Trend Analysis of HIV Prevalence Rates amongst Gen X and Y Pregnant Women Attending Antenatal Clinics in South Africa between 2001 and 2010

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Abstract

This research investigated the changes in HIV prevalence rates amongst Generation X (Gen X) and Generation Y (Gen Y) pregnant women attending antenatal clinics across the nine provinces of the Republic of South Africa over a period of ten years from 2001 to 2010. Gen X individuals were born after the Western post World War II baby-boomers, during the period 1961 to 1981. In the South African context, Gen Xers are individuals that were born in an era charged with political strife and dangers of a possible civil war. This period was also characterised by angry social protests, academic boycotts and Soweto student uprisings of 1976. Gen Y (also called Millenium Generation) is the demographic cohort that followed Gen X during the period 1982 to 2002. Gen Y is typified by the escalation of social unrest leading towards the democratic elections in 1994. The political change in 1994 ushered in a new political dispensation characterised by major changes in social and economic circumstances of most South Africans. The new government promoted open access to institutions of higher education resulting in a major transformation in the demographics of the country's public service. Amongst the new working and middle class, sociological literature reports a remarkable increase in materialism and consumerism. However, the social privileges of a few existed hand-in-glove with unprecedented levels of youth unemployment. Youths from impoverished backgrounds found it increasingly difficult to attain a descent education. Most of these youths grew in homes characterised by physical violence and emotional abuse. In view of the widely held tenet that a generation is one of the fundamental social classifications in a society, this research aims to investigate the possible link between generational values and beliefs and the spread of HIV within the female population in South Africa.

Keywords: *Gen X; Gen Y; demographic characteristics; HIV*

1. Introduction

Annual antenatal HIV seroprevalence surveys are the main indicators of changes in HIV infection rates in South Africa. These surveys were started in 1990 and remain the most comprehensive HIV surveys in Africa south of the Sahara (National Department of Health, 2010). The surveys are an important tool for tracking the spatial and temporal trends of the epidemic amongst pregnant women and using sophisticated algorithms the trend is extrapolated to the entire population. It is widely believed that the antenatal clinic data closely approximates HIV prevalence rates in the adult population. However, the exact relationship between HIV prevalence rates amongst antenatal clinic attendees and that of the general population remains uncertain (Salmon & Murray, 2001). Numerous demographic characteristics are captured for each pregnant woman attending an antenatal clinic in South Africa, such as the pregnant woman's age, educational level, gravidity (number of pregnancies), parity (number of children), male sexual partner's age, race, syphilis and HIV status. This study aims to analyse the trend in HIV prevalence rates amongst South African generation X and Y pregnant women attending antenatal clinics during the period 2001 to 2010. This study does not indicate to consider the effect of antiretroviral treatment. It is important that to note that the South African HIV antenatal data does not make mention of any HIV treatment regimes taken by pregnant women attending antenatal clinics in the republic.

2. Literature Review

The term generation refers to a cohort of people within a given population who experience the same significant events over a period of time (Pilcher J, 1994). A generation is therefore one of the most important social classifications in a society. It therefore refers to an entire group of human beings born and living at almost the same age, exhibiting similar

ideas, challenges and attitudes. Karl Mannheim elaborated on three fundamental aspects of a generation, namely shared temporal location, shared historical location, and a shared socio-cultural location (Mannheim, 1952). This research is cognisant of the fact that there are numerous variations in attitudes, values, behaviour and lifestyles within a given generation. However, the latter observation does not denigrate the importance of the concept of generation, but merely enhances its complexity.

