 0.45 year per year over the same period. These trends would result in male life expectancy reaching 68.2 years and female 69.4 years by 2030. Even with a faster rate of increase in female life expectancy, the difference between male and female life expectancy still remains small by 2030 with females living on average 1.2 years longer than males.

Finally, a third assumption was formulated to reflect the possibility that the mortality component of the demographic transition in Papua New Guinea might accelerate rather than simply continue at its historically slow pace. The assumption of a more rapid increase in life expectancy is analogous to the assumption of a faster decline in the TFR. These assumptions form the basis for "Projection three". The final set of mortality assumptions for all three projections is shown at 10-year intervals in table 4.

Table 4. Assumed life expectancy 2000-2030, Projections one to three

Projection number	2000		2010		2020		2030	
	M	F	M	F	M	F	M	F
Projection one	56.2	55.9	56.2	55.9	56.2	55.9	56.2	55.9
Projection two	56.2	55.9	60.2	60.4	64.2	64.9	68.2	69.4
Projection three	56.2	55.9	60.9	61.1	65.5	66.2	70.2	71.4

International migration

No assumptions are required for international migration as net international migration in this Pacific country is small and has a negligible impact on population change. It is unlikely that this will change in the future.

Base year population

The base year of a set of population projections is normally the most recent census, which in this case would be the 2000 census. But a projection to assess the impact of HIV/AIDS should ideally start from the onset of the epidemic. While HIV/AIDS was evident in Papua New Guinea by the late 1980s, the supply of epidemiological information prior to 1990 is inadequate to justify a starting date earlier than 1990. Consequently, 1990 has been selected as the base year for the projection rather than 2000, as would otherwise have been the case.

However, the use of 1990 as the starting year for the population projections raises technical problems because the census conducted in that year suffered from significant coverage error (Stott, 1992). In order to bring about a reasonable consistency between the 2000 census count and the 1990 census count as well as the estimated rates of natural increase derived from the 1991 Demographic and Health Survey, the 1996 DHS, and the 2000 census, it is necessary to adjust the 1990 census data to allow for underenumeration. Unfortunately, no information is available on the age pattern of the undercount in the 1990 census because of the limited scope of the post-enumeration check (PEC) conducted after the census.[3] Census undercounts are normally concentrated in certain ages – such as the under-five population or older women. In the absence of a detailed post-enumeration survey, one has to assume that the 1990 census undercount was across the entire age range. In effect, this is equivalent to an assumption that the undercount was due to entire census units being missed (rather than specific individuals across the entire country) and that the population characteristics of these missed units were the same as the national average. This may or may not be a valid assumption.

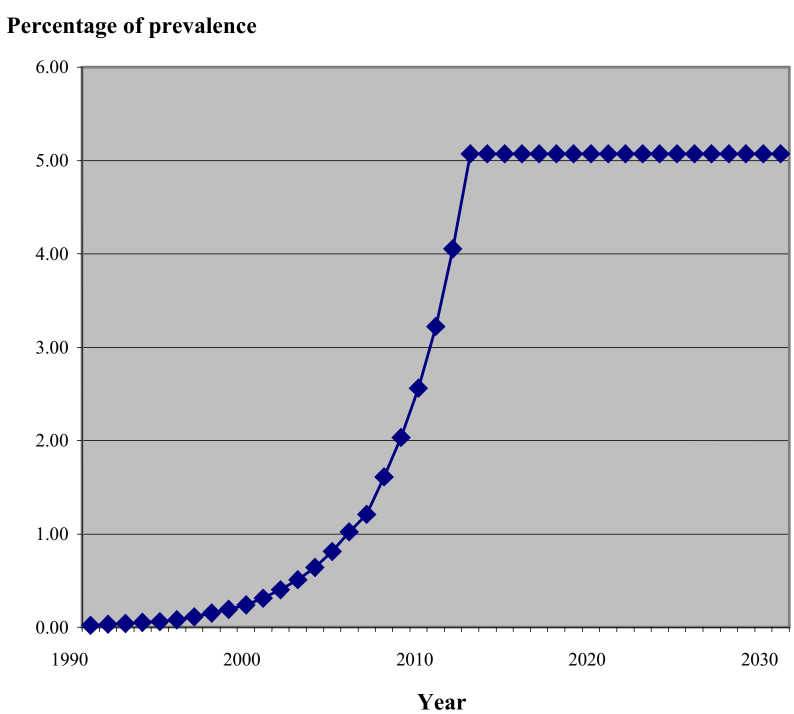
The method employed to adjust the 1990 census for underenumeration was to manually adjust all age-sex groups (using MS Excel) successively until the projected 2000 population reached the population enumerated in the 2000 census given the prevailing birth and deaths rates over the 1990-2000 period.[4] In the case of some age groups (0-4, 5-9, 10-14), further upward adjustment of the female population was performed in order to reduce the excessively high sex ratios in the census count, which could not be justified on the grounds of differential mortality and presumably were in error. The overall adjustment was 15 per cent of the total 1990 citizen population and slightly higher in some of the aforementioned age-sex groups.[5] The adjusted 1990 population was then used as the base for the projections for the 1990-2030 period. The age data were not smoothed to remove the effects of age-heaping.

