Trends in South African fertility between 1970 and 1998

An analysis of the 1996 Census and the 1998 Demographic and Health Survey

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SOUTH AFRICA

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By

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FOREWORD

Secondary analysis of survey and census data is important both to uncover new insights as well as to highlight where future data collection needs to be improved. This study has served both these purposes well by combining the wealth of information from two major sources: the 1996 census and the 1998 Demographic and Health Survey.

The description of the declining trends is South African fertility has been deepened by this analysis to reveal that while the transition has followed a typical pattern observed in Africa with declines at all ages, this has occurred over an unusually long period and South Africa has experienced a unique phenomenon of very long intervals between births. This study reiterates the observation that the majority of women do not use contraception before the birth of their first child while contraceptive usage is high after the first birth. This has important policy implications, particularly in the context of the HIV epidemic. The authors recommend that family planning and reproductive health strategies need to focus on youth and make barrier methods acceptable to young people before they have their first child.

The detailed analysis and comparison of these data sets has identified some problems in the quality of the data. These need to be addressed in the future collection of such data, but also need to be taken into account when the results presented here are assessed.

This study makes an important contribution to the growing knowledge base of South African demography and provides robust estimates for the current level of fertility that can be used for planning and policy development.

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EXECUTIVE SUMMARY

The 1996 South Africa Census and the 1998 Demographic and Health Survey (DHS) provide the first widely available, comprehensive and nationally representative demographic data since 1970, and permit the analysis of aspects of South African demography that have never been investigated before. This report provides a detailed account of the South African fertility decline from 1970 to the present, and provides the most robust estimates of current levels of fertility in South Africa yet published using the 1996 census data.

South African fertility has been in decline for almost 30 years, and is currently the lowest in sub-Saharan Africa. Inadequate data and apartheid policies meant that, until recently, most demographers have not had the opportunity to investigate the level of, and trend in, South African fertility. The resultant uncertainty about the past level of fertility has led to widely divergent estimates of fertility levels in South Africa in recent years, even with the benefit of more-recently collected data.

Both data sets suffer from errors. The DHS data describes a population that is slightly more urbanised and better educated than the census data, and it seems that some age misreporting in the DHS occurred among older rural women. Unadjusted, the census data on recent fertility are of poor quality. Data for many childless women were not captured correctly, and frequently stillbirths were included among women's reported live births. Most seriously, many women reported the number of births in the 12 months before the census as being the same as their total number of children ever borne. A series of technical adjustments, described in detail in the Appendices, are required to render the data usable, and from these age-specific fertility rates are derived for each population group and for each of South Africa's nine provinces.

Data from the DHS indicate a national level of fertility in 1996 of 2.9 children per woman, and 3.1 for Africans. Our investigations here suggest that these are underestimates, and that more accurate estimates of total fertility in 1996 are 3.2 and 3.5 children per woman respectively. Adolescent fertility is very high: of births to African South Africans aged between 15 and 49, nearly one sixth are to women aged between 15 and 19.

Fertility is close to, or below, replacement level for White women. Total fertility in 1996 was 2.5 children per woman for Asian/Indian women and 2.6 for Coloured women. Childbearing by White and Asian/Indian women is heavily concentrated in the 25-29 year age group. Differentials in fertility by province reflect both their differing racial composition and the different levels of urbanisation, education, and access to health and family planning services

created by apartheid. Total fertility is lowest in the Western Cape and Gauteng, while the highest is in the Northern Province and Eastern Cape. A summary of estimated fertility, by province and population group is shown below.

Summary of estimates of total and age-specific fertility in South Africa in 1996, by population group and province

		Age specific fertility rates (per 1000)						
	Total	15-19	20-24	25-29	30-34	35-39	40-44	45-49
National	3.23	78	151	156	125	87	42	7
Population group								
African	3.49	86	159	159	135	102	50	7
Coloured	2.64	68	144	133	97	60	23	2
White	2.02	19	89	151	88	31	16	10
Asian/Indian	2.45	24	120	185	85	45	23	8
Province								
Western Cape	2.35	55	131	122	88	53	19	2
Eastern Cape	3.80	79	170	178	154	116	56	8
Northern Cape	2.82	71	155	143	105	65	24	2
Free State	2.75	60	147	142	107	67	25	2
KwaZulu-Natal	3.32	78	157	157	130	94	43	6
North-West	3.00	76	151	145	114	78	33	4
Gauteng	2.50	59	131	126	96	62	24	3
Mpumalanga	3.42	93	170	161	128	89	39	5
Northern Province	4.01	101	181	180	154	118	59	9

Using the age distributions from the 1996 and 1970 censuses and recent estimates of South African mortality, we estimate the trends in South African fertility from 1955 through to 1996. From these data, it is clear that the South African fertility transition started in the mid-1960s, and has followed an unusually long and gradual trajectory. The pace of decline has accelerated since the early 1980s.

The birth history data in the South Africa DHS allow the investigation of changes in family size and birth intervals among African South Africans that make up this fertility decline. The proportion of women having another birth is falling not just for women with several children, but also for women of low parity. Thus, growing numbers of African women are having two children, and some possibly even only one child.

In parallel, mean birth intervals in South Africa have increased from around 30 months to approximately 50 months in the last 25 years. The current fertility patterns of women of childbearing age indicate that these intervals may lengthen further. Nowhere else in sub-Saharan Africa are similarly long birth intervals found.

Our results describe a pattern of fertility decline that is in some ways typically African and in other ways uniquely South African. The pattern of decline in parity progression ratios follows a pattern first described by Caldwell, Orubuloye and Caldwell (1992). Like their other African counterparts, African South African women's decisions about whether to have another child seem less influenced by the exact number that they have already had than by other considerations. This stands in contrast to the European fertility transition where the fertility decline was largely accounted for falls in higher-order parity progression ratios at older ages. However, the development of very long birth intervals is uniquely South African. Moreover, in no other sub-Saharan African country has fertility yet fallen as far.

The spread of the HIV epidemic will accelerate the future decline in South African fertility. Recent evidence suggests that women infected with HIV have lower fertility as a result of secondary sterility and foetal loss brought on by the disease and its associated opportunistic infections (Zaba and Gregson, 1998). HIV/AIDS morbidity and mortality will be highest among women in their mid-30s, thus reducing the number of children borne by these women. In addition, long birth intervals raise the mean age of childbearing, thereby reducing the number of children borne by women by the time they reach their mid-30s. Indeed, the effects of HIV/AIDS on fertility can be observed from the fact that, according to a Department of Health report into maternal mortality, 82 out of 565 maternal deaths in 1998 were recorded as being due to AIDS[§], and of these women (nearly three quarters of whom were less than thirty) more than 87 percent had had fewer than three deliveries (Department of Health, 1999a).

The high level of adolescent fertility and the length of birth intervals indicate that the majority of women do not use contraception before their first birth, while contraceptive usage after the first birth is high. In this regard, we agree with the conclusions drawn by Garenne, Tollman and Kahn (2000). Family planning and reproductive health strategies

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[§] Due to the manner in which deaths, and causes of deaths, in South Africa are reported, HIV/AIDS-related deaths are almost certainly underreported.

need to shift towards promoting safe sex and making barrier methods acceptable to young people before their first child is born, and away from providing contraception to women only after their first birth. By promoting barrier methods over other forms of contraception, the spread of HIV among South Africans may be mitigated.

1 INTRODUCTION

The collection of the 1996 South Africa Census and 1998 South Africa Demographic and Health Survey (DHS) data has opened up many avenues for substantive research into recent demographic trends in South Africa that were previously restricted and circumscribed through lack of data.

Until recently, South African fertility has been under-examined for two reasons. First, South African demography has been hampered for most of the last century by inadequate census and vital registration data relating to the African population[1]. According to Mostert, van Tonder and Hofmeyr (1987:3), "the census coverage of the African population in the 1904, 1911 and 1921 censuses is viewed as being poor in all respects, the 1936 and 1970 censuses as reasonably good, and those of 1946, 1951, 1960 and 1980 again as less good". The granting of "independence" to the TBVC states[2] between 1976 and 1981 further exacerbated the difficulties of census collection in the country. In 1980, the three then-independent states conducted their own censuses, while five separate censuses were conducted in 1985.

Questions on African fertility (the number of births in the last year and deaths of children under the age of 1 in the last year) were introduced in the 1960 census, and included again in the 1970 census. A further question on children ever borne was introduced in the 1980 census. While "usable" age-specific fertility rates were derived from the 1960 data, the results from the 1970 census "could not have given a true representation of reality," and those from the 1980 census were so bad as to be "completely and utterly unusable" (Mostert, van Tonder and Hofmeyr, 1987:4-5). Thus, since 1960, the calculation of age-specific fertility rates directly from census data has been impossible.

Investigations into African fertility were undertaken periodically in the 1970s and 1980s by the Human Sciences Research Council (HSRC), the government's official social science research body (Lötter and van Tonder, 1976; Mostert and Lötter, 1990; van Wyk, 1980), but the results of these were not disseminated widely. South Africa's international isolation, too, meant that it was excluded from the scope of the World Fertility Survey in the 1970s and the first rounds of the Demographic and Health Surveys (DHS). During this time, the HSRC replicated those surveys,

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[1] The use of apartheid-era classifications based on population group or skin colour should in no way be taken as condoning that system. However, the unfortunate legacy of apartheid and segregationist policies is such that important demographic outcomes (especially mortality, but also some of the proximate determinants of fertility) differ in crucial ways according – broadly – to racial categorisations.

[2] Transkei, Bophuthatswana, Venda and Ciskei

especially with the 1987-89 “DHS”, using many of the same questions as the USAID-funded series of DHS surveys run with technical assistance from Macro International.

The most frequently cited estimates of past African and South African fertility (cited by Caldwell and Caldwell (1993) and Chimere-Dan (1993) amongst others) are those from Mostert, van Tonder and Hofmeyr (1987). However, these estimates need to be treated with greater circumspection than has been afforded to them by some citing them, since they appear to have been determined in part by what the original authors deemed to be reasonable estimates of fertility[3].

Table 1.1 shows estimates of South African fertility derived from HSRC and census data by HSRC demographers for the period 1945-95.

Table 1.1 “Official” estimates of total fertility in South Africa, 1945-95

Period	*All South African women*	*African women*
1945-50	6.0	6.8
1950-55	6.1	6.8
1955-60	6.0	6.7
1960-65	6.0	6.7
1965-70	5.8	6.5
1970-75	5.5	6.3
1975-80	4.9	5.8
1980-85	4.6	5.4 - 5.6
1985-90	4.0	4.6
1990-95	3.5	4.0

Source: Mostert, Hofmeyr, Oosthuizen *et al.* (1998) for All South Africans and Africans 1985-95; Mostert, van Tonder and Hofmeyr (1987) for Africans 1945-85. The higher value for Africans in 1980-85 comes from Mostert *et al* (1987), the lower from Mostert *et al* (1998).
Note: Oosthuizen (2000), citing the same sources, gives a figure of 3.6 for Africans in 1990-95. This figure is implausible, given that total fertility in the country was still estimated as 3.5 children per woman. Hence, his discussion on the “plummeting” decline in African fertility after 1980 appears to be based on flawed data.

The second reason for the limited research on South African demography is that apartheid policies and practices politicised demography and demographic results more than in most other countries. As Mostert, van Tonder and Hofmeyr (1988:59) have noted, the Afrikaans for demography (prior to the widespread use of the anglicism *demografie*) was *politiese wiskunde* “political arithmetic,” a term that indicates the reflexive relationship that existed between population and polity in the country. The term itself is not unique to South Africa, and was in common use in Europe in the eighteenth century. However, the overtly politicised connotations

[3] The authors used the 1936 South Africa Census results to project the African South African population on three different bases, with fertility and mortality assumptions as inputs. The first was a projection that lead to an age-structure equivalent to that in the 1970 Census; the second a similar projection leading to the population age-structure in the 1980 Census; and the third (the one finally used) “a projection that is based on acceptable fertility rates, if none of the aforementioned projections are acceptable in terms of their fertility estimates” Mostert, van Tonder and Hofmeyr (1987:31). Thus, the rates published, and subsequently frequently cited, were determined in part by the authors’ *a priori* perceptions of what “acceptable fertility rates” in South Africa were at that time.

of the term are of heightened relevance in South Africa. Mostert, van Tonder and Hofmeyr continue: "The political arena in South Africa is, to a large extent, dominated by the 'arithmetic' of the local population structure, while political decisions have, over the years, exerted a great influence on population trends… In the discussion of demographic trends in South Africa, 'political arithmetic' in this country will of necessity occupy a prominent place."

Such sentiments reflect the long-standing politicisation of demographic research in South Africa. Notions of "swamping" and the resultant need to limit African fertility were frequent in the rhetoric of Grand Apartheid[4]. The political climate, then, politicised demographic inquiry in South Africa until the early 1990s. The sensitivity of demographic information meant that data collected on behalf of the South African government by the HSRC were not made generally available to researchers, while the reports based on these surveys and studies were usually published only in Afrikaans, thereby further restricting the reports' accessibility to outsiders.

Further, demography was absent from the teaching programmes of the English-medium universities. In part, this reflected the ideologically tainted nature of South African demography and the paucity of data. However, the effect was to focus research emerging from these institutions not on South African demography *per se* (although some demographic research was done by individuals), but on sociological and anthropological contextualisations of demographic processes as exemplified by the work of Preston-Whyte (1988, 1994) and van der Vliet (1991).

Two other factors contributed to the limited demographic research in South Africa. Apartheid policies and racial capitalism led many researchers to view South Africa as being not fully "African", with the consequence that the country tended to be ignored in discussions of the demography of the sub-continent. Furthermore, South Africa's frequent omission from international statistical series (such as those published by the UN and World Bank) meant that data for South Africa were difficult to come by outside the country, and hence often ignored by non-specialists.

These factors, together with the boycott of South Africa by foreign academics that commenced in earnest in the 1980s, have ensured that South African demography has remained a *terra incognita* on the international map for much longer than that of any other Southern African country.

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[4] The threat of the subsumation of the White population, for example, led in 1967 to a cabinet minister, MC Botha, encouraging White South Africans to increase their fertility through tax relief and other benefits, and "have a baby for Botha". In 1962, Prime Minister Verwoerd articulated strongly the need for the independence of the Transkei, since the failure to grant the "homelands" independence would lead to the swamping of White South Africans in the Republic: "… it would inexorably lead to Bantu domination. Because in the long run numbers must tell." (Verwoerd, 1978 (1962)). This last phrase is a direct quote from a paper written in 1950 by one of South Africa's most eminent demographers, Jan Sadie: "In South Africa the outstanding problem, dominating all others, is the relative numbers of the different races constituting the Union's population, and their differential rates of growth. For in the long run, numbers must count." (Sadie, 1950)

Few demographers outside of the HSRC wrote on South African fertility until the early 1990s, and those that did had to make do with unverifiable published statistics. Their research tended to be derivative, insofar as they were not able to manipulate data themselves, and they focused instead on presenting syntheses, summaries and alternative interpretations of what published data were available. Examples of this literature include Lucas (1992); Caldwell and Caldwell (1993); Chimere-Dan (1993a, 1993b, 1994). However, this state of affairs could, and did, lead to erroneous interpretations of South African fertility and the pace of the South African fertility decline.