Generation X individuals were born after the Western post World War II baby-boomers, during the period 1961 to 1981 (Kupperschmidt, 1998). In the South African context, Gen Xers are individuals that were born during an era charged with political strife and dangers of a possible civil war. This period was also characterised by angry social protests, academic boycotts and Soweto student uprisings of 1976. Gen Y (also called Millennium Generation) is the demographic cohort that followed Gen X during the period 1982 to 2002 (McCrindle, 2003). Generation Y is typified by the escalation of social unrest leading towards democratic elections in 1994. The political change in South Africa in 1994 heralded a new political dispensation characterised by major changes in social and economic circumstances of most South Africans. Formerly disadvantaged Africans were admitted to institutions of higher learning, resulting in a rapid transformation in the racial demographics of senior public service within the country. Amongst the new working and middle class, sociological literature reports a gradual increase in materialism and consumerism (Schenk & Seekings, 2010). However, the social privileges of a few existed hand-in-glove with unprecedented levels of youth unemployment. Youths from poor neighbourhoods faced huge challenges in attaining a descent education. An increasing number of youths grew up in homes characterised by physical violence and emotional abuse. In view of the widely held tenet that a generation is one of the fundamental social classifications in a society, this research aims to investigate the possible link between generational values and beliefs the spread of HIV within the female population in South Africa.

3. Research Methodology

3.1 Data Sources

This study used South African annual antenatal HIV seroprevalence data from year 2001 to 2010. The national antenatal sentinel HIV and Syphilis prevalence survey is conducted in all the nine provinces of the Republic of South Africa. HIV testing is conducted as per standard requirement from the World Health Organisation (WHO). The South African antenatal survey is aimed at pregnant women between the ages of 15 and 49. In order to reduce the likelihood of individuals being included in the survey more than once, only pregnant women attending clinics for the first time were interviewed. The survey has grown over the years from an average of 16 000 to over 34 000 since the early 2000's, covering 52 health districts in all the nine provinces.

3.2 Data Analysis

3.2.1 Gen X and Gen Y Demographic Characteristics

The study considered Gen X to be the period between the years 1961 and 1981. However, the available data for the study was for the period 2001 to 2010. On that basis, considering the year 2001, it means that the youngest Gen X individual is 20 years, while the oldest is 40 years old. This therefore means that in the year 2001, pregnant women between the ages of 20 and 40 who attended antenatal clinics were considered to be Gen X. The same approach was applied to the subsequent years of 2002 to 2010, as shown in Table 1. The average values for each demographic were determined for each age range (Gen X) for each year of the study between 2001 and 2010. A similar calculation was conducted for Gen Y pregnant women, however taking into account that Gen Y is defined to be between the years 1982 and 2002. The values of the different Gen Y demographic characteristics are shown in Table 2.

Table 1. Gen X demographic characteristics

Year of study	GenX	Age range	Means						
			HIV	Agewoman (years)	Agepartner (years)	Educat	Grav	Parity	Syphilis
2001	1961-1981	20-40	0.27	27.3	31.34	1.13	2.46	1.35	0.03
2002	1961-1981	21-41	0.30	27.84	32.7	1.14	2.50	1.42	0.04
2003	1961-1981	22-42	0.32	28.53	34.61	1.20	2.65	1.55	0.03
2004	1961-1981	23-43	0.34	29.25	33.96	1.14	2.62	1.67	0.03
2005	1961-1981	24-44	0.36	29.87	34.43	1.15	2.75	1.66	0.03
2006	1961-1981	25-45	0.35	30.65	35.10	1.14	2.87	1.76	0.02
2007	1961-1981	2646	0.36	31.41	35.88	1.11	2.97	1.83	0.03
2008	1961-1981	27-47	0.37	32.15	36.55	1.14	3.05	1.89	0.02
2009	1961-1981	28-48	0.38	32.88	37.14	1.84	3.14	1.99	0.02
2010	1961-1981	29-49	0.40	33.49	37.46	1.84	3.21	2.07	0.02

Table 2. Gen Y demographic characteristics

Year	GenY	Age range	Means						
			HIV	Agewoman	Agepartner	Educat	Grav	Parity	Syphilis
2001	1982-2002	15-19	0.153	17.69	22.7	1.31	1.10	0.09	0.02
2002	1982-2002	15-20	0.17	18.33	22.50	1.29	1.16	0.15	0.03
2003	1982-2002	15-21	0.19	18.83	23.34	0.130	1.18	0.17	0.03
2004	1982-2002	15-22	0.22	19.35	23.96	1.21	1.21	0.32	0.02
2005	1982-2002	15-23	0.23	19.87	24.32	1.20	1.36	0.35	0.02
2006	1982-2002	15-24	0.22	20.37	25.02	1.19	1.42	0.39	0.02
2007	1982-2002	15-25	0.24	20.84	25.39	1.15	1.49	0.44	0.02
2008	1982-2002	15-26	0.24	21.24	25.80	1.16	1.55	0.48	0.02
2009	1982-2002	15-2	0.25	21.69	26.30	1.96	1.61	0.56	0.02
2010	1982-2002	15-28	0.26	22.09	26.63	1.96	1.67	0.63	0.02