HIV/AIDS data and assumptions

The HIV/AIDS data employed in the projection were imported into the SPECTRUM computer program from a data file produced by the Estimation and Projections Package (EPP), a computer program developed by WHO and UNAIDS to estimate and project the HIV infection rate in the context of a "generalized" epidemic.[5] The methods and assumptions used to construct these estimates are explained in the 2007 Consensus Report (NACS, 2007) and are not described here in detail. It suffices to say that the quality of these estimates is superior to that of earlier estimates using different methodology because the number of surveillance sites around the country has increased substantially in recent years. However, the demographic assumptions used in the EPP program may not be identical to those employed in the present article.

The estimated and projected adult HIV prevalence rate 2000-2030 is shown in figure 2. The pattern of change suggests exponential growth up to 2012 with the prevalence rate reaching a peak of 5.07 per cent of the adult population in that year. Thereafter the prevalence rate remains stable at the same 5.07 per cent. The rationale for maintaining the prevalence rate at just over 5 per cent through to 2030 is not provided in the 2007 report and for the purposes of this study, this rate has simply been taken at face value.[7]

Figure 2. Estimated and projected adult HIV prevalence rate, 1990-2030



The method employed to measure the HIV/AIDS impact under different demographic scenarios is to first run Projections one to three using the SPECTRUM software (incorporating DemProj) without including HIV/AIDS data, following which the same projections are run again with the AIDS data included through the AIM sub-routine. The output from the second set of projections (here described as Projections four to six) includes new estimates of life expectancy and TFR that reflect the impact of AIDS on these indicators. These estimates are calculated by the AIM routine and are therefore outputs rather than inputs – as is the case in Projections one to three.

Results

Population growth

It is evident from table 5 that while the AIDS epidemic will have an impact on future population growth in Papua New Guinea, that impact will be relatively small in proportion to the total projected population size. The country will experience substantial population growth over the next two decades regardless of the AIDS epidemic. Comparing the middle projections (Projection two without AIDS and projection five with AIDS) it is apparent that by 2030, the population would reach 9.86 million in the absence of AIDS and 9.34 million with AIDS – a difference of about 520,000. This number is made up of the excess deaths that would occur because of the epidemic and the slightly fewer births that would occur owing to the reduced fertility of HIV positive women. While this is a large number in absolute terms, it represents only a little over 5 per cent of what the total population would have been in the absence of HIV/AIDS.