In their 1993 article, Caldwell and Caldwell (1993) identified an apparent anomaly in South African fertility. They contrasted the high level of African fertility with the extent and scope of the South African government's implementation of an "Asian-type" family planning programme and the level of socio-economic development in the country and proposed three explanations of the anomaly. Their first suggestion was that widespread community and political resistance existed to the government's family planning programme. As Kaufman (1996) has shown, however, while political resistance to the programme did exist, this resistance did not translate into a large-scale rejection by African women of government-sponsored contraception. The Caldwells' second explanation was that fertility control was "pointless", since the social stratification of South African society made social mobility impossible. This does not square with economic histories of South Africa. Both Beinart (1994) and Lipton (1985) discuss the social changes that occurred in South African society, and the South African labour market particularly, between 1970 and 1990. They argue that, while social mobility was indeed difficult and obstructed, it was not impossible. More importantly, this period was characterised simultaneously by both political repression and the gradual freeing up of the South African social order, as economic growth systematically undid racist job-reservation policies and the government lost the political will to enforce restrictions on African urbanisation. The Caldwells' third argument, that there are "profound cultural and social differences" in South Africa, resulting in a "refusal" by Africans to limit their fertility has been shown to be wrong by more recent data. As this report documents, these data reveal that South African fertility has been falling gradually for the best part of half a century, to a level that is low by developing country standards.

The political transition in the 1990s created the scope for non-governmental agencies to collect new demographic data, and allowed demographers access to previously restricted data sets. The 1993 Living Standards and Development Study (SALDRU, 1994), organised with the assistance of the World Bank, provided the first large-scale data set not collected by the South African government or its agencies. While the LSDS is primarily an economic and poverty study, it did collect important demographic data relating to fertility and mortality. In doing so, the study provided researchers with independent means of evaluating the level and context of South African fertility. Fuller and Liang (1999) use this study to explore the relationships between socio-economic variables (especially education) and teenage pregnancy, while Mencarini (1999) uses the same data to estimate the level and correlates of fertility in South Africa.

Kaufman's doctoral research (Kaufman, 1996; 1998; 2000) marked an important milestone in the analysis of South African demography. She was among the first non-South Africans to gain access to HSRC data, and used the 1987-9 DHS-type survey to investigate the political context of reproductive control in South Africa. In so doing, she integrated demographic and political theory to give a more nuanced interpretation of the dynamics and political context of contraceptive usage during the South African fertility transition.

The government's statistical agency, Statistics South Africa, has also become more willing in recent years to present and share demographic analyses. This has contributed to the debate on the level of fertility in South Africa. A summary of published estimates of total fertility in South Africa using data collected since 1993 is shown in Table 1.2. Two reports (Udjo, 1997; 1998) presenting analyses of South African fertility using the 1995 October Household Survey (OHS) and the 1996 South Africa Census have been issued and the first independent assessments of the current level of fertility in the country using the 1996 South Africa Census have started to emerge (Dorrington, 1999; Dorrington, Nannan and Bradshaw, 1999).

Table 1.2 Summary of estimates of total fertility in South Africa using data collected since 1993

Author and year of publication	*Population*	*Data Source*	*Year(s) to which estimate applies*	*TFR*
Sibanda and Zuberi (1999)	African	1996 Census	1985	5.2
Mencarini (1999)	African	1993 LSDS	1984-88	4.8
Sibanda and Zuberi (1999)	African	1996 Census	1990	4.7
Mencarini (1999)	African	1993 LSDS	1989-93	3.7
Sibanda and Zuberi (1999)	African	1996 census	1995	3.1
Dorrington, Nannan and Bradshaw (1999)	African	1996 Census	1996	3.6
Sibanda and Zuberi (1999)	African	1996 Census	1996	3.0
Department of Health (1999b)	African	1998 DHS	1996-8	3.1
Udjo (1997)	All	1995 OHS	1980	4.2
Udjo (1997)	All	1995 OHS	1985	3.5
Sibanda and Zuberi (1999)	All	1996 Census	1985	4.5
Udjo (1997)	All	1995 OHS	1990	3.3
Sibanda and Zuberi (1999)	All	1996 Census	1990	4.2
Udjo (1997)	All	1995 OHS	1995	3.2
Sibanda and Zuberi (1999)	All	1996 Census	1995	2.9
Udjo (1998)	All	1996 Census	1996	3.3
Dorrington, Nannan and Bradshaw (1999)	All	1996 Census	1996	3.2
Sibanda and Zuberi (1999)	All	1996 Census	1996	2.8
Department of Health (1999b)	All	1998 DHS	1996-8	2.9

A further contribution to our understanding of the South African fertility transition has come from Sibanda and Zuberi (1999). They use a variant of the reverse-survival technique (the "own-child" method) to assess the trend in South African fertility from 1981 to 1996 using the 1996 South Africa Census data. While their methodology and assumptions have been criticised as being inappropriate to the South African context (Dorrington, Nannan and Bradshaw, 1999), their results nevertheless add to the limited body of research on South African fertility.

Table 1.2 reveals wide variations in estimated levels of South African fertility. One of the primary objectives of this Technical Report is to derive more robust estimates of the trend in South African fertility over the last few decades, using multiple data sources.

The report describes and analyses the trends in South African fertility between 1970 and 1998. Thus use of advanced demographic techniques reveals patterns of change that are indicative of the decline in South African fertility over this period. The report provides a comprehensive account of the South African fertility decline from 1970 to the present, and provides the most robust estimates of current levels of fertility in South Africa yet published using the 1996 census.

The principal focus of this Technical Report is on the fertility of the black African population in South Africa. The first reason for this is the comparative lack of detailed analysis of African fertility as a result of past government policies and lack of data. The African population in South Africa is of the order of six or seven times the size of any other population group in the country, and hence national levels of fertility are closely related to levels of fertility in the African population. The fertility of other population groups is very different. Furthermore, the sample of both Whites and Indians/Asians in the DHS is insufficient for a detailed analysis of the level of fertility in these two populations.

One area where this paper makes a specific contribution is in the analysis of the trends in, and levels of, birth intervals by parity and age group for the African population. Such investigations have not been attempted in the last thirty years. The comparison of those earlier results with ours (presented in Section 4) shows a dramatic increase in birth intervals.

The report is divided into five sections. Section 2 investigates the internal and external (relative to the 1996 South Africa Census) consistency of the DHS data. Section 3 presents estimates of the current level, and past trends in South African fertility, while Section 4 analyses the changing patterns of family formation among African women in South Africa over the last 30 years, and presents new material documenting the lengthening of birth intervals in South Africa. The final section summarises the preceding material, and draws some conclusions about the process and nature of fertility decline in South Africa.

2 DATA SOURCES AND QUALITY

2.1 Introduction

The two main sources of data used are the 10 percent public-use sample from the 1996 South Africa Census, and the 1998 South Africa Demographic and Health Survey (DHS). Section 2.2 describes the sampling methodologies employed in the collection of the census and DHS data, as well as the 1970 South Africa Census, that are used to estimate fertility in earlier periods. Section 2.3 describes the background characteristics of women (all South Africans and Africans separately) of reproductive age in both data sets. Section 2.4 investigates the data for African women in greater detail to highlight discrepancies between the DHS and the census, and Section 2.5 details the adjustments to the 1996 South Africa Census data that are required to produce accurate estimates of recent fertility in the country.

2.2 Data sources

2.2.1 1996 South Africa Census

The 1996 South Africa Census was the first conducted in a post-apartheid South Africa, and was carried out on behalf of the South African government by the Central Statistical Service (now Statistics South Africa). The official census date was the night of 9-10 October 1996, but fieldwork was conducted over a three-week period from 10-31 October.

A post-enumeration survey (PES) in November 1996, together with detailed matching of records between the census and the PES, indicated that the undercount in the census was 10.7 percent (Statistics South Africa, 1998a), and varied by province (from 8.7 percent in the Western Cape to 15.6 percent in the Northern Cape). According to Statistics South Africa, infants and young adult men were particularly prone to under-enumeration, while Africans and Coloureds were less likely than Whites and Indians/Asians to have been enumerated. Statistics South Africa suggest that this pattern of underenumeration reflects different levels of urbanisation, and difficulties in achieving comprehensive coverage in rural areas (Statistics South Africa, 1998a: 20-21).

Statistics South Africa has made a 10 percent sample of the data available to researchers and included a weighting variable, designed to correct for the undercount as well as for the fact that the sample provided comprises one tenth of those enumerated. The data provided are based on a systematic sample of households, stratified by province and District Council. The individual-level data file includes all members of selected households, as well as a 10 percent systematic sample of people in “special institutions” (old age homes, prisons, schools etc.) and hostels. Full details of the methods employed to derive the household sample are given in the documentation provided with the data (Statistics South Africa, 1998b).

The raw data was checked and adjusted for double counting, as well as other errors, and cleaned and validated before its release. However, the algorithms employed to do this have not been published, making it impossible to assess the extent of imputation or modification of the data between its raw and final forms or to arrive at an independent judgement of whether any bias could have been introduced by this cleaning.

2.2.2 1998 South Africa DHS

The 1998 South Africa Demographic and Health Survey (DHS) was co-ordinated by the Medical Research Council of South Africa (MRC) on behalf of the South African Department of Health. Technical assistance was provided by Macro International Inc.

The aims of the 1998 South Africa DHS were very different from those of the census. While the census aimed to provide a complete enumeration of the South African population (and its main characteristics) in October 1996, the purpose of the DHS was to collect detailed data on demographic and health variables within the country to assist policy making in the health sector (Department of Health, 1999b).

The South Africa DHS employed a two-stage sample selected from the 1996 census demarcations. The census’ Enumeration Areas were used, and sample numbers of households were derived in proportion to those in the census. For reasons explained in the Preliminary DHS report (Department of Health, 1999b), the sample design was not self-weighting at a national level. Sample weights are provided with the DHS data file, and are used to adjust the responses collected to be representative of the underlying sample frame.

2.2.3 1970 South Africa Census

The results from the 1970 South Africa Census were used to derive estimates of South African fertility for the period 1955 to 1970. The data were provided on CD-Rom by Statistics South Africa, and contain a 100 percent sample of Whites, Coloureds and Asians, and a 5 percent sample of Africans. No sample weights are available for the African population in the data provided, so the data for Africans have been multiplied by 20 where required.

The quality of the 1970 census data for Africans is not nearly as good as those in the 1996 census. Strong digit-preference exists in the reporting of ages. Whipple’s Index of digit preference for ages ending 0 or 5 is 140 for men aged 18 to 52, and 153 for women of the same ages. According to a United Nations scale, these values classify the reliability of the age data as “rough”

(Newell, 1988). In addition, noticeable troughs exist in the reported population at age 1 for both sexes, as well as a dearth of male infants.

Despite these deficiencies, the 1970 census data provide the best demographic data for the South African population prior to the 1987-9 South Africa "DHS", and allow us to derive estimates of South African fertility for earlier dates than is possible using only the 1996 census and 1998 DHS data.

The 1996 census and 1998 DHS data are not directly comparable. First, the DHS was conducted approximately 18 months after the census. With declining fertility (and rising mortality due to the HIV/AIDS epidemic), this difference may matter. Fertility measures from the DHS based on reported fertility in the three years before the interview, classified by age of mother at birth, however, refer to the census date.

Second, the census and the DHS differed markedly in their questionnaires and in their data collection procedures. Fieldworkers administering the DHS were well-trained compared with the census enumerators; no proxy respondents were used in the DHS (whereas in the census, enumerators asked questions of one person about all of the household's members); and DHS fieldstaff were women, which should minimise any reticence on the part of respondents to discuss matters relating to sexual behaviour and childbearing. Further, the census asked only summary questions about the fertility of women aged 12-49 in the household, while the DHS collected detailed birth histories and data on child health and welfare from female respondents aged between 15 and 49.

Proxy responses in the census may have exacerbated the observed differences between the DHS and the census in the socio-economic and other characteristics of South African women of childbearing age, since if the respondent was not the woman in question, he/she may not have had full knowledge of the information required. Thus, the marital status, educational and fertility variables relating to women of childbearing age in the census may suffer somewhat from a certain amount of imputation (or guessing).

One advantage of the census data is that the large size of the 10 percent sample produces reasonable distributions of the South African population, even when the data is subjected to a high degree of disaggregation. The much smaller DHS sample usually does not permit analysis of fertility (or, indeed, any other demographic outcome) by more than a few characteristics at a time.

2.3 A comparison of the data from the 1996 South Africa Census and the 1998 DHS

This section provides an overview of the attributes of the female population of South Africa aged 15-49 as documented in the 1996 census and the 1998 DHS. In the first instance, the distribution of these women by age, province of residence (*de facto* and *de jure*[5]), and attained level of education are compared. Where discrepancies clearly originate in one of the data sets, this is pointed out. In general, however, it is hard to ascribe differences in the reported distributions to problems with one or the other inquiry.

The distribution of South African women of reproductive age by their background characteristics is shown in Table 2.1 below. Table 2.2 shows the same distributions for all African women. In aggregate, the DHS describes a population that is more urbanised, marginally older, and better educated than the census results suggest. Additionally, the DHS finds more women of reproductive age living in Gauteng (and fewer in the Eastern Cape and KwaZulu-Natal), and reports a higher proportion of African, Coloured and Asian women (and fewer White women) than the census. The differences in reported levels of education between the DHS and the census may not be "real," but rather a reflection of enumerator error or misstatement by respondents in the census.

[5] *De facto* residence refers to the province in which women were enumerated or surveyed; *de jure* refers to women's "usual" province of residence.

Table 2.1 Background characteristics of South African women aged 15-49

Background	*DHS Data*			*Census Data*		
	All South African women 15-49			*All South African women 15-49*		
Characteristic	*Weighted %*	*Weighted N*	*Unweighted N*	*Weighted %*	*Weighted N*	*Unweighted N*
Age						
15-19	19.2	2249	2373	19.5	2135672	190557
20-24	17.7	2075	2086	18.9	2067653	182607
25-29	15.8	1857	1811	16.3	1790412	158317
30-34	14.1	1654	1616	14.8	1617576	144323
35-39	13.9	1636	1628	12.6	1375399	123101
40-44	11.0	1294	1255	10.1	1105325	99650
45-49	8.3	970	966	7.9	863268	78684
Residence						
Urban	60.5	7095	6518	57.7	6321903	565041
Non-urban	39.5	4640	5217	42.3	4633401	412198
Province (de facto)						
Western Cape	10.2	1193	919	10.2	1120698	102114
Eastern Cape	13.3	1566	2756	14.6	1600910	142883
Northern Cape	2.2	253	1041	2.0	221107	18758
Free State	6.5	763	936	6.6	721896	65760
KwaZulu-Natal	20.1	2364	1826	21.0	2296584	200083
North West	7.7	909	931	8.1	891976	80913
Gauteng	21.7	2552	1057	19.4	2120387	190981
Mpumalanga	7.0	819	1131	6.8	749418	65977
Northern Province	11.2	1316	1138	11.2	1232330	109770
Province (de jure)						
Western Cape	10.3	1210	953	10.0	1093522	99748
Eastern Cape	13.2	1553	2728	14.3	1561831	139716
Northern Cape	2.4	279	1038	2.0	214823	18269
Free State	6.7	787	951	6.5	707481	64506
KwaZulu-Natal	20.0	2345	1813	20.4	2230458	194533
North West	7.6	894	927	8.0	875358	79401
Gauteng	21.6	2534	1063	19.0	2084731	187788
Mpumalanga	7.0	822	1134	6.8	742996	65411
Northern Province	11.0	1294	1119	11.0	1202493	107278
Other country	0.0	4	2	2.2	241613	20589
Missing	0.1	12	7	0.0	0	0
Education						
No education	6.8	804	810	11.5	1259929	111956
Primary	24.8	2916	3134	23.6	2587923	230455
Secondary	60.5	7103	6929	55.3	6062741	541518
Higher	7.8	912	862	5.9	649052	58166
Other / Missing	0.0	0	0	3.6	395660	35144
Population group						
African	77.9	9147	8993	76.4	8369644	744577
Coloured	10.2	1201	1533	9.2	1011770	90343
White	7.8	916	755	10.8	1179002	105736
Asian	3.5	406	393	2.8	305130	28533
Missing	0.6	66	61	0.8	89759	8050
Total	100.0	11735	11735	100.0	10955305	977239

Source: 1998 DHS and 1996 Census

2.4 Analysis of background characteristics of African women aged 15-49

Table 2.2 shows the background characteristics of African South African women aged between 15 and 49 in the census and the DHS.