3.2.2 National HIV and Syphilis Seroprevalence Rates

Table 3 shows the average national annual antenatal HIV seroprevalence rates for the study period between 2001 and 2010. The results were determined from the raw antenatal survey data and the values were similar to those reported by the National Department of Health of South Africa.

Table 3. National HIV and Syphilis seroprevalence rates

Year	National HIV Prevalence rate	National Syphilis Prevalence rate
2001	0.248	0.021
2002	0.265	0.033
2003	0.279	0.029
2004	0.295	0.024
2005	0.302	0.028
2006	0.291	0.019
2007	0.294	0.028
2008	0.293	0.019
2009	0.294	0.019
2010	0.302	0.015

4. Findings and Discussion

4.1 Trend Analysis

The HIV prevalence rates were consistently lower for Gen Y women compared to their Gen X counterparts. Evidently,

there was a gradual increase in HIV prevalence rates for the two groups over the ten-year study period. The yearly HIV prevalence rates for Gen X were considerably higher than the average annual national HIV prevalence rates. While Gen Y prevalence rates were significantly lower than the corresponding annual national HIV prevalence rates, as shown in Figure 1.

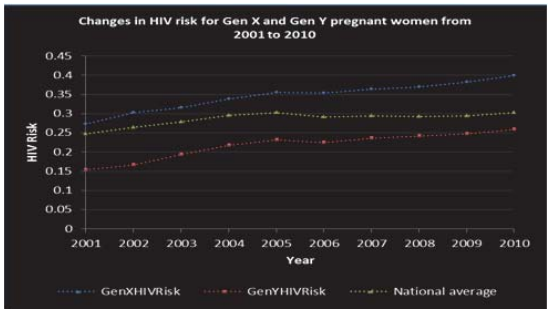

Figure 1. Annual HIV prevalence rates amongst Gen X and Gen Y pregnant women

A paired t-test was used to compare the changes in HIV prevalence rates between Gen X and Gen Y individuals as shown in Table 4.

Table 4. Paired Gen X and Gen Y HIV t table

	Paired Differences								
	Mean	Standard deviation	Standard error of mean	N	95% Confidence Interval of difference		t	df	Sig (2 tailed)
					Lower	Upper			
(GenXHIV-GenYHIV)	0.128	0.07	0.002		0.124	0.133	64.00	9	0.00
GenXHIV	0.345	0.04	0.012	10					
GenYHIV	0.128	0.04	0.011	10					

The value of the t-value is related to the size of the difference between the mean HIV prevalence rates of the two generations being compared. A large t-value indicates a correspondingly large difference between the mean HIV prevalence rates. However, the t-value by itself is not the most useful statistic to report, it is also important to report the p-value. The p-value helps to decide whether to accept or not accept the null hypothesis. It is therefore imperative to decide how low the p-value should be before rejecting the null hypothesis. The cut-off point is called the significance level and is usually set at 0.05 or 0.01.

The 95 percent confidence interval of the difference provides an estimate of the boundaries between which the true mean difference lies in 95 percent of all possible random samples of individuals participating in this study. The t-statistic is obtained by dividing the mean difference by its standard error to give a t-value of 64, as shown in Table 4. The Sig. (2-tailed) column shows that the probability of obtaining a t statistic whose absolute value is equal to or greater than the obtained t statistic is zero. Since the significance value for the difference in HIV prevalence rates between Gen X and Gen Y is less than 0.05, it can be concluded that the average difference in HIV prevalence rate of 0.128 is not due to chance variation.

This study also investigated the annual changes of HIV prevalence rates from one year to the other. Gen Y women exhibited a positive increase in HIV prevalence rate from the basal year of 2001 to 2002. However, from 2003 to 2005 there was a gradual decrease in the magnitude of increase in HIV prevalence rate. In 2006, the increase in HIV prevalence rate was negative, meaning that a decrease in overall HIV infection rate was observed, as shown in Figure 2.