Table 5. Projected population of Papua New Guinea 2000-2030, with and without HIV/AIDS

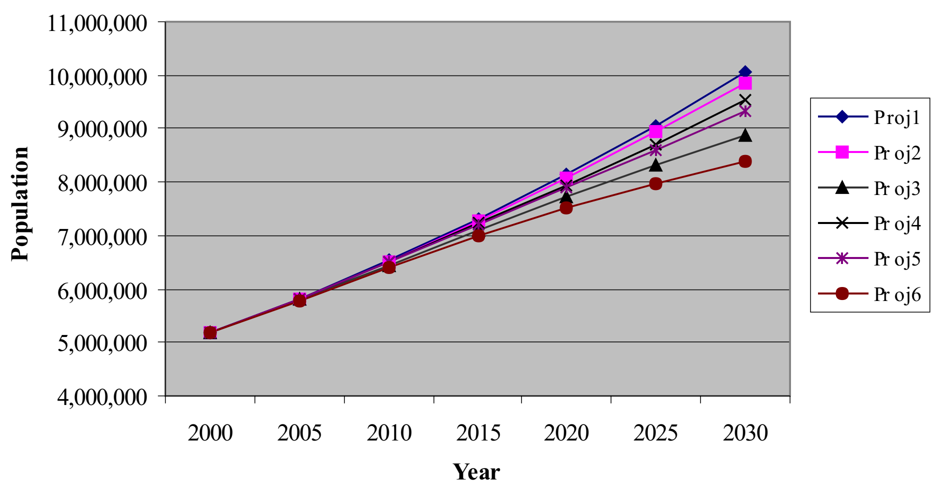
Projection number	Year						
	2000	2005	2010	2015	2020	2025	2030
Without HIV/AIDS							
One (High)	5,183,558	5,821,540	6,533,860	7,308,890	8,148,760	9,063,580	10,067,100
Two (Medium)	5,183,558	5,817,683	6,520,009	7,276,389	8,085,420	8,946,887	9,855,327
Three (Low)	5,183,558	5,797,385	6,438,746	7,083,315	7,716,885	8,318,170	8,859,486

.../

Table 5. *(Continued)*

Projection Number	Year						
	2000	2005	2010	2015	2020	2025	2030
With HIV/AIDS							
Four (High)	5,182,514	5,815,875	6,510,478	7,226,706	7,946,995	8,711,043	9,547,600
Five (Medium)	5,182,514	5,812,031	6,496,852	7,194,979	7,884,485	8,594,552	9,335,515
Six (Low)	5,182,514	5,791,789	6,416,065	7,004,350	7,524,156	7,985,906	8,380,551
Difference							
(High)	-1,044	-5,665	-23382	-82,184	-201,765	-352,537	-519,914
(Medium)	-1,044	-5,652	-23157	-81,410	-200,935	-352,335	-519,812
(Low)	-1,044	-5,596	-22680	-78,965	-192,729	-332,272	-478,935

Figure 3. Projected population growth 2000-2030 with and without AIDS under three demographic scenarios



The potential impact of HIV/AIDS is also apparent in the overall population growth rate. Comparing the two medium projections (two and five), the rate of population growth with HIV/AIDS would be about 16 per cent lower than it would have been in the absence of the epidemic – 1.6 per cent per annum rather than 1.9 per cent (table 6).

Table 6. Projected population growth rates in Papua New Guinea with and without HIV/AIDS (percentage)

Projection number	Year						
	2000	2005	2010	2015	2020	2025	2030
Without HIV/AIDS							
One (High)	2.3	2.3	2.3	2.2	2.1	2.1	2.1
Two (Medium)	2.3	2.3	2.2	2.1	2.1	2.0	1.9
Three (Low)	2.3	2.2	2.0	1.8	1.6	1.4	1.2
With HIV/AIDS							
Four (High)	2.3	2.3	2.2	2.0	1.8	1.8	1.8
Five (Medium)	2.3	2.3	2.1	1.9	1.8	1.7	1.6
Six (Low)	2.3	2.1	1.9	1.6	1.3	1.1	0.9
Difference							
(High)	0.0	0.0	-0.1	-0.2	-0.3	-0.3	-0.3
(Medium)	0.0	0.0	-0.1	-0.2	-0.3	-0.3	-0.3
(Low)	0.0	-0.1	-0.1	-0.2	-0.3	-0.3	-0.3

It is clear that the population of Papua New Guinea will continue to grow in the context of a generalized HIV/AIDS epidemic. Even the lowest of the projections (Projection six) suggests a population in 2030 that is 3.2 million higher than that of the year 2000. The medium projection incorporating AIDS (Projection five) suggests that the population would still grow by 4.2 million persons between 2000 and 2030. As Projection three implies, the rate of population growth would decline more quickly if fertility decline were to accelerate at the rate proposed in the National Population Policy than it would by means of the AIDS epidemic. The acceleration of the death rate to reduced population growth is obviously not a policy option in most societies.