Table 2.2 Background characteristics of African South African women aged 15-49

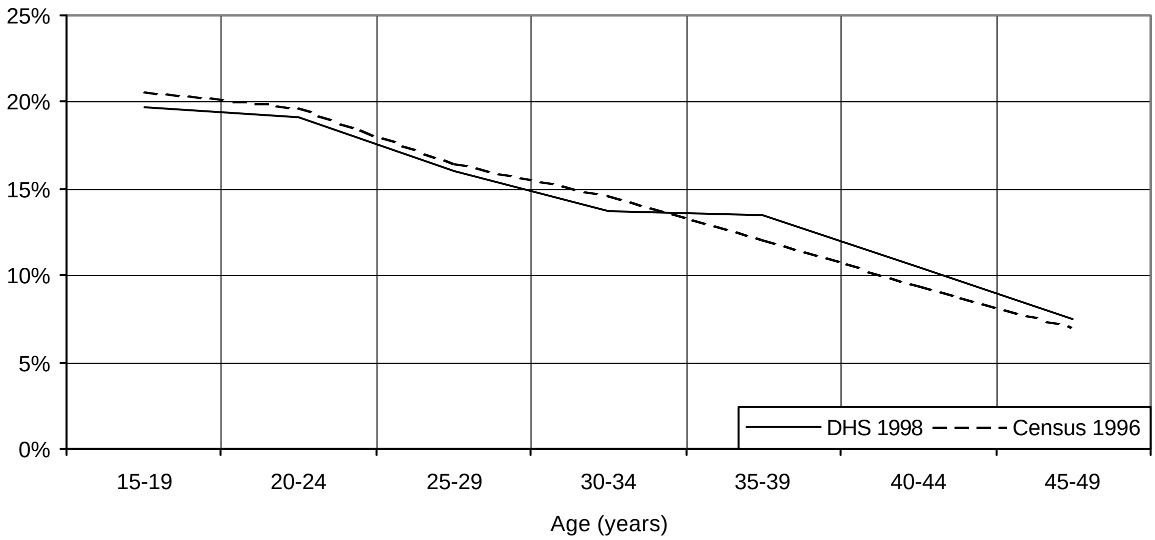
Background Characteristic	*DHS Data African women 15-49*			*Census Data African women 15-49*		
	Weighted %	*Weighted N*	*Unweighted N*	*Weighted %*	*Weighted N*	*Unweighted N*
Age						
15-19	19.7	1802	1910	20.6	1725039	153891
20-24	19.1	1746	1704	19.7	1646314	145236
25-29	16.0	1460	1380	16.5	1379924	121598
30-34	13.7	1257	1211	14.7	1226909	109089
35-39	13.5	1236	1209	12.1	1011310	90070
40-44	10.5	958	911	9.4	789731	70963
45-49	7.5	688	668	7.1	590416	53730
Residence						
Urban	53.3	4873	4274	48.1	4022753	357513
Non-urban	46.7	4274	4719	51.9	4346891	387064
Province (de facto)						
Western Cape	3.2	294	223	3.0	253916	22982
Eastern Cape	14.6	1338	2410	16.4	1374009	122578
Northern Cape	0.8	73	305	0.9	74946	6427
Free State	7.2	659	808	7.3	613515	56152
KwaZulu-Natal	21.0	1922	1370	22.4	1872755	161876
North West	9.1	828	851	9.7	813826	73770
Gauteng	21.4	1957	819	18.0	1506955	134695
Mpumalanga	8.6	788	1094	8.0	667507	59536
Northern Province	14.1	1288	1113	14.2	1192215	106561
Province (de jure)						
Western Cape	3.5	316	261	3.0	247831	22440
Eastern Cape	14.5	1324	2380	16.0	1342567	119953
Northern Cape	1.1	97	312	0.9	72608	6263
Free State	7.4	677	818	7.2	602868	55247
KwaZulu-Natal	20.8	1907	1360	21.7	1815066	157046
North West	8.9	812	841	9.6	799870	72501
Gauteng	21.3	1949	829	17.7	1484229	132676
Mpumalanga	8.6	790	1094	7.9	661431	58995
Northern Province	13.8	1262	1091	13.9	1164313	104209
Other country	0.0	2	1	2.1	178861	15247
Missing	0.1	10	6	0.0	0	0
Education						
No education	8.2	747	710	14.1	1177405	104605
Primary	27.7	2537	2606	27.0	2258219	200816
Secondary	58.5	5353	5168	52.6	4402487	392001
Higher	5.6	511	509	3.5	297012	26475
Other / Missing	0.0	0	0	2.8	234521	20680
Total	100.0	9147	8993	100.0	8369644	744577

Source: 1998 DHS and 1996 Census

2.4.1 Age

The DHS describes a population that is, on average, 0.4 of a year older than the population enumerated in the census, with the distribution of women by age in the DHS finding smaller proportions at younger ages, and higher proportions at older ages, as shown in Figure 2.1. This figure also suggests that the DHS interviewed too many women aged 35-39 relative to women aged 30-34.

Figure 2.1 Percent distribution of African women aged 15-49, according to age group



2.4.2 Urban residence

The DHS describes a more urbanised population than the census. Table 2.3 shows the proportion of African women living in urban areas by age group in the DHS and census[6].

Given that fertility is generally lower in urban areas than rural areas, the DHS fertility estimates will, *ceteris paribus*, be lower than those arising from the census. The age pattern of urban residence in the DHS also reveals a particular error in the DHS data. The proportion of women living in urban areas is highest in the 40-44 age group, while the proportion of women living in urban areas in the 35-39 age group is lower than that reported in either of the adjacent age groups. We suspect that rural women aged 40-44 had a tendency to report that they were aged less than 40, thereby artificially inflating the rural population in the 35-39 age group, and deflating the rural population among women aged 40-44. This error would also explain the relatively large proportion of the population in the DHS survey reported as being aged 35-39, relative to the size of the population in the adjacent age groups.

[6] One might speculate that this reluctance to admit to being 40 is less of a problem in the census because many women's ages were reported by proxy respondents.

Table 2.3 Proportions and numbers of African women aged 15-49 living in urban areas by age group

	DHS			Census		
Age	*Weighted %*	*Weighted N*	*Unweighted N*	*Weighted %*	*Weighted N*	*Unweighted N*
15-19	45.0	812	767	38.0	654870	58330
20-24	52.6	917	794	47.1	775140	68222
25-29	56.1	819	691	53.2	652504	58056
30-34	57.7	725	633	53.0	731915	64494
35-39	54.9	679	606	52.3	528889	47115
40-44	58.0	556	461	50.5	399092	35817
45-49	53.2	366	322	47.5	280343	25479
TOTAL	53.3	4873	4274	48.1	4022753	357513

Source: 1998 DHS and 1996 Census

A further implication of this error is that the fertility estimates from the DHS for women aged 40-44 are likely to be biased downwards, while those for women aged 35-39 are likely to be biased upwards.

2.4.3 Province of residence

Differences also exist between the DHS and census in the provincial distribution of African women of reproductive age. Two measures of residence were captured by each inquiry, *de jure* (i.e. usual place of residence), and *de facto* (i.e. residence at the time of data collection, either on the census night itself, or on the day the household was interviewed). There are no substantial differences between the *de facto* and *de jure* measures of residence in the two data sets, although the DHS found fewer differences between the two measures than the census. In part, this can be attributed to differential coverage of women whose *de jure* residence was a country other than South Africa. Such individuals accounted for approximately 2.1 percent of African women of childbearing age in the census, while the DHS recorded only two women as being usually resident in a foreign country.

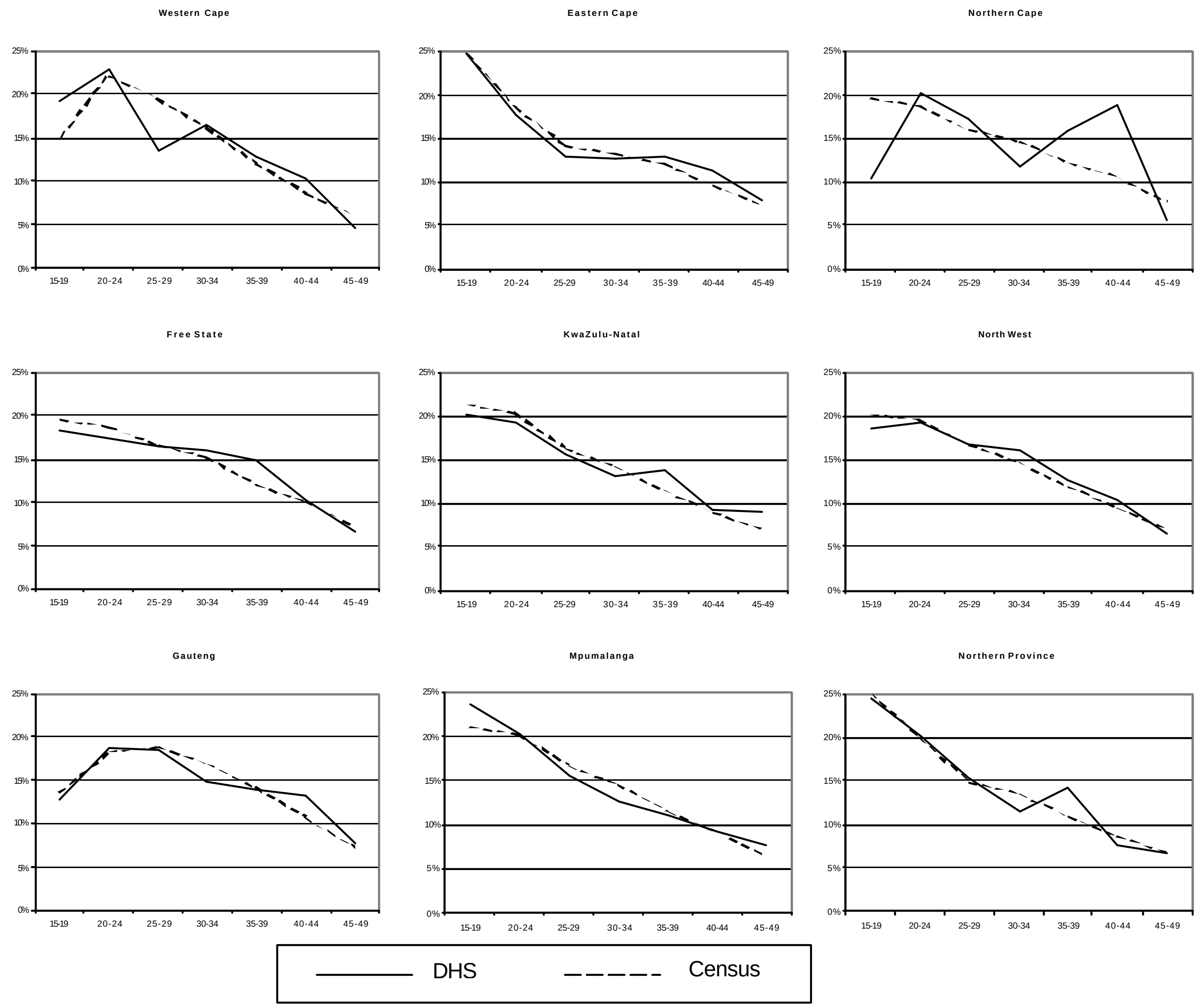
The DHS and census data are reasonably close in the Western Cape, Free State, Northern Province and Northern Cape, but a fairly big difference exists between the samples for Gauteng (the proportion of the population in Gauteng is 3.5 percent greater in absolute terms in the DHS than the census) and the Eastern Cape (the DHS found a smaller proportion of the population in this province than the census). Noticeable, but smaller, differences in the samples can be discerned in KwaZulu-Natal and the North-West (DHS under-represented) and Mpumalanga (DHS over-represented).

This pattern, together with the data presented in Table 2.3, suggests that either the DHS failed to accurately cover the more rural Eastern Cape and North-West provinces, or that census enumerators experienced difficulties in enumerating in Gauteng, and the census PES failed to correct fully for this. Such differences have implications for the analysis of fertility in South

Africa, since it is well-established that sizeable differentials in fertility by province exist (Dorrington, Nannan and Bradshaw, 1999), partly due to differences in the residential composition of individual provincial populations.

Figure 2.2 presents the age distributions of African women in each of the nine provinces. In the Free State, KwaZulu-Natal, Northern Province and the Eastern Cape, the excess of women reported to be 35-39 relative to women aged 40-44 is clearly visible. In these more rural provinces, age misstatement was a significant problem among older women.

Figure 2.2 Percent distribution of African women aged 15-49, according to age group and province of usual residence, 1998 DHS and 1996 census



The age distribution of African women in Gauteng is very different from that in other provinces. This could be indicative of consistently falling fertility in the region over the last 25 years, but is more likely to be due to the high rates of labour migration into the province once women have completed their education. Furthermore, while there was age understatement in the more rural provinces, there seems to have been age exaggeration in Gauteng, with women aged 30-34 reporting their ages as 35-39, and those aged 35-39 reporting their ages as being 40-44.

Even allowing for the relatively small numbers of Africans in the Western Cape surveyed for the DHS, the age distribution of Africans in that province, especially at ages 25-29, is problematic. The erratic pattern of the age distribution among Africans in the Northern Cape arises from the small size of that population.

2.4.4 Education

Just as notable differences by age and regional composition are found between the DHS and the census, so differences exist in reported levels of education of African women of childbearing age. The DHS describes a much better-educated population than the census does, with fewer women being reported as having none or primary education, and more with secondary or higher education. Except in the youngest age groups (where women may yet to have completed their education), these differences cannot be ascribed to the 18-month interval between the two surveys. Likewise, differences between the two sets of data cannot be ascribed to differences in the form of the questions on education: both surveys asked respondents to state the highest level of education actually completed.