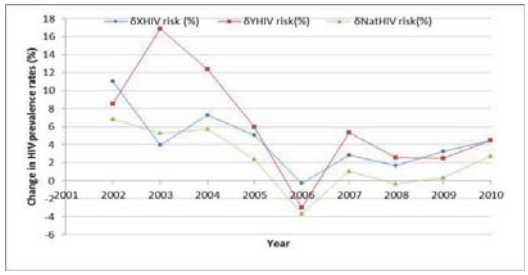

Figure 2. Plot changes (δ) in HIV prevalence from one year to the next during the period 2001 to 2010

In general, the plot of the annual syphilis prevalence trends for Gen X and Gen Y, (Figure 3) seemed to suggest on average a gradual decrease between the years 2001 and 2010. However, it was observed that consistently Gen X individuals exhibited higher syphilis infection rates compared to their Gen Y counterparts, as shown in Figure 3. Epidemiological research literature has shown that individuals infected with other sexually transmitted diseases such as syphilis tend to have a higher probability of contracting an HIV infection (Zetola & Klausner, 2007).

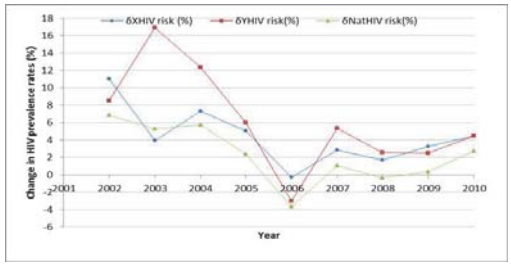

Figure 3. Annual syphilis prevalence rates amongst Gen X and Gen Y antenatal clinic attendees

A paired t-test was used to compare the annual changes in Gen X and Gen Y syphilis rates between the years 2001 and 2010. As shown in Table 5, a t-value of 1.05 was obtained for the difference between Gen X and Gen Y syphilis prevalence rates at a 95 percent confidence level. The 2-tailed significance column shows that the probability of obtaining a t statistic whose absolute value is equal to or greater than the obtained t statistic is 0.321. Since the significance value for the difference in syphilis prevalence rates between Gen X and Gen Y is greater than 0.05, it can be concluded that the average difference in syphilis rates of 0.0292 is not significant and could be due to chance variation.

Table 5. Paired Gen X and Gen Y Syphilis t table

	Paired Gen X and Gen Y annual Syphilis Differences								
	Mean	Standard deviation	Standard error of mean	N	95% Confidence Interval of difference		t	df	Sig (2 tailed)
					Lower	Upper			
(GenXSyphilis-GenYSyphilis)	0.0292	0.088	0.0028		-0.0034	0.0092	1.05	9	0.321
GenXSyphilis	0.024	0.0099	0.0031	10					
GenYSyphilis	0.021	0.0038	0.0012	10					

During the years 2001 to 2008, the educational levels that were captured for each antenatal clinic attendee were categorised as zero (no education), one (primary education) and two (secondary education). However, after 2009 category three was added, representing tertiary education. Throughout the study period, 2001 to 2010, Gen Y individuals exhibited slightly higher levels of education compared to their Gen Y counterparts (Figure 4). Perhaps the slight advantage in educational levels of Gen Y could explain their observed lower levels of HIV prevalence rates compared to their Gen X counterparts. Documented research findings have confirmed that there is a negative linear relationship between years of education and HIV infection rate (Smith et. al, 2012).

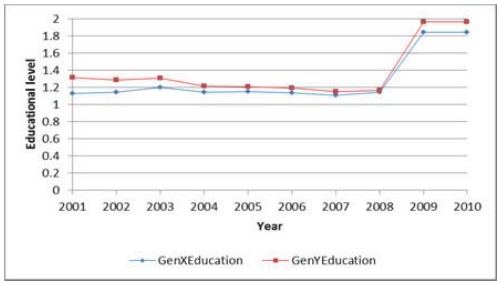

Figure 4. Educational levels of Gen X and Gen Y antenatal clinic attendees

4.2 Time series forecasting

Time series analysis entails the study of time series data in order to extract meaningful statistics and other characteristics of the data. Time series forecasting therefore uses statistical models to predict future values based on previously observed values. Time series forecasting predicts future values of time series variables by extrapolating trends and patterns in the past values of the series or by extrapolating the effect of other variables on the series. The purpose of this research was to use the available antenatal HIV seroprevalence data to predict the future trend of the HIV epidemic. The time series analysis was conducted for both Gen X and Gen Y pregnant women attending antenatal clinics in South Africa between the years 2001 and 2010.