Life expectancy

The main demographic effect of an HIV/AIDS epidemic is an increasing death rate, particularly among young adults, and this in turn will have an impact on life expectancy. Table 7 shows that regardless of which demographic scenario comes to pass, the HIV/AIDS epidemic will result in a significant increase in the number of deaths in Papua New Guinea. By 2030, the excess deaths caused by HIV/AIDS would rise by up to 23,191 annually depending on which projection comes to pass. The largest increase in the number of deaths would occur according to Projection five; in this scenario the number of deaths would be 36 per cent higher than would otherwise have been the case in the absence of AIDS.

Table 7. Projected annual deaths with and without HIV/AIDS

Projection number	Year						
	2000	2005	2010	2015	2020	2025	2030
Without HIV/AIDS							
One (High)	56,446	64,431	73,109	82,619	93,449	105,662	119,275
Two (Medium)	56,446	57,572	58.240	59,321	60,356	62,005	63,680
Three (Low)	56,446	55,991	55,119	54,447	54,024	54,031	54,220
With HIV/AIDS							
Four (High)	56,746	65,708	77,708	96,200	113,427	125,400	138,832
Five (Medium)	56,746	58,846	62,847	73,180	81,541	84,068	86,871
Six (Low)	56,746	57,255	59,647	68,111	75,007	75,744	76,668
Difference							
(High)	300	1,277	4,559	12,581	19,978	19,735	19,557
(Medium)	300	1,274	4,607	13,859	22,063	22,063	23,191
(Low)	300	1,264	4,528	13,664	21,713	21,713	22,448

The potential impact of the increased deaths caused by AIDS on life expectancy is presented in table 8. In the absence of the HIV/AIDS epidemic, life expectancy could reasonably be expected to reach 70.2 years for males and 71.4 years for females by 2030, given a modest acceleration of past trends (projection two). In the “worst case” scenario, life expectancy could decline to 51.0 years for males and 49.3 years for females – a loss of 19.2 years and 22.1 years of life for males and females, respectively. In other words, under this scenario there would be virtually no improvement in life expectancy from 1980 through to 2030 – a period of 50 years.

However, this scenario would only occur under projection four, which assumes that in the absence of HIV/AIDS, life expectancy would otherwise have remained unchanged from 2000 to 2030. This is not very likely based on past experience. Taking the possibly more realistic scenario (Projection five) that life expectancy would continue to improve at the historical rate regardless of the AIDS epidemic (which implies that progress would continue to be made in combating malaria and tuberculosis and other infectious diseases, even in the face of the AIDS epidemic), the reduction in life expectancy attributable to excess AIDS would be 7.2 years for males and 9.3 years for females.