Table 2.4 Percent distribution of African women aged 15-49 by age and completed level of education

		Completed level of education			
Age		*None*	*Primary*	*Secondary*	*Tertiary*
15-19	DHS	0.9	23.0	74.6	1.4
	Census	4.8	29.7	64.7	0.8
20-24	DHS	1.7	15.3	75.2	7.8
	Census	7.4	18.1	72.0	2.5
25-29	DHS	4.8	22.9	63.3	9.0
	Census	11.0	23.2	60.7	5.1
30-34	DHS	9.8	30.9	52.2	7.2
	Census	16.2	30.2	48.0	5.7
35-39	DHS	14.9	33.7	45.8	5.6
	Census	22.2	33.5	38.7	5.5
40-44	DHS	16.6	42.7	37.0	3.7
	Census	29.0	35.2	31.3	4.5
45-49	DHS	23.7	44.5	28.6	3.2
	Census	34.9	35.0	26.7	3.4

Source: 1998 DHS and 1996 Census

These differences persist after allowing for the fact that the age distributions of the populations in each data set differ, as shown in Table 2.4. The DHS reports much fewer women of no education, and more women with post-secondary education, than the census after stratifying by age.

2.5 Fertility data in the 1996 census

A substantial number of corrections were required to make the 1996 census fertility data usable. These are outlined in this section. Detailed descriptions of both the methods and the rationale behind these corrections are provided in Appendices 1 through 3.

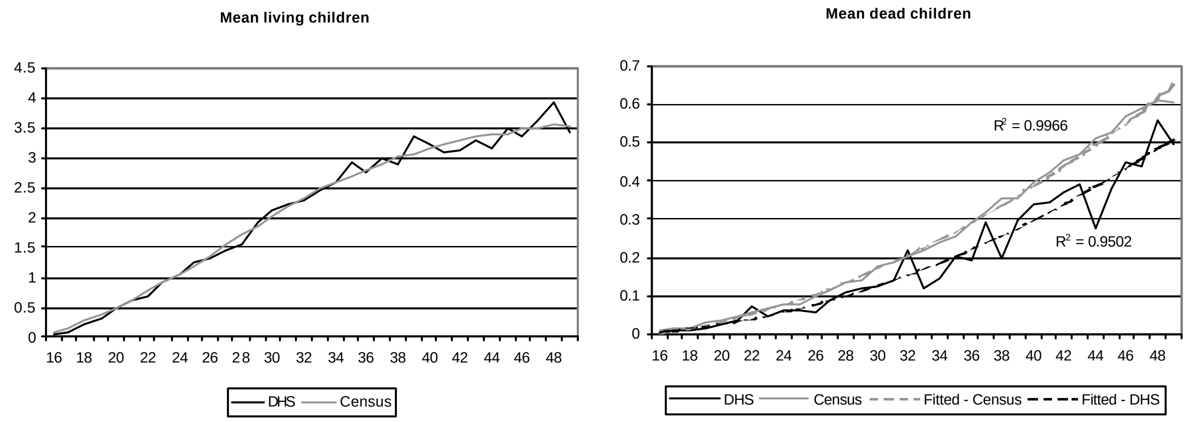
2.5.1 Adjustment of lifetime fertility data in the 1996 South Africa Census

The 1996 South Africa Census asked two questions from which South African fertility can be assessed. The first question was "How many children, if any, has the woman ever given birth to?" The second was "How many children (live births), if any, has she given birth to in the last twelve months?" Responses to the first of these questions were not obtained for a significant proportion of women of childbearing age. Moreover, it seems that many respondents did not fully understand the second question, or that their responses were recorded inaccurately. Unadjusted, the census data cannot provide robust estimates of fertility and a series of corrections were made to these data to obtain better estimates.

The first correction made to the census data uses the El-Badry correction (described in detail in Appendix 1) to adjust for the fact that many of the women of childbearing age who did not respond to the first of the two fertility questions are evidently childless. Second, while the conventional formulation of the El-Badry correction applies to the reported numbers of children ever borne, the approach can also be applied to adjust women's reported births in the 12 months prior to the census, since women who have never given birth cannot have had a birth in the preceding 12 months.

A second correction makes allowance for the inclusion of stillbirths in the reported number of children ever borne. Comparison of the DHS and census data on the proportions of children ever borne that have died, and children reported as still living (by age of mother) reveal higher numbers of dead children at all ages in the census, while the reported numbers of children still living were very similar (Figure 2.3). For reasons set out in Appendix 2, we believe that this reflects the inclusion of stillbirths among women's enumerated children ever borne in the census. This appendix also sets out in detail the methodology employed to correct the data for this error.

Figure 2.3 Mean living and mean dead children for all South African women, by age group



2.5.2 Adjustment of current fertility data in the 1996 South Africa Census

Further problems exist with the question on current fertility in the census. A significant proportion of enumerators or respondents seems not to have appreciated the distinction between the two questions, and recorded the same answer (i.e. children ever borne) to them both. Consequently, large numbers of women report upward of three children born in the 12 months preceding the census. This error has severe implications for the calculation of age-specific fertility rates and total fertility from the census data unless it is compensated for. Older women tend to have had more children, and hence age-specific fertility rates calculated without adjusting for this error are particularly exaggerated at the older age groups. A series of adjustments, detailed in Appendix 3 were required to compensate for this.

The adjustments made have the effect of eliminating about half the births that were reported as having occurred in the 12 months before the census, resulting in very low estimated fertility rates. It is clear once one adjusts for problems with the coding and misinterpretation of the question listed already, that not all births that actually occurred in the 12 months before the census were reported. Reasonable estimates of recent fertility in South Africa were then derived using a variant of Brass' P/F method, which estimates the current level of fertility from the lifetime fertility of women at the average age of childbearing (Feeney, 1998; United Nations, 1993).

These adjustments suggest that the current fertility data in the census are of particularly poor quality, largely as a result of enumerator error. It is imperative that any analysis of the 1996 South Africa Census fertility data adjusts for the deficiencies outlined. Failure to do so will result in seriously distorted estimates of current South African fertility. The equivalent DHS data are of relatively good quality.

3 CURRENT FERTILITY, AND FERTILITY DECLINE IN SOUTH AFRICA, 1970-1998

3.1 Introduction

This section compares the levels of lifetime and current fertility as estimated from the adjusted census and the 1998 South Africa Demographic and Health Survey (DHS). Section 3.2 presents data on mean children ever borne by population group, while Section 3.3 presents estimates of fertility by population group, and from these we derive estimates of national fertility. Section 3.4 uses the 1996 and 1970 census data to investigate the past trends in South African fertility by means of reverse-survival techniques. Finally, Section 3.5 presents and discusses cohort-period fertility rates for African women of reproductive age calculated from the DHS birth histories.

3.2 Estimates of lifetime fertility by population group

Table 3.1 shows the estimated mean children ever borne (CEB) by women, after the corrections made to the census data outlined in the previous section, by population group and age group in the 1996 South Africa Census and the 1998 South Africa DHS.

Table 3.1 Mean children ever borne by women aged 15-49 by age and population group

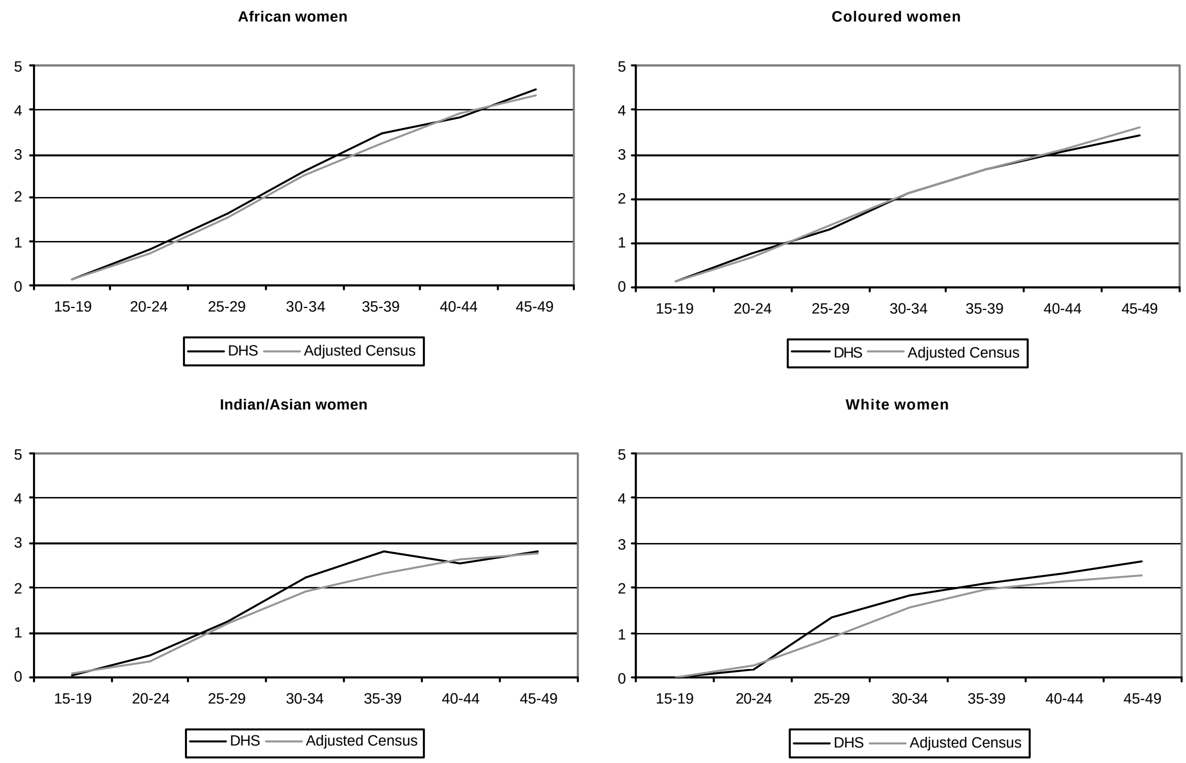
	African women			*Coloured women*		
Age	*Unadjusted Census*	*Adjusted Census*	*DHS*	*Unadjusted Census*	*Adjusted Census*	*DHS*
15-19	0.23	0.16	0.15	0.18	0.14	0.16
20-24	0.91	0.74	0.83	0.79	0.68	0.80
25-29	1.74	1.55	1.65	1.52	1.39	1.33
30-34	2.69	2.50	2.63	2.24	2.11	2.12
35-39	3.48	3.27	3.46	2.82	2.68	2.66
40-44	4.16	3.92	3.81	3.27	3.12	3.07
45-49	4.61	4.33	4.46	3.74	3.60	3.42

	Asian/Indian women			*White women*		
Age	*Unadjusted Census*	*Adjusted Census*	*DHS*	*Unadjusted Census*	*Adjusted Census*	*DHS*
15-19	0.07	0.05	0.03	0.06	0.04	0.02
20-24	0.53	0.33	0.47	0.35	0.29	0.19
25-29	1.34	1.20	1.26	1.02	0.92	1.37
30-34	2.06	1.94	2.24	1.67	1.58	1.82
35-39	2.43	2.32	2.79	2.05	1.96	2.11
40-44	2.71	2.61	2.55	2.24	2.15	2.33
45-49	2.92	2.78	2.84	2.40	2.31	2.59

Source: Appendices 1-3, DHS (1998)

The estimated mean lifetime fertility from the adjusted census results and the DHS are shown in Figure 3.1. For African and Coloured women the estimates from the census and the DHS correspond extremely well. For White and Asian/Indian women, the data sources agree less well. This is no doubt partially a function of the small samples of women in these two groups in the DHS. As discussed earlier, the estimates of African women's lifetime fertility flatten out between ages 35 and 44 in the DHS. This further supports the idea (suggested in Section 2.4) that rural African women in the 40-44 age group tend to understate their ages.

Figure 3.1 Mean children ever borne, by age group and population group



3.3 Estimates of current fertility

3.3.1 Age-specific fertility rates by population group

The estimated age-specific fertility rates arising from the census and the DHS are shown in Table 3.2. The rates are directly comparable insofar as they refer to the same date. The census rates reflect the level of fertility at the census date, while the DHS rates are based on the fertility in the three years before the survey, and refer on average to a date 18 months before the DHS survey interviews. Thus, since almost 70 percent of the DHS interviews were conducted between February and April 1998, the DHS rates also refer to October 1996.

The effect of the adjustments made to the census data is not apparent if one only looks at total fertility. In contrast, the age distribution of fertility in the adjusted and unadjusted estimates obtained from the census is radically different. The estimates of Asian/Indian (and, to a lesser extent, White) fertility from the DHS are based on too small a sample to be reliable.

Table 3.2 Age-specific fertility rates for women aged 15-49 by population group

	African women			*Coloured women*		
Age	*Unadjusted Census*	*Adjusted Census*	*DHS*	*Unadjusted Census*	*Adjusted Census*	*DHS*
15-19	0.050	0.086	0.081	0.048	0.068	0.081
20-24	0.104	0.159	0.139	0.105	0.144	0.162
25-29	0.117	0.159	0.142	0.121	0.133	0.128
30-34	0.127	0.135	0.119	0.095	0.097	0.083
35-39	0.113	0.102	0.088	0.066	0.060	0.042
40-44	0.096	0.050	0.038	0.050	0.023	0.010
45-49	0.080	0.007	0.013	0.035	0.002	0.001
TFR	3.44	3.49	3.11	2.60	2.64	2.53

	Asian/Indian women			*White women*		
Age	*Unadjusted Census*	*Adjusted Census*	*DHS*	*Unadjusted Census*	*Adjusted Census*	*DHS*
15-19	0.013	0.024	0.026	0.013	0.019	0.020
20-24	0.087	0.120	0.138	0.063	0.089	0.087
25-29	0.112	0.185	0.095	0.110	0.151	0.185
30-34	0.086	0.085	0.066	0.082	0.088	0.069
35-39	0.048	0.045	0.036	0.046	0.031	0.016
40-44	0.035	0.023	0.000	0.035	0.016	0.000
45-49	0.035	0.008	0.000	0.033	0.010	0.000
TFR	2.09	2.45	1.80	1.91	2.02	1.88

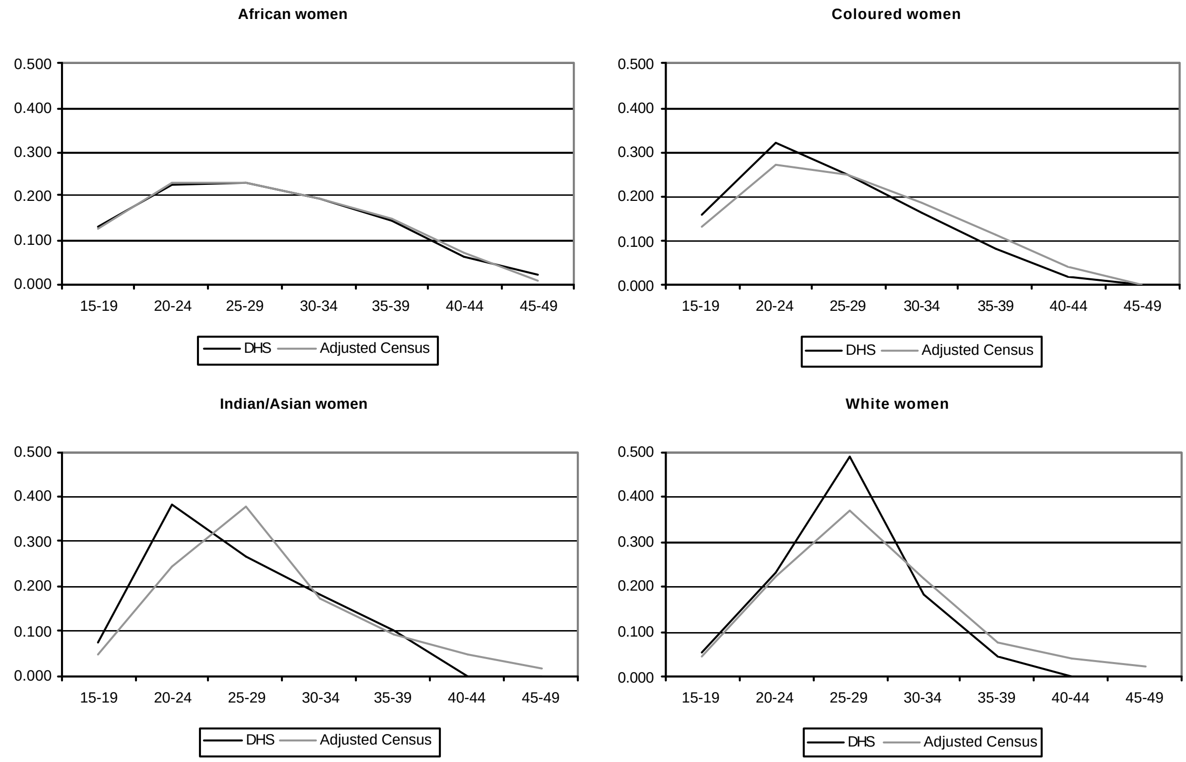
Source: Appendices 1-3, DHS (1998)

The adjusted level of fertility (i.e. the Total Fertility Rate) estimated from the census data is somewhat higher than that indicated by the DHS data, particularly for African women. This largely reflects the more urban, more educated population in the DHS relative to that shown by the census data. The detailed evaluation we have made of the current fertility data in the census, and the much larger sample sizes involved, lead us to view the estimates arising from the census as being probably more accurate than those from the DHS, especially when the provincial and spatial differences in the population distributions between the two inquiries are taken into account.