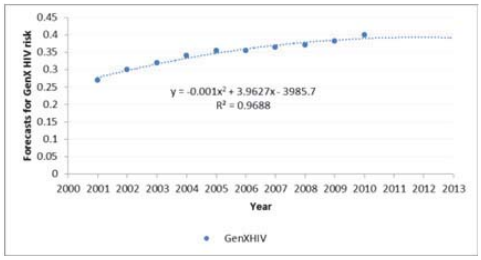

Figure 5. Time series forecasting of Gen X HIV prevalence rates using a quadratic model

A polynomial model of order 2 (also called a quadratic model) was used for our time series analysis. The coefficient of determination (R^2) of the quadratic model was found to be 0.97, which indicated that the data points fitted the statistical model well, as shown in Figure 5. The equation of the quadratic model was $y = -0.001x^2 + 3.9627x - 3985.7$. Three forward forecast periods were developed. The time series forecasting exercise using a quadratic trend line indicated that there was a likelihood of the HIV trend decreasing beyond the year 2010. This result has been independently collaborated by the South African National Department of Health that has predicted that the HIV pandemic was likely to start decreasing beyond the year 2010.

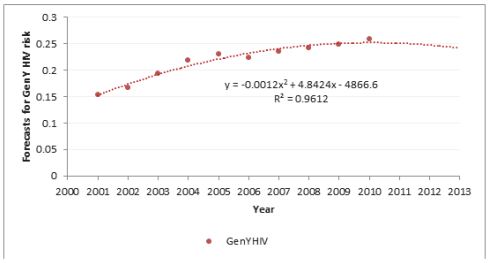

Figure 6. Time series forecasting of Gen Y HIV prevalence rates using a quadratic model

A quadratic model was used for time series forecasting of the HIV trend amongst Gen Y pregnant women attending antenatal clinics in South Africa. The coefficient of determination (R^2) of the quadratic model was 0.96, as shown in Figure 6, and the equation of the quadratic model was $y = -0.0012x^2 + 4.8424x - 4866.6$. The time series forecasting using the above quadratic model demonstrated that the HIV prevalence rates were likely to decrease amongst Gen Y individuals beyond the year 2010.

5. Concluding Remarks

We have shown that HIV prevalence rates during the period 2001 to 2010 were higher for Gen X antenatal clinic attendees than their Gen Y counterparts. Furthermore, the annual Gen X prevalence rates were observed to be higher than the national HIV prevalence rates. On the other hand, Gen Y individuals exhibited HIV prevalence rates that were significantly lower than the national average. This research also demonstrated that the differences in annual syphilis prevalence rates amongst Gen X and Gen Y pregnant women were statistically insignificant using a paired t-test. The educational levels of Gen Y individuals in the study were consistently higher than Gen X individuals. Again, education has been found to heighten awareness of risk factors associated with HIV infection and thus reduce risk-taking behaviour of individuals. On that basis, it was observed that Gen Y antenatal clinic attendees exhibited lower levels of HIV infection compared to Gen Y pregnant women. However, further research needs to be undertaken to understand the implications of changes in categorisation of educational levels in this data. During the years 2001 to 2008, only three categories of educational levels were stipulated, namely zero (no education), one (primary education) and two (secondary education). During the years 2009 to 2010, an additional category was added, namely 3 (tertiary education).

Time series forecasting indicated that the epidemic likely to decrease beyond the year 2010 amongst both Gen X and Gen Y antenatal clinic attendees. It was also observed that the projected HIV prevalence rates for Gen Y were significantly lower than the national average, while Gen X predictions remained higher than the national average.

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