Table 8. Projected life expectancy at birth with and without HIV/AIDS

Projection number	Year						
	2000	2005	2010	2015	2020	2025	2030
				Males			
Without HIV/AIDS							
One (High)	56.2	56.2	56.2	56.2	56.2	56.2	56.2
Two (Medium)	56.2	58.2	60.2	62.2	64.2	66.2	68.2
Three (Low)	56.2	58.5	60.9	63.2	65.5	67.9	70.2
With HIV/AIDS							
Four (High)	55.9	55.6	54.4	52.1	51.1	51.0	51.0
Five (Medium)	55.9	57.5	58.3	57.4	57.9	59.5	61.0
Six (Low)	55.9	57.8	58.9	58.2	59.0	60.9	62.8
Difference							
(High)	0.0	-0.6	-1.8	-4.1	-5.1	-5.2	-5.2
(Medium)	0.0	-0.7	-1.9	-4.8	6.3	-6.7	-7.2
(Low)	0.0	-0.7	-2.0	-5.0	-6.5	-7.0	-7.4
				Females			
Without HIV/AIDS							
One (High)	55.9	55.9	55.9	55.9	55.9	55.9	55.9
Two (Medium)	55.9	58.2	60.4	62.7	64.9	67.2	69.4
Three (Low)	55.9	58.5	61.1	63.7	66.2	68.8	71.4
With HIV/AIDS							
Four (High)	55.6	55.2	54.0	51.2	49.2	49.3	49.3
Five (Medium)	55.6	57.3	58.2	57.0	56.5	58.3	60.1
Six (Low)	55.6	57.7	58.8	57.9	57.5	59.6	61.7
Difference							
(High)	-0.3	-0.7	-1.9	-4.7	-6.7	-6.6	-6.6
(Medium)	-0.3	-0.9	-2.2	-5.7	-8.4	-8.9	-9.3
(Low)	-0.3	-0.8	-2.3	-5.8	-8.7	-9.2	-9.7

It is important to stress that this outcome presupposes that the adult HIV prevalence rate does actually level-off at 5.07 per cent in 2011 and remain constant thereafter. Should the prevalence rate continue to climb beyond this level, a plausible possibility in the light of the experience of several African countries, then the impact would obviously be even greater.

But even this rather positive scenario implies that the improvement in life expectancy would drop to the extremely low rate of about 4 years in total over the 30-year period from 2000 to 2030, an average of only 0.13 years per year. To the extent that life expectancy is a measure of the overall quality of life, this rate of change implies that the quality of life would barely improve over a period of three decades.

Births

While the main impact of an HIV/AIDS epidemic is on deaths, the number of births will also decline relative to what it might otherwise have been owing to the reduced fecundity of HIV-positive women.[8] As table 9 shows, the projected number of births is lower given the HIV/AIDS epidemic than it would have been in the absence of HIV/AIDS, but the difference is not very large – a reduction of about 5 per cent in the "Medium" projection.

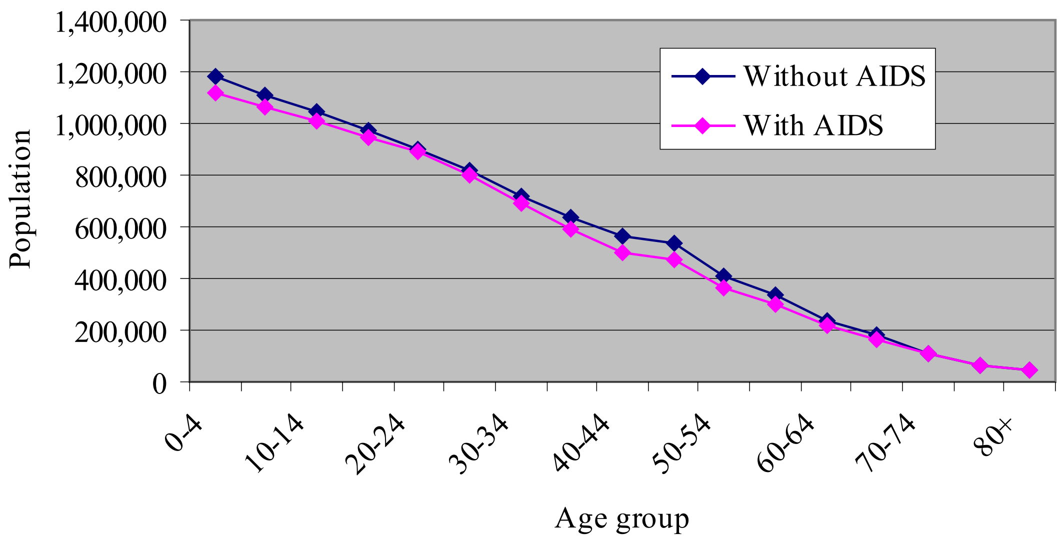
Table 9. Projected annual births with and without HIV/AIDS