The standardised fertility distributions (i.e. the age pattern of fertility if the TFR is 1) differ markedly by population group, with the distributions for African and Coloured women being relatively flat, and those for Asians/Indians and Whites being far more concentrated around the mode (see Figure 3.2). The standardised distributions of fertility for African women are almost identical in the DHS and the adjusted census results. Minor differences exist for the 40-44 age group, as one would expect if the misstatement of age by rural women in this age group occurs in the DHS (cf. Section 2.4). The flatness of the fertility distribution at younger ages (and the high rate of fertility among adolescents) for African women is similar to a pattern identified in rural Northern Province by Garenne, Tollman and Kahn (2000), which they discovered to be the result of two components of similar magnitude: high levels of premarital fertility among women aged 15 to 25, and marital fertility among women aged 15 to 49.

The shape of the fertility distribution among Coloured women differs quite substantially between the two data sets. Difficulties were experienced by DHS fieldworkers in adequately surveying the population of the Western Cape, where the majority of the Coloured population live, and this may account for the difference. The fertility schedules for Indian/Asian women differs between the DHS and the census. Although the mode of the DHS fertility distribution seems to be too low, this probably reflects the small sample size. The fertility schedule for White women has the same shape in both DHS and census; although the higher peak in the 25-29 age group in the DHS simply reflects the fact that no White women over the age of 40 reported births in the three years before the survey.

Figure 3.2 Percent distribution of fertility according to age by population group



3.3.2 National age-specific fertility rates

Two approaches could be adopted for the calculation of national South African age-specific fertility rates. The first would be to use the national data set (i.e. not disaggregated by population group) from the census, and apply adjustments to it of the form set out in Appendices 1 through 3. The second approach is to weight the age- and population group-specific estimates presented above to give an estimated national schedule of fertility rates. The second method seems preferable to the first. There is strong heterogeneity in the fertility schedules by population group presented in Table 3.2, in terms of both their level and their shape. Moreover, not all the adjustments we make to the data on African women are applicable to the data on minority population groups (for example, the correction in respect of stillbirths and the Relational Gompertz model for Whites and Indians/Asians).

These points are not relevant to the DHS data, since neither the adjustment in respect of stillbirths, nor the Relational Gompertz model was applied. For the census, however, we estimate fertility for the country by combining rates for the four population groups weighting by the racial distribution of women in each age group. The final estimates of the national age-specific fertility rates are shown in Table 3.3

Table 3.3 National age-specific fertility estimates, Census 1996 and DHS 1998

Age	*15-19*	*20-24*	*25-29*	*30-34*	*35-39*	*40-44*	*45-49*	*TFR*
Census	0.078	0.151	0.156	0.125	0.087	0.042	0.007	3.23
DHS	0.076	0.139	0.142	0.109	0.074	0.029	0.009	2.89

3.3.3 Provincial fertility estimates from the revised census data and the DHS

Past apartheid policies on urbanisation, and the creation of the so-called “homelands” have created wide provincial disparities in health, education and socio-economic markers, as well as the racial composition of each province. These differentials translate into widely disparate levels of fertility across the country. Provincial estimates of fertility using the adjusted census data and the DHS are shown in Table 3.4 below. Unlike the national estimates, the provincial estimates are not calculated from a weighted average of estimated fertility for each population group in the province, as the number of observations in the DHS data (required to make the correction in respect of inclusion of stillbirths) preclude analysis by population and province simultaneously.

While in all cases the level of fertility shown by the adjusted census data is lower than that shown by the DHS, there is a good correspondence between total fertility estimated from the census and the DHS, except in the Eastern Cape, Free State, North-West and Mpumalanga. The rankings of provinces by their total fertility, according to the two inquiries, are in reasonably good agreement.

Table 3.4 Estimates of age-specific fertility by province of usual residence, Census 1996 and DHS 1998

	Western Cape		*Eastern Cape*		*Northern Cape*	
Age	*Census*	*DHS*	*Census*	*DHS*	*Census*	*DHS*
15-19	0.055	0.067	0.079	0.079	0.071	0.076
20-24	0.131	0.120	0.170	0.146	0.155	0.156
25-29	0.122	0.121	0.178	0.175	0.143	0.148
30-34	0.088	0.092	0.154	0.141	0.105	0.092
35-39	0.053	0.051	0.116	0.107	0.064	0.044
40-44	0.019	0.007	0.056	0.037	0.024	0.015
45-49	0.002	0.000	0.008	0.008	0.002	0.005
TFR	2.35	2.29	3.80	3.47	2.82	2.68

	Free State		*KwaZulu-Natal*		*North-West*	
Age	*Census*	*DHS*	*Census*	*DHS*	*Census*	*DHS*
15-19	0.060	0.055	0.078	0.092	0.076	0.060
20-24	0.147	0.103	0.157	0.148	0.151	0.137
25-29	0.142	0.116	0.157	0.158	0.145	0.091
30-34	0.107	0.094	0.130	0.109	0.114	0.108
35-39	0.067	0.043	0.094	0.098	0.078	0.076
40-44	0.025	0.027	0.043	0.042	0.033	0.016
45-49	0.002	0.000	0.006	0.019	0.004	0.000
TFR	2.75	2.19	3.32	3.33	3.00	2.44

	Gauteng		*Mpumalanga*		*Northern Province*	
Age	*Census*	*DHS*	*Census*	*DHS*	*Census*	*DHS*
15-19	0.059	0.052	0.093	0.100	0.101	0.090
20-24	0.131	0.125	0.170	0.129	0.181	0.179
25-29	0.126	0.136	0.161	0.124	0.180	0.187
30-34	0.096	0.084	0.128	0.136	0.154	0.142
35-39	0.062	0.047	0.089	0.097	0.118	0.089
40-44	0.024	0.024	0.039	0.015	0.059	0.059
45-49	0.003	0.000	0.005	0.016	0.009	0.029
TFR	2.50	2.34	3.42	3.09	4.01	3.88

3.4 Trends in South African fertility 1955 – 1998

Using the data from the 1996 and 1970 South Africa Censuses, reverse-survival techniques can be applied to the data for all South African women, and for African South African women separately, to better understand the trends in South African fertility over the last fifty years and place the results derived above in an historical context.

3.4.1 All South African women

With appropriate assumptions (the most important of which is the requirement that no differential under-enumeration has occurred in particular age groups in the data being analysed), reverse-survival techniques can provide valuable insights into fertility trends for periods up to 15 years before a census or survey (Bogue, 1993). The method is intuitively simple: if the level of mortality by age for the 15 years prior to the survey or census can be estimated accurately, it is possible to estimate the number of births that occurred in earlier years to give rise to the current population. Using estimates of South African mortality derived by Timæus, Dorrington, Bradshaw and Nannan (forthcoming), total fertility rates for the period from 1981 to 1996 can be derived from the 1996 census data. A similar exercise was performed using the data from the 1970 South Africa Census, using the Princeton Regional Model Life Tables (Coale, Demeny and Vaughan, 1983) to estimate mortality[7]. Using a schedule of the fertility distribution in quinquennial groups to apportion the births by age of mother, estimates of the age-specific fertility rates for each of the 15 years preceding the survey, and hence estimates of total fertility, can be derived. The fertility distributions needed to do this for the period 1981 to 1996 were interpolated from the estimated fertility in 1996 (Table 3.3), and data for 1978 (South Africa, 1983:115).

The reverse-survival estimates of fertility calculated using the 1970 census data are more approximate, not only in their use of model life tables, but also because no published data on the distribution of fertility by age exist for this period. Estimates of the racial composition of South Africa for the period 1955-1970 were derived by interpolating between published estimates that are available for 1960 and 1970 (South Africa, 1983:12). Sadie's (1973) estimates of fertility by population group and period were then combined using these weights and interpolation between them was used to derive annual national fertility schedules. Annual fertility schedules for Africans were interpolated directly between Sadie's estimates. Schedules for the first and last periods of each reverse-survival projection, for South Africans and African South Africans separately, are shown in Table 3.5.

Table 3.5 Distributions by age of fertility used in the reverse-survival projections

	1956		*1970*		*1982*		*1996*	
Age	*All*	*Africans*	*All*	*Africans*	*All*	*Africans*	*All*	*Africans*
15-19	0.053	0.045	0.061	0.056	0.074	0.078	0.102	0.123
20-24	0.213	0.190	0.228	0.212	0.234	0.218	0.227	0.227
25-29	0.233	0.220	0.251	0.241	0.261	0.240	0.244	0.228
30-34	0.195	0.198	0.203	0.207	0.199	0.200	0.199	0.193
35-39	0.156	0.167	0.143	0.153	0.133	0.148	0.140	0.146
40-44	0.096	0.111	0.075	0.084	0.069	0.080	0.072	0.072
45-49	0.054	0.069	0.040	0.048	0.030	0.037	0.015	0.010

Source: Derived from Sadie (1973), South Africa (1983), and Table 3.2 and Table 3.3

The estimates derived from the application of the reverse-survival technique are shown in Figure 3.3, together with estimates published by Mostert *et al* (1998) and Sibanda and Zuberi (1999).

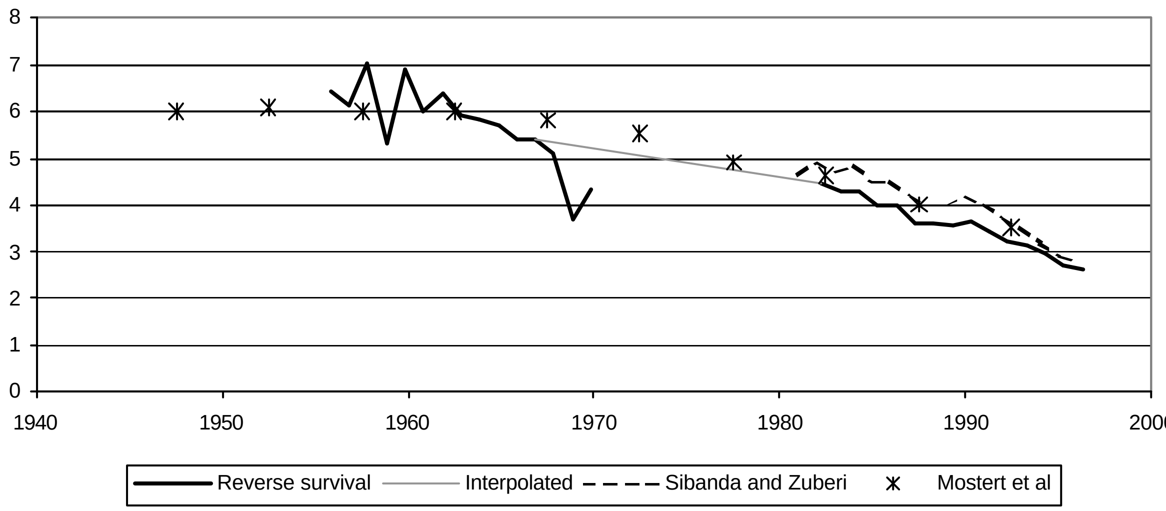
[7] The reverse-survival for this period was calculated on three different bases using the West Regional Life Tables: A fast mortality decline scenario used Level 11 for 1955-60, Level 13 for 1960-65 and Level 15 for 1965-70. A medium mortality decline scenario (shown in the graphs) used Levels 12, 13 and 15 for the same time periods, while a slow mortality decline scenario used Levels 13,14 and 15. The general level of mortality was chosen so that the resulting tables showed values of e_0 and ${}_5q_0$ roughly in line with estimates for the population at the time.

The absence of reliable census data for South Africa between 1970 and 1996 creates a gap in our knowledge relating to the period 1970-1981. However, linear interpolation between the two series (to avoid errors associated with misreporting of infants' age, and under-enumeration at the youngest ages, we have interpolated using the values for 1966 and 1983) allows some tentative conclusions to be drawn and enhances our understanding of the trend in South African fertility over the 50 years since 1948.

The deficiencies of the data and the limitations of the methodologies applied notwithstanding, Figure 3.3 indicates that – especially for more recent time periods – the resulting estimates of past South African fertility are generally consistent with those of other demographers, and provides some support for the use of the reverse-survival approach. The estimates we have derived for the 1950s and 1960s are indeed rough approximations as the variability in fertility estimates from one year to the next indicates. The very low levels of fertility estimated for 1968 and 1969 reflect the underenumeration of children under the age of 2, while the pattern in the later years of the 1950s shows strong digit preference in the recording of children's ages.

Most importantly, the estimates indicate that South African fertility has been in decline since the late 1960s, but that the pace of decline has increased since the early 1980s.

Figure 3.3 Trends in total fertility, all South African women, 1948-1996



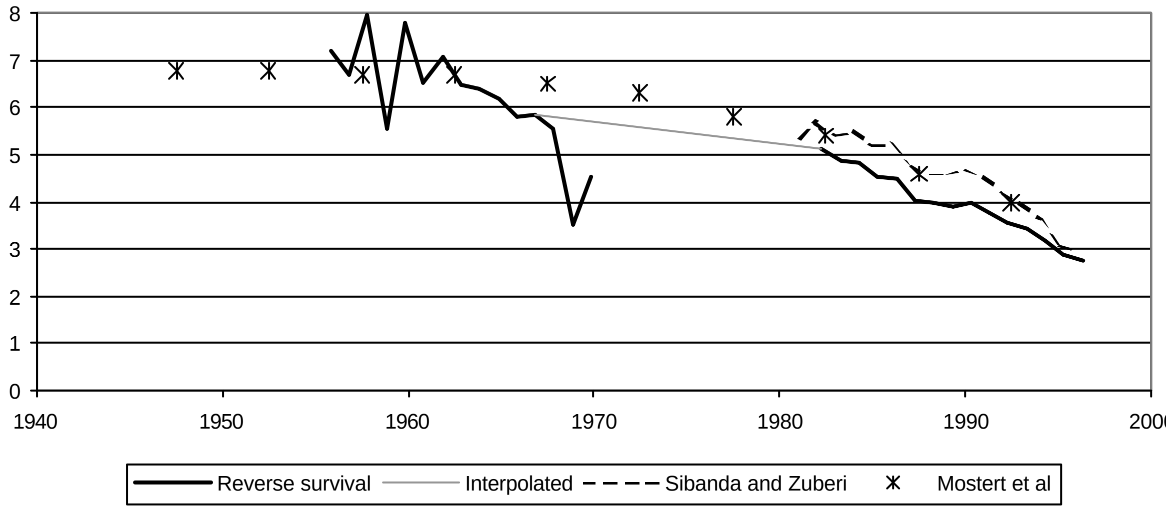
Source: Census 1996; Census 1970; Mostert *et al.*, 1998; Sibanda and Zuberi, 1999

3.4.2 African women

Applying the same reverse-survival techniques to the African population produces the results shown in Figure 3.4. Given the racial composition of the South African population, it is not surprising that the trends shown in Figure 3.3 and Figure 3.4 are very similar. The two back projections (and the interpolation between them) show clearly that the decline in African women's fertility began in the 1960s. Fertility only fell slowly over the following decade. As in the general population, fertility has declined at a faster pace since the early 1980s.

While the pattern shown by our estimates is broadly similar to those shown by other estimates, some features are worthy of additional comments. First, the estimates are lower than those produced by Sibanda and Zuberi, especially for the period 1982 to 1994. This difference is most probably attributable to their inadvertent linking of children to their grandmothers (not their mothers), and hence inflating estimates of fertility among older women. Second, the use of reverse-survival techniques produce estimates of recent fertility that are substantially lower than those indicated in Section 3.3. This suggests that despite the corrections made in the post-enumeration survey, there was a significant undercount of young children in the 1996 census.

Figure 3.4 Trends in total fertility, African South African women, 1948-1996



Source: Census 1996; Census 1970; Mostert *et al.*, 1998; Sibanda and Zuberi, 1999

3.4.3 Undercount of infants and children under 5 in the 1996 South Africa Census

Dorrington (1999) suggests that, as in other South African censuses, a systematic undercount of infants and children less than 5 years of age occurred in the 1996 census. Mostert *et al* (1987), in a reconstruction of the African South African population, estimated that children under the age of five had been underenumerated in earlier censuses to the extent shown in Table 3.6.

Table 3.6 Percent undercount of African South African children (0-4) by sex, various years

	Census Year		
Sex	*1936*	*1970*	*1980*
Males	15.8	26.9	38.0
Females	9.2	23.8	37.2

Source: Mostert *et al* (1987)

The undercount of children under the age of 5 in the 1996 South Africa Census was probably not as high as in earlier censuses. Dividing the estimate of total fertility in 1996 from the current fertility data in the census by that from the reverse-survival procedure suggests that the undercount of infants (aged less than one) in the 1996 South Africa Census was 22.9 percent. For African infants, the equivalent estimate is 26.6 percent.

3.5 Cohort-period fertility rates for African women

Cohort-period fertility rates measure the fertility of a cohort of women (usually grouped into quinquennial age groups) in a defined period (usually grouped in five year periods before the survey). Using cohort-period fertility rates to analyse birth history data from surveys such as the DHS is preferable to using conventional age-period rates because the calculations are simple; one can readily sum the rates to obtain measures that represent the experience of real cohorts of women; and because they allow direct calculation of P/F ratios.

The cohort-period rates and P/F ratios are presented in Table 3.7. Panel A presents the number of women in each age group at the time of the survey, and the reported number of births to women in each age group, grouped by time before the survey. Thus, for example, after weighting, between 1989 and 1993 1056.6 births occurred to the 1435.8 women who were aged 25-29 at the time of the survey.

Panel B presents the annual cohort-period fertility rates, derived by dividing the number of births to each cohort of women in a given time period before the survey by the number of women in that age group at the time of the survey, and dividing the result again by 5 to give the annual rate. Reading across the rows in Panel C (from right to left) indicates how fertility has changed over time for women of the same age, while Panel E provides equivalent data cumulated by age. The results confirm those of the reverse-survival analysis. While fertility has been falling since at least the early 1970s, the pace of fertility decline accelerated 10-14 years before the DHS (i.e. between 1983 and 1988).

Table 3.7 Cohort-period fertility rates and P/F ratios, African women aged 15-49

			Years prior to survey						
			0-4	*5-9*	*10-14*	*15-19*	*20-24*	*25-29*	*30-34*
	Age group of cohort at survey								
A		No. WOMEN	NUMBER OF BIRTHS						
	15-19	1771.746	266.001	3.184					
	20-24	1716.206	1055.096	356.955	9.679				
	25-29	1435.828	991.502	1056.621	314.643	16.494			
	30-34	1235.566	783.452	1053.272	1086.243	334.444	9.873		
	35-39	1215.648	621.143	981.586	1227.718	1052.915	328.473	16.015	
	40-44	941.870	291.786	621.853	801.306	887.200	796.458	195.943	10.311
	45-49	676.136	86.741	284.848	540.161	602.667	768.016	595.601	144.121
B	COHORT PERIOD FERTILITY RATES								
	15-19		0.030	0.000					
	20-24		0.123	0.042	0.001				
	25-29		0.138	0.147	0.044	0.002			
	30-34		0.127	0.170	0.176	0.054	0.002		
	35-39		0.102	0.161	0.202	0.173	0.054	0.003	
	40-44		0.062	0.132	0.170	0.188	0.169	0.042	0.002
	45-49		0.026	0.084	0.160	0.178	0.227	0.176	0.043
	Age group of cohort at end of period								
C	COHORT PERIOD FERTILITY RATES								
	15-19		0.030	0.042	0.044	0.054	0.054	0.042	0.043
	20-24		0.123	0.147	0.176	0.173	0.169	0.176	
	25-29		0.138	0.170	0.202	0.188	0.227		
	30-34		0.127	0.161	0.170	0.178			
	35-39		0.102	0.132	0.160				
	40-44		0.062	0.084					
	45-49		0.026						
D	CUMULATIVE FERTILITY OF COHORTS AT END OF PERIOD (P)								
	15-19		0.150	0.208	0.219	0.271	0.270	0.208	0.213
	20-24		0.823	0.955	1.150	1.136	1.054	1.094	
	25-29		1.646	2.002	2.146	1.996	2.230		
	30-34		2.636	2.954	2.846	3.121			
	35-39		3.465	3.507	3.920				
	40-44		3.816	4.341					
	45-49		4.470						
E	CUMULATIVE FERTILITY WITHIN PERIODS (F)								
	15-19		0.150	0.208	0.219	0.271	0.270	0.208	0.213
	20-24		0.765	0.944	1.098	1.137	1.116	1.089	
	25-29		1.455	1.796	2.108	2.079	2.252		
	30-34		2.090	2.604	2.959	2.970			
	35-39		2.601	3.264	3.758				
	40-44		2.910	3.685					
	45-49		3.039						
F	P / F RATIOS								
	20-24		1.076	1.012	1.047	1.000	0.944	1.005	
	25-29		1.131	1.115	1.018	0.960	0.990		
	30-34		1.262	1.134	0.962	1.051			
	35-39		1.332	1.074	1.043				
	40-44		1.311	1.178					
	45-49		1.471						

Source: 1998 DHS

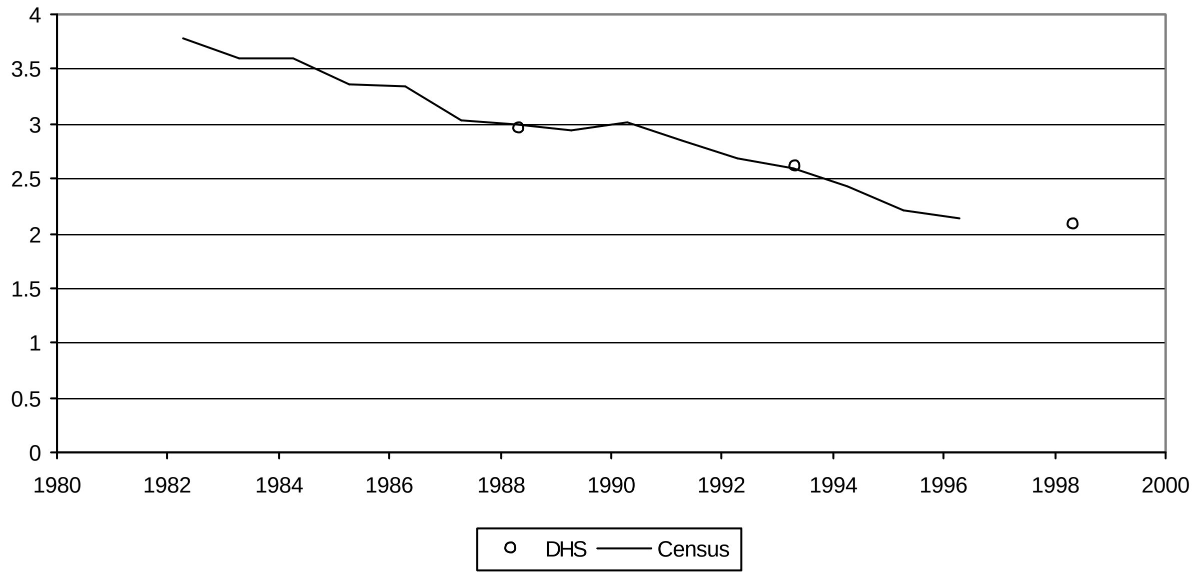
Reading up a diagonal in Panel D from left to right shows the cumulative fertility of a cohort at five-yearly intervals (i.e. of that cohort at younger ages). Reading across the rows shows the cumulative fertility of different cohorts of women by the same age. The data on the diagonal associated with the cohort of women aged 40-44 are inconsistent with the data for adjacent cohorts, since the cumulative fertility of this cohort at younger ages is lower than the cumulative fertility of the 35-39 cohort at the same ages. This could result from displacement of births from more distant to more recent periods for women in that cohort (i.e. Potter (1977) effects). The investigations discussed earlier, however, suggest that it is the age reporting of women in that cohort that is at fault, not imperfect recall of past fertility by women in one specific cohort.

Finally, Panel F presents P/F ratios derived by dividing the age- and period-specific rates in Panel D, by those in Panel E. The ratios compare lifetime fertility with current fertility and are a check on the quality of the data. Were the data to be perfect and fertility unchanging, the ratios would be very close to unity at all ages in all periods. However, increasing ratios point to declining fertility, and as such, deviations from unity allow the identification of the approximate time period in which fertility started declining (Centre for Population Studies, n.d.). The strongly upward trend in P/F ratios in the most current time periods (0-9 years before the survey) again provides evidence of an acceleration in the decline in South African fertility, as these trends are not as readily discernible in earlier periods.

Data errors are identifiable if the ratios in a given cohort deviate markedly from the trend in surrounding cohorts. The 40-44 cohort has low rates in every period. The absence of similar errors in the 35-39 or 45-49 cohort lends further weight to the conclusion that the 1998 DHS data for this age-group are distorted by rural women aged 40-44 reporting their age as 35-39.

A further check on the comparability of the census and DHS data can be made by comparing the cumulative fertility of African women up to age 34. The reverse-survival estimates of these women's fertility from the 1996 census, and the appropriate cohort-period fertility rates from the DHS are shown in Figure 3.5.

Figure 3.5 Cumulative fertility of African women 15-34, 1982-98



The remarkable agreement between the two earlier estimates from the DHS and the census-based series inspires confidence about both the quality of the age distribution of African women in the census, as well as the enumeration of African children aged between 5 and 15. The more recent fertility estimates from the census seems a little low and provide further evidence that some underenumeration of young children and infants in the census occurred.

4 PARITY PROGRESSION AND BIRTH INTERVALS IN SOUTH AFRICA

The previous section examined the current level of, and past trends in, African fertility in South Africa. This section presents analyses of the trends in childbearing and child spacing in South Africa. Two distinct approaches are adopted. The first examines the proportion of women who progress from one parity to the next (i.e. parity progression ratios and associated measures). The second approach investigates the length of time elapsed between one maternity and the next (i.e. the length of birth intervals).

4.1 Data requirements for the estimation of parity progression and birth intervals

The data requirements for most methods of investigating parity progression are fairly onerous. For the more advanced methods, detailed maternity history data giving the date of each birth to each woman in the survey are required. Consequently, the data collected in censuses are generally inadequate to the task. However, while this tends to limit the application of these techniques to data collected in demographic surveys such as that conducted in 1998, our understanding of the dynamics of parity progression and birth intervals in South Africa is enhanced with the use of data from the 1987-9 South Africa Demographic and Health Survey.

The international academic boycott of South Africa that was in place at the time meant that this survey does not form part of the international programme of surveys conducted with the assistance of the United States Agency for International Development (USAID) and Macro International Inc. However, the South African Human Sciences Research Council's survey used a questionnaire very similar to that used in the first round of DHS surveys. Almost 22 000 women of reproductive age, across all race groups, and across the entire country, including – importantly – the so-called "independent" and other homelands were interviewed.

The methodology underlying the survey and the quality of the data collected have been investigated in detail by Carol Kaufman (1997). In her assessment,

> in spite of methodological shortcomings and hazardous fieldwork conditions, careful analysis and presentation of results based on these data can provide useful and important information regarding the demographic processes of South Africans in the late 1980s … Responsible use of these data will provide important insights into the history of fertility processes, health conditions, and mortality in South Africa … (Kaufman, 1997:22)

For the purposes to which the data are applied here, the crucial limitation of the data from this survey is that the criteria for inclusion in the survey specified that women must either have been married, or have borne a child. Consequently, many, if not most, childless women were excluded from the survey, rendering impossible the investigation of entry into motherhood from these data. Notwithstanding this limitation, the data permit the analysis of trends in parity progression and childbearing among parous women over time, and it is on these trends that this section concentrates.

4.2 Measures of parity progression

Three measures of parity progression are presented here. The first, the parity progression ratio, is presented in Section 4.2.1. This is not only the simplest measure of parity progression, but also it is the only measure that can be computed from data where no full maternity history has been collected, as is the case with census data. By contrast, the two other indices (Projected Parity Progression Ratios and Brass and Juárez' variant of the Censored Parity Progression Ratio method) derived in Sections 4.2.2 and 4.2.3 require detailed maternity histories.

4.2.1 Parity Progression Ratios (PPRs)

Parity Progression Ratios measure the proportion of women in a given cohort and of a given parity that has progressed to a specific parity. As such, the measure is generally only applied to women at the end of their childbearing years, as ratios for younger cohorts will be more strongly affected by changes in the timing of births, and will – in any event – represent incomplete maternity histories. Accordingly, the analysis below is restricted only to the oldest cohort of women for whom full data are available (i.e. women aged 45-49) in both the 1996 South Africa Census and the 1998 South Africa DHS.

Using the notation in Preston, Heuveline and Guillot (2001:104-5), W_i is defined as the number of women of parity *i*. The number of women of parity *i* or higher is denoted by P_i (= $\sum_{a \geq i}^{\infty} W_a$).

The parity progression ratio is then given by $PPR_{(i,i+1)} = P_{i+1} / P_i$.