Projection number	Year						
	2000	2005	2010	2015	2020	2025	2030
Without HIV/AIDS							
One (High)	174,192	198,287	220,528	242,557	267,068	295,351	327,724
Two (Medium)	174,192	190,151	203,151	214,704	226,564	238,275	248,845
Three (Low)	174,192	181,577	184,029	182,921	179,021	170,510	156,088
With HIV/AIDS							
Four (High)	174,153	198,055	219,587	239,311	259,430	283,689	312,184
Five (Medium)	174,153	189,929	202,285	211,832	220,074	228,791	236,877
Six (Low)	174,153	181,365	183,244	180,475	173,881	163,655	148,452
Difference							
(High)	-39	-152	-941	-3,246	-7,638	-11,662	-15,540
(Medium)	-39	-222	-866	-2,875	-6,490	-9,484	-11,958
(Low)	-39	-212	-805	-2,446	-5,140	-6,855	-7,636

Age structure

Because HIV/AIDS is disproportionately concentrated in the young adult age range, the epidemic has the potential to change the age structure of the population. This is evident in figure 4, which shows a disproportional drop in the population affected by AIDS from age 25-29 and from 0-14 to 15-19 by the year 2030. The difference is not large by comparison with countries with a higher prevalence rate, but it is noticeable. Unexpectedly, the age groups most affected by AIDS are under 15 and over 35. Changes to the age structure on a scale necessary to bring about a shrinking labour force do not appear to be a likely prospect in Papua New Guinea – so long as the adult HIV prevalence rate does not rise above the maximum rate assumed in these projections.

Figure 4. Age distribution of projected population in 2030 ("medium projection") with and without AIDS



Conclusions and discussions

HIV was first detected in Papua New Guinea in the late 1980s. By 2005 it had become a "generalized epidemic" with an estimated 1 per cent of the adult population infected with the virus. While originally concentrated in urban areas, the disease has spread throughout the country and the national prevalence rate is now determined by the rate of spread in the rural areas where more than 80 per cent of the population lives. Analysis of the most recent surveillance data indicates that the adult prevalence rate reached 1.6 per cent in 2007 and this is projected to reach 5.1 per cent by 2012 after which it is expected to remain stable.

A series of population projections incorporating the impact of HIV/AIDS indicates that the demographic effects of AIDS were already emerging by 2000. Projected annual deaths in 2000 are 300 higher with AIDS than would have been the case without AIDS and the excess deaths attributable to AIDS rises steadily to reach more than 23,000 by 2030. Combined with a small decline in the expected births, the increased deaths results in a lower rate of natural increase, hence (in a population experiencing little net migration) a lower rate of population growth. By 2030, the population would be around 520,00 smaller than it would otherwise have been in the absence of AIDS and the growth rate would drop by approximately 16 per cent. The increase in the number of deaths would in turn have a significant impact on life expectancy. Depending on which set of demographic scenarios come to pass in the future, by 2030 life expectancy could decrease to the levels of the 1980s or rise only slightly.

Although the HIV/AIDS epidemic will reduce the population growth rate, the effect will not be sufficient to significantly slow down population growth. The middle projection suggests that the population could increase to 9.3 million by 2030 even allowing for the impact of AIDS. This would represent an increase of 4.2 million people over the period 2000-2030. Thus it appears that Papua New Guinea will face two related challenges over the next two to three decades. On the one hand, the population will continue to increase, although possibly at a slower rate than in the past. On the other hand, the AIDS epidemic will result in reduced life expectancy and therefore a lower overall quality of life. With population growth, and assuming a continual increase in the HIV prevalence rate, at least up to 2012, the number of HIV-positive persons will grow substantially, possibly reaching 300,000 by 2030. As greater numbers of infected persons seek hospital care or medical treatment for AIDS-related conditions, the health- care system would come under increasing strain.