A cumulative measure, the proportion of women in a cohort who have *i* children, is calculated by $PPR_{(0,i)} = P_i / P_0$. Summing this latter quantity over all parities, *i*, gives the average number of births to women in that cohort. Brass, Juárez and Scott (1997) describe the advantages of the parity progression ratio method thus:

> parity progression ratios for a cohort of women are simply a reorganisation of the distribution of completed family sizes at the end of the reproductive period. Unlike the traditional total fertility rates, these indices are not affected by the timing of births in the family build-up and hence by the transient effects of alterations in mating patterns. … [t]he estimation of precise measures is dependent on accurate reporting of total births but not on their location in time… (Brass, Juárez and Scott, 1997:83)

Parity progression ratios can be calculated from the 1996 census as well as both the 1987-9 and 1998 DHS data. The absence of any parity data precludes the calculation of parity progression ratios from the 1970 census data. The criteria for inclusion in the 1987-9 DHS mean that it is not possible to calculate accurate ratios for the progression from zero to first birth or, consequently, cumulative parity progression ratios. The calculation of PPRs from the 1998 DHS is straightforward, while the ratios derived from the 1996 census data are based on tabulations by parity and age after the application of the El-Badry adjustment, and after correcting for the inclusion of still-births.

Table 4.1 Parity progression ratios ($PPR_{(i,i+1)}$) and cumulated parity progression ratios ($PPR_{(0,i)}$) for African women aged 45-49, 1996 census, 1998 DHS and 1987-9 DHS

	1996 census		*1998 DHS*		*1987-9 DHS*
Parity (i)	$PPR_{(i,i+1)}$	$PPR_{(0,i)}$	$PPR_{(i,i+1)}$	$PPR_{(0,I)}$	$PPR_{(i,i+1)}$
0	0.922		0.959		(0.987)
1	0.924	0.922	0.906	0.959	0.941
2	0.872	0.852	0.855	0.869	0.896
3	0.820	0.743	0.813	0.743	0.845
4	0.767	0.609	0.766	0.605	0.781
5	0.729	0.467	0.697	0.463	0.710
6	0.687	0.341	0.626	0.323	0.661
7	0.642	0.234	0.608	0.202	0.651
8	0.588	0.150	0.609	0.123	0.601
9	0.545	0.088	0.672	0.075	0.471
10	0.478	0.048	0.501	0.050	0.558
11	0.525	0.021	0.430	0.025	0.357
12	0.483	0.011	0.825	0.011	0.213
13	0.509	0.005	0.338	0.009	0.505
14	0.551	0.003		0.003	

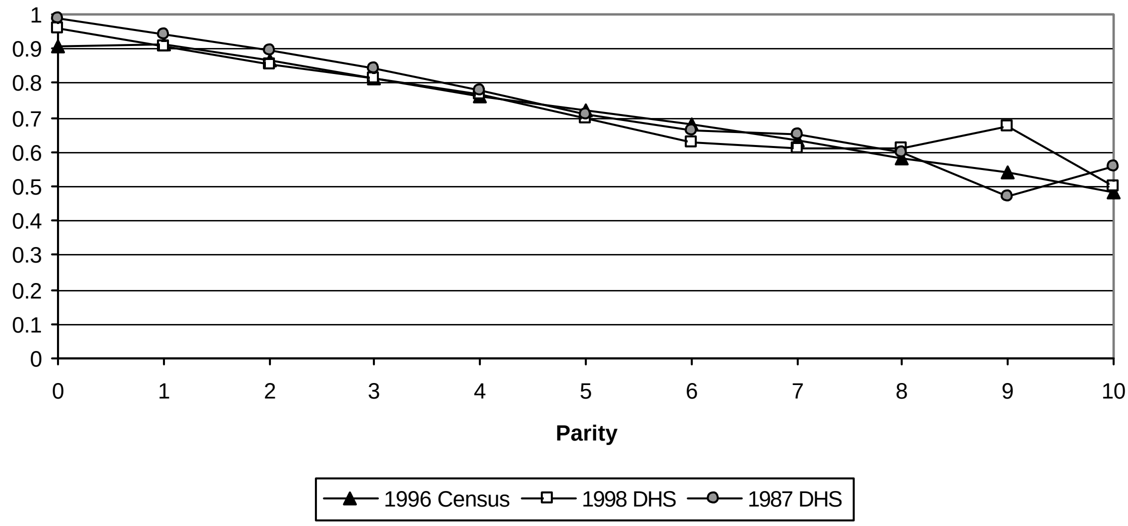
Table 4.1 presents the PPRs and cumulated parity progression ratios for women aged 45-49 in the 1996 census and the 1998 DHS. The final column gives the parity progression ratios calculated from the 1987-9 DHS.

Other than a slight difference at the lowest parities, in part a function of the magnitude of the El-Badry correction applied to the 1996 census data, the ratios from these data and the 1998 South Africa DHS correspond extremely well. In addition, these data show that the lifetime fertility of this cohort of African women in the late 1990s was somewhere between 4.33 children per woman (according to the 1996 census) and 4.46 children per woman (as shown by the DHS data).

Of greater significance though, is the strongly linear trend in the PPRs in both data sets, a pattern further confirmed by the data from the 1987-9 DHS (Figure 4.1). The fact that the ratios do not show any obvious 'steps' leads to the tentative conclusion that there is no socially sanctioned 'optimum number' of children among African South Africans. If there was, one would expect that the ratios would indicate that the vast majority of women would progress to that parity, and thereafter show a declining proportion of women progressing to higher parities.

The pattern indicated by the ratios, on the other hand, suggests a process of increasing fertility control with higher parity, even in the 1987-9 DHS. Some women terminate their childbearing at relatively low parities. The probability of progressing to a further birth diminishes with each child born, and an ever-diminishing proportion of women progress to each subsequent parity.

Figure 4.1 Parity progression ratios ($PPR_{(i,i+1)}$) for African women aged 45-49, 1996 census, 1998 DHS and 1987-9 DHS



Furthermore, the absence of evidence relating to the operation of a socially sanctioned norm in the cohorts of women aged 45-49 in these three data sets suggests that such norms are unlikely to have existed in earlier cohorts.

PPRs for cohorts of younger women can be used to derive estimates of future parity progression ratios (discussed in the following section). In addition, these ratios are important in determining the reliability of calculated projected median birth intervals (presented in Section 4.3.2). The tables below show the PPRs, by age group and parity, calculated from the two DHS surveys.

Table 4.2 Parity progression ratios by age group, 1998 DHS and 1987-9 DHS

1998 DHS					*Parity progression*					
Age group	*0-1*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*	*9-10+*
15-19	0.142	0.051	0.246							
20-24	0.609	0.297	0.183	0.081						
25-29	0.840	0.586	0.428	0.337	0.360	0.301	0.146	0.604	0.500	1.000
30-34	0.945	0.802	0.631	0.562	0.401	0.473	0.382	0.227	0.493	0.000
35-39	0.961	0.876	0.776	0.698	0.613	0.559	0.449	0.428	0.371	0.457
40-44	0.958	0.880	0.829	0.741	0.704	0.595	0.485	0.514	0.568	0.599
45-49	0.959	0.906	0.855	0.813	0.766	0.697	0.626	0.608	0.609	0.672

1987-9 DHS					*Parity progression*					
Age group	*0-1*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*	*9-10+*
15-19	..	0.097	0.319							
20-24	..	0.344	0.261	0.257						
25-29	..	0.623	0.497	0.412	0.324	0.414	0.352	0.171	0.566	0.617
30-34	..	0.798	0.706	0.611	0.552	0.513	0.388	0.451	0.423	0.237
35-39	..	0.912	0.816	0.739	0.669	0.590	0.525	0.507	0.504	0.360
40-44	..	0.949	0.861	0.830	0.776	0.690	0.637	0.599	0.566	0.522
45-49	..	0.941	0.896	0.845	0.781	0.710	0.661	0.651	0.601	0.471

Note: Data on parity progression to first birth from the 1987-9 DHS are not shown as a consequence of the criteria imposed for inclusion in that survey.

4.2.2 Projected parity progression ratios (P_i)

A more detailed measure of the evolution of African women's propensity to limit the size of their families is provided by the Projected Parity Progression Ratios (PPPRs) method, derived by Brass and Juárez (1983). These ratios, denoted P_i , are derived from the proportions of women in two contiguous cohorts (aged (x, x +5) and (x+5, x+10) respectively) with i children and who have had an $i+1^{th}$ child. The proportion for the older of the two cohorts is truncated by excluding births to women in that cohort in the immediately preceding five-year period. These truncated parity progression ratios are shown in Table 4.3. As a result of the truncation process, the experience of the older cohort is rendered comparable to that of the younger cohort, since they both refer to childbearing up to the same age. The method precludes the use of census data, since these cannot be manipulated to permit identification and exclusion of all children born to mothers in the five years before the census.

Table 4.3 Truncated parity progression ratios by age group, 1998 DHS and 1987-9 DHS

1998 DHS					*Parity progression*					
Age group	*0-1*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*	*9-10+*
20-24(t)	0.200	0.066								
25-29(t)	0.654	0.342	0.274	0.290	0.249	0.153	0.500			
30-34(t)	0.889	0.691	0.504	0.416	0.344	0.303	0.218			
35-39(t)	0.935	0.843	0.730	0.618	0.518	0.434	0.320	0.389	0.053	0.000
40-44(t)	0.952	0.868	0.795	0.707	0.662	0.512	0.474	0.520	0.465	0.283
45-49(t)	0.959	0.902	0.857	0.786	0.757	0.682	0.619	0.557	0.637	0.674
1987-9 DHS					*Parity progression*					
Age group	*0-1*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*	*9-10+*
20-24(t)	..	0.189								
25-29(t)	..	0.403	0.301	0.346	0.390	0.441	0.269			
30-34(t)	..	0.701	0.562	0.492	0.456	0.358	0.381			
35-39(t)	..	0.875	0.752	0.662	0.570	0.526	0.479	0.363	0.530	
40-44(t)	..	0.934	0.850	0.807	0.757	0.637	0.572	0.529	0.614	0.388
45-49(t)	..	0.936	0.890	0.836	0.770	0.703	0.660	0.636	0.547	0.471

Note: Data on parity progression to first birth from the 1987-9 DHS are not shown as a consequence of the criteria imposed for inclusion in that survey.

The ratio of these two proportions (that for the younger cohort divided by the that for the older (truncated) cohort) for each parity and cohort gives "indices of relative change", a measure of the change in fertility between the two equally truncated cohorts. An index less than one implies that the fertility of the younger cohort has fallen relative to the older cohort's fertility five years previously, and conversely.

These indices can then be chained to derive projected values of P_i, on the assumption that the relative speed at which women in each pair of cohorts progress to the next parity will differ by the same amount in the future as in the past. Starting with the value of P_i for the 45-49 cohort (which is also the projected P_i for that cohort), the projected P_i for the 40-44 cohort is derived by multiplying the projected P_i for the older cohort by the index of relative change between those cohorts, and similarly for each successively younger cohort. (Since the indices of relative change do not apply to the oldest cohort, the projected P_i for this cohort are identical to the parity progression ratios derived earlier). A comparison of the untruncated and truncated PPRs among older women confirms that the effect of truncation on the projected ratios is negligible (as would be expected, given that many of these women would have completed their childbearing), while the cohort differences in both the truncated and untruncated series are more substantial.

Table 4.4 shows, for example, that by the end of their childbearing years, 97.6 percent of African women aged 30-34 surveyed in the 1998 DHS are expected to have had a child. More important for future fertility trends in South Africa, the proportions of women who go on to bear children of higher parities are declining rapidly in comparison to the cohort of African women aged 45-49. While more than four-fifths of older women in the 1998 DHS with three children have progressed to a fourth birth, less than 70 percent of women aged 30-34 are expected to do so. Higher proportions in almost all combinations of age and parity are observed in the 1987-9 DHS.

Table 4.4 Projected parity progression ratios for African women, 1998 DHS and 1987-9 DHS

1998 DHS					*Parity Progression*					
Age group	*0-1*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*	*9-10+*
20-24	0.858	0.624								
25-29	0.922	0.721	0.593	0.557	0.533					
30-34	0.976	0.850	0.697	0.688	0.509	0.723	0.554			
35-39	0.966	0.893	0.807	0.757	0.659	0.664	0.465	0.462	0.434	
40-44	0.958	0.884	0.827	0.766	0.712	0.608	0.490	0.561	0.544	0.598
45-49	0.959	0.906	0.855	0.813	0.766	0.697	0.626	0.608	0.609	0.672

1987-9 DHS					*Parity Progression*					
Age group	*0-1*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*	*9-10+*
20-24	..	0.646								
25-29	..	0.756	0.690	0.593	0.479					
30-34	..	0.851	0.782	0.709	0.675	0.631	0.475			
35-39	..	0.932	0.832	0.768	0.696	0.646	0.586	0.587	0.511	
40-44	..	0.955	0.867	0.839	0.787	0.697	0.638	0.613	0.623	0.523
45-49	..	0.941	0.896	0.845	0.781	0.710	0.661	0.651	0.601	0.471

Note: The first column of projected parity progression ratios cannot be calculated with accuracy from the 1987-9 DHS as a consequence of the criteria applied for inclusion of women in that survey.

Other measures can also be derived from these projected parity progression ratios. The projected completed fertility of women in each cohort by the end of their childbearing years can be calculated from the 1998 DHS in a manner analogous to the calculation of cohort fertility rates from parity progression ratios described earlier (Table 4.5). Equivalent data for women surveyed in the 1987-9 DHS cannot be calculated for the reasons outlined earlier.

Table 4.5 Projected completed fertility of African women by cohort, 1998 DHS

Age group	*30-34*	*35-39*	*40-44*	*45-49*
	3.21	3.81	3.89	4.46

Thus, based on the 1998 DHS data and the assumptions underlying the method, African women aged 30-34 will have had, on average, 3.2 children by age 49, while women aged 40-44 will have had 3.9 children by the end of their childbearing years. As mentioned in Section 2.4.2, however, the estimates for women aged 35-39 are likely to have been biased upwards, and those for women aged 40-44 to be biased downwards, as a result of age misstatement of rural women aged 40-44.

4.2.3 Truncated pairwise measures of parity progression (B_t)

Before developing the simplified approach set out in the previous section, Brass and Juárez proposed another method to derive unbiased estimates of quantum changes in fertility, using life table techniques to deal more effectively with the problem of censoring. This method is a variant of that proposed by Rodríguez and Hobcraft (1980), but avoids the structural bias introduced in this latter approach arising from its systematic exclusion of women with long birth intervals.