The analysis reported here should be considered preliminary owing to the fact that only one possible scenario of the future trend in the adult HIV prevalence rate has been employed. The HIV prevalence rate trend curve (shown in figure 2) should be further refined for future analyses and other scenarios should be developed. While it may well be that Papua New Guinea will achieve the Millennium Development Goal 6 and its related target of halting the spread of HIV/AIDS by 2015 and beginning to reverse it, the most recent MDG report for the country expresses considerable skepticism that any of the goals can be achieved by the target date (Government of Papua New Guinea, 2004). Given the potential impact of HIV/AIDS on a wide range of socio-economic indicators, it is important to continue to refine the estimates and projections used to chart the potential course of the epidemic.

More work is also needed on the analysis of the demographic impact of the HIV/AIDS epidemic. This study examined a limited number of variables, not including such important ones as infant and child mortality. However, further demographic work should only be undertaken once the epidemiological data on HIV/AIDS have been further refined.

Acknowledgments

The present article is a revised version of one prepared during a recent UNFPA-supported activity to assist the Department of National Planning and Monitoring to carry out population projections for Papua New Guinea for the period 2000-2030. The author wishes to acknowledge the assistance of the Joint United Nations Programme on HIV/AIDS (UNAIDS) and that of the National AIDS Council Secretariat in supplying the AIDS data on which the analysis is based. Responsibility for the analysis and interpretation of the results lies solely with the author.

Endnotes

1. The 1991 survey was in fact conducted over a two-year period from 1991 to 1993. Little analysis was performed on the data from this survey and its results were never fully published. An analysis of the mortality data can be found in Hayes (1996).

2. Census takers in Papua New Guinea have long held the view that it is culturally insensitive to ask people about their father's survival status and that as a result the data obtained would be inaccurate. The survey results suggest that this is not the case.

3. The PEC conducted after the 1990 census itself was subject to error due to the time lapse after the census (Stott, 1992).

4. Reverse survival of the 2000 population did not produce satisfactory results, therefore manual methods were used.

5. The percentage adjustment of 15 per cent is within the range of the estimated coverage, which is of 79-87 per cent based on a limited post-enumeration check, as estimated by Stott (1992).

6. The data were supplied by UNAIDS and are used with permission.

7. A sharp cessation of an exponential growth curve followed by a levelling-off is characteristic of a "logistic" growth pattern. Normally, however, a logistical curve would be much smoother than is shown in figure 2 as the rate of change normally slows gradually as the upper asymptote is approached (Shryock, Siegel and Associates, 1975, 385).

8. Studies reported by Stover (2007:22) suggest that biological rather than behavioural factors are the underlying causes because most HIV-positive women are unaware of their seropositive status.

References

Department of National Planning and Monitoring (DNPM) (1999). *National Population Policy 2000-2010,* Waigani: Department of National Planning and Monitoring, Papua New Guinea.

Government of Papua New Guinea (2004). *Millennium Development Goals: Progress Report for Papua New Guinea 2004*, Waigani: Government of Papua New Guinea.

Hayes, G. (1996). *Estimates of Mortality in Papua New Guinea Based on the 1990 Census and the 1991 Demographic and Health Survey*. Port Moresby: UNFPA/ILO Project PNG/94/P01.

National Aids Council Secretariat (NACS) (2007). *The 2007 Consensus Report on the HIV Epidemic in Papua New Guinea,* Port Moresby: NACS.

National Statistical Office (1990). *Report on the 1990 National Population and Housing Census in Papua New Guinea,* Port Moresby .

________ (2003). *Recent Fertility and Mortality Indices and Trends in Papua New Guinea,* Port Moresby

Shryock, Henry S., Jacob S. Siegel and Associates (1975). *The Methods and Materials of Demography*. 2 volumes, Orlando, Florida: Academic Press, United States of America.

Stott, H. (1992). "Post Enumeration Check, Papua New Guinea Census 1990: Estimates of Coverage", unpublished paper.

Stover, J. and S. Kirmeyer (2005). DemProj Version 4: A Computer Program for Making Population Projections. Washington, D.C.: The Futures Group.

Stover, J. (2007). *AIM Version 4: A Computer Program for Making HIV/AIDS Projections and Examining the Social and Economic Impact of AIDS,* Glastonbury, CT.: The Futures Group.