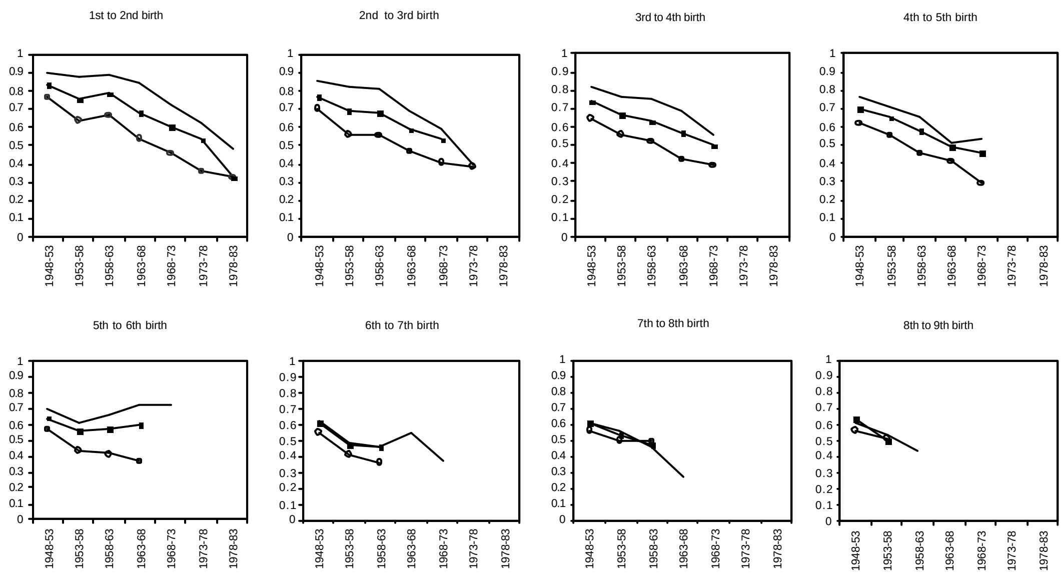
The method uses the proportion (B_t) of women progressing to a subsequent parity within *t* months of the last birth. Adjusted B_ts are derived using a truncated pairwise comparison method, similar to that used to derive projected parity progression ratios. As with the P_is this truncation technique deals with the fact that "fast breeders" are more likely to move from one parity to the next at younger ages than "slow breeders." However, B_ts deal more carefully with the problem of censoring than the P_i method discussed above. The method is preferable since the P_i are biased if the distribution of exposure-to-risk of women is changing, while the use of life table methods standardises for this. In addition, use of this method also allows one to calculate median birth intervals, which cannot be done with the projected parity progression ratio approach.

Typically, a value of *t* is chosen so that the proportion of women ever progressing to a higher parity (i.e. the projected parity ratio, P_i) is close to the values of B_t. A value of 60 months (i.e. 5 years, and hence the term *quintum*, see Section 4.3.1) is frequently suggested as being long enough for most women who will ever do so to progress to a next birth, while avoiding the problem of increasingly sparse data when higher values of *t* are chosen.

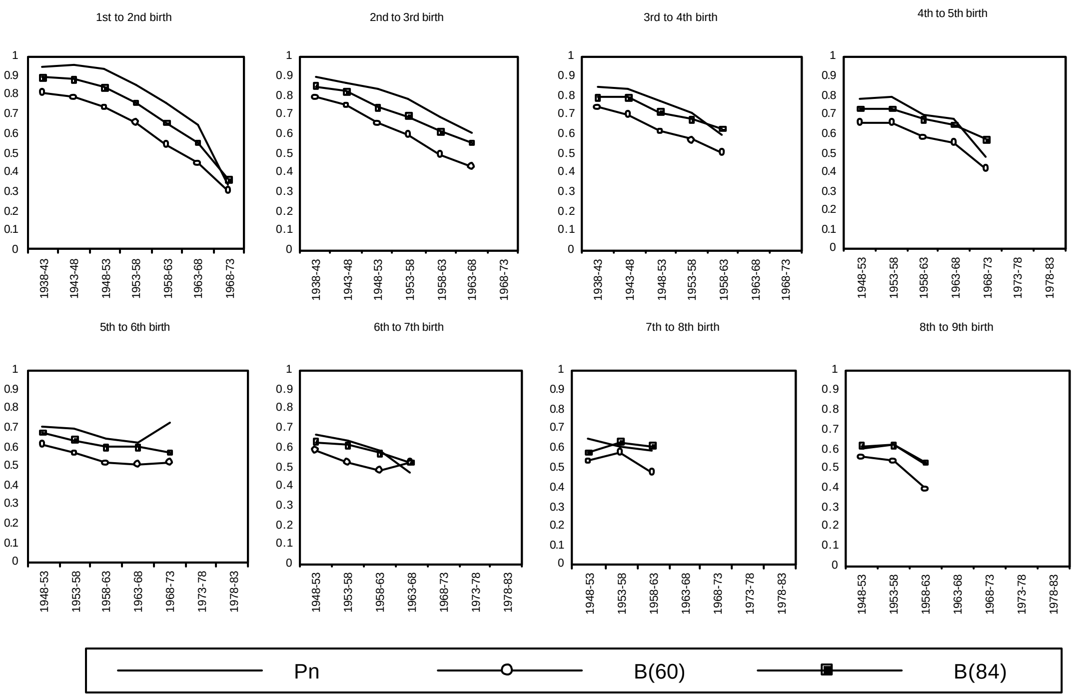
In South Africa, the *mean* progression time from one birth to the next is in excess of 40 months for most age groups and parities. Accordingly, a value of *t* of much greater than 60 months is required to estimate parity progression. After examination of the data, and calculating adjusted B_t (using the same truncation approach as above) values, a more appropriate value of *t* was adopted of 84 months – thus allowing 7 years between births. Values of the adjusted B_t closer to the P_i could be achieved through use of B_{90}s, but the additional data loss is not justifiable. The values of P_i, B_{60}, and B_{84} calculated from the 1998 DHS and the 1987-9 DHS are shown in Figure 4.2.

Figure 4.2 Indices of parity progression by birth cohort and parity for African women, 1998 DHS and 1987-9 DHS

1998 DHS



1987-9 DHS

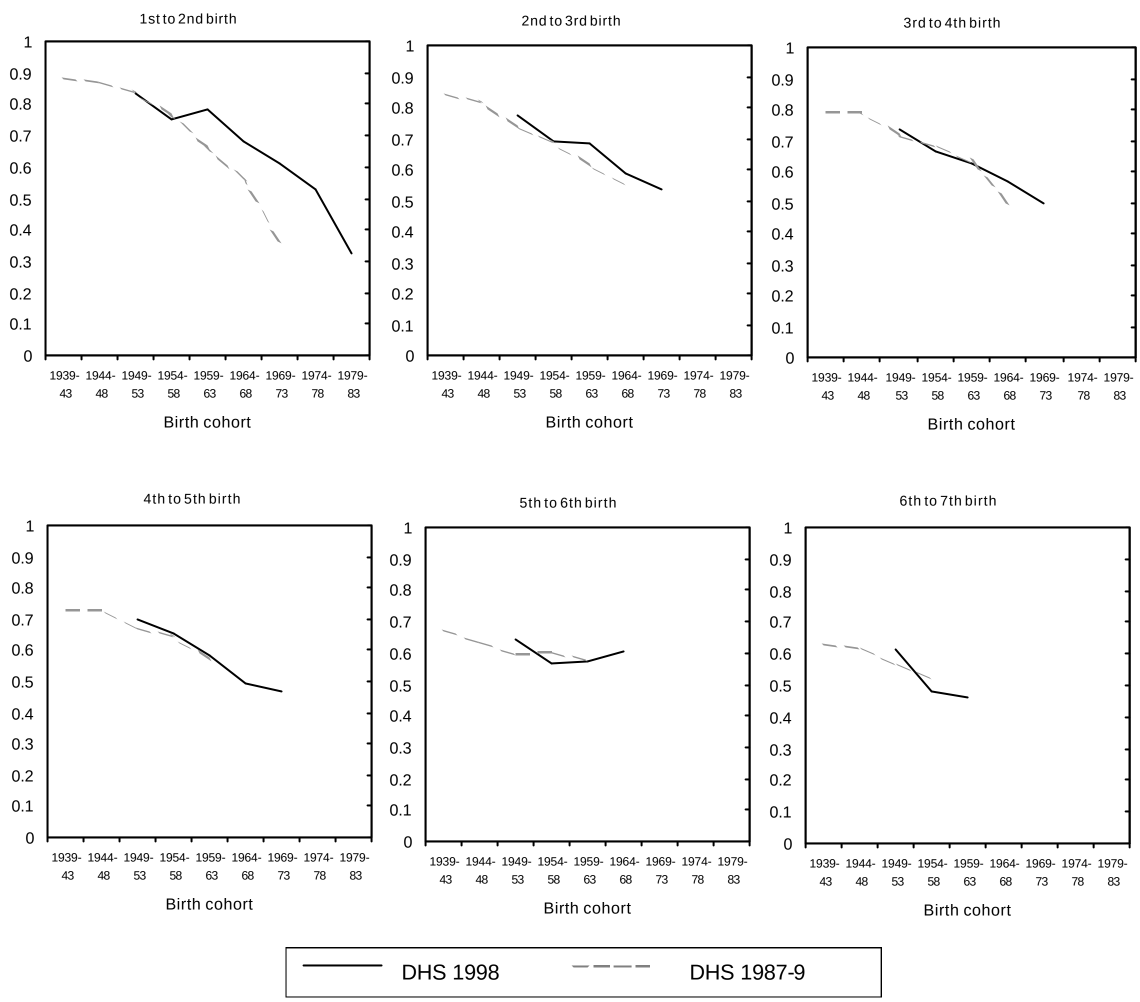


Looking at progression from first to second births in the 1998 DHS, values of both P_1 and B_{84} remain approximately constant for women in the three oldest cohorts (i.e. aged 35-49) but are lower for younger cohorts. Similar patterns can be identified for second to third order progressions. The implication is that there has been an increasing tendency (not discernible among older cohorts) for younger women to delay or stop childbearing even after the birth of a first child. There is no specific parity before which the P_n and B_{84}s are invariant, and above which they drop.

A further advantage of this approach is that it permits the use of data from the 1987-9 DHS since it is not necessary to investigate the entry of young women into motherhood in order to derive the measure. Observations similar to those made above in respect of the 1998 DHS also apply.

In addition, the (approximate) ten-year gap between the two surveys means that the values of B_{84} for women in the same birth cohort derived from two different surveys can be plotted against each other, and results in the patterns of parity progression shown in Figure 4.3.

Figure 4.3 Proportion of women progressing to another birth within seven years: 1987-9 DHS and 1998 DHS



Except for the first transition (from a first to a second birth), the correspondence between the two data series is remarkable, suggesting that the quality of the 1987-9 DHS data (at least in relation to fertility and childbearing) may not be as poor as has been suggested. In particular, Figure 4.3 demonstrates that the proportion of women progressing to a subsequent birth has been falling for all cohorts of women born after 1949. Thus, for example, while nearly four out of every five African women born before 1949 were expected to progress from a third to a fourth birth, that proportion had declined to a round half among women born twenty years later.

Given the general level of agreement between the parity progression ratios calculated from the two surveys, the large discrepancy between the ratios at younger ages in the transition from a first to second birth is surprising. One explanation for the discrepancy may be that the sampling design of the 1987-9 survey (which included only married women, or unmarried women who had borne a child), encouraged fieldworkers to omit births to younger, unmarried women.

One limitation of the B_{84}s is that they mask the effect of changing times within that seven-year period during which women have a subsequent birth. This is investigated through the analysis of median birth intervals, which are presented in the next section.

4.3 The length of birth intervals among African South Africans

Survival analysis (or life table techniques) can reduce censoring bias by including truncated observations in the calculation of the exposed to risk. Summary measures of birth interval lengths that suffer less from censoring bias than simple means and medians can thus be derived from application of these techniques. Whereas life tables typically record the numbers of people surviving at a given age, those used in the evaluation of birth intervals record the numbers of women of parity i who have yet to have an $i+1$th t months since the ith birth. The survival function (a function of time, t) gives the probabilities of survival (i.e. not having a next birth within t months) and the median birth interval length is calculated (interpolating if necessary) as the time in months for which the survival function is equal to 0.5.

4.3.1 Adjusted measures of birth interval length – trimeans and quintums

Two variants of the approach outlined above are of particular value in assessing median birth intervals. The first is that suggested by Rodríguez and Hobcraft (1980). The method involves calculating separate life tables by single months since the previous birth and for each parity. The quintum, the cumulative proportion of women having a subsequent birth within 60 months, is then calculated. By standardising the life tables used to derive the quintum so that the quintum is equal to one, and calculating the durations q_1, q_2 and q_3 from this standardised life table at which 25, 50 and 75 percent of women who have a birth in the five year period have done so, the trimean, T, is calculated by

$$T = \tfrac{1}{4} (q_1 + 2 q_2 + q_3)$$

Further insight into the nature of the South African fertility transition relative to that in other countries undergoing the fertility transition can be gained from using the 1998 DHS data for African South African women to calculate quintums and trimeans comparable with those produced by Hobcraft and McDonald (1984) using data from the World Fertility Surveys. Values of the quintum for South Africa are shown in Table 4.6, together with those for a few other countries considered by Hobcraft and McDonald.

Table 4.6 Values of the quintum by parity, selected countries and African South African women

		Parity Progression						
Country	*3-year TFR*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*
Kenya	8.0	0.91	0.92	0.91	0.91	0.89	0.87	0.86
Senegal	7.1	0.89	0.90	0.91	0.90	0.91	0.87	0.85
Lesotho	5.9	0.85	0.84	0.81	0.82	0.81	0.74	0.75
Venezuela	4.3	0.88	0.80	0.80	0.79	0.79	0.79	0.76
South Korea	4.0	0.91	0.89	0.81	0.73	0.67	0.63	0.54
Panama	4.0	0.87	0.83	0.79	0.77	0.77	0.74	0.73
Costa Rica	3.5	0.85	0.81	0.79	0.78	0.80	0.79	0.79
Sri Lanka	3.5	0.87	0.84	0.81	0.79	0.77	0.74	0.70
Trinidad and Tobago	3.1	0.83	0.77	0.79	0.74	0.74	0.70	0.66
SOUTH AFRICA	3.2	0.59	0.58	0.58	0.57	0.53	0.52	0.58

Source: Hobcraft and McDonald (1984), except South Africa: own calculation

By this measure, parity progression and birth intervals in South Africa are such that less than 60 percent of African women progress from one parity to the next within five years. Even when South Africa is compared only to those countries with similar levels of fertility, a clear difference exists in the values of the quintum. South African women's birth intervals are substantially longer than those elsewhere in the developing world.

The trimean for South African women, too, is noticeably longer compared to those for women in developing countries with similar levels of fertility (Table 4.7).

Taken together, the two preceding tables indicate some substantive differences between the South African fertility transition and that observed elsewhere. Comparing the data for South Africa with that for South Korea, for example, indicates that the proportion of women having a birth within 60 months is much lower at all parities, and whereas the quintums for South Korean women show a strongly decreasing trend, those for African South Africans are roughly constant. Examination of the trimean, however, suggests that the interval between births of those women having a subsequent birth within 60 months is not dissimilar. Both Senegal and Lesotho demonstrate similar patterns of fertility and childbearing to those observed among African South Africans.

Table 4.7 Values of the trimean, selected countries and African South African women

		Parity Progression						
Country	*3-year TFR*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*
Kenya	8.0	25.5	25.4	25.5	25.8	26.3	26.6	26.3
Senegal	7.1	30.2	30.2	29.9	30.0	29.9	29.9	29.7
Lesotho	5.9	32.1	31.8	30.8	32.6	32.6	31.7	32.1
Venezuela	4.3	22.1	22.7	23.2	23.7	23.3	23.8	23.7
South Korea	4.3	28.3	30.6	31.5	31.7	31.2	31.7	31.2
Panama	4.0	22.7	24.1	24.5	24.3	24.4	25.0	24.8
Costa Rica	3.5	21.6	21.3	22.5	21.6	22.4	22.2	21.6
Sri Lanka	3.5	25.0	27.2	27.5	28.0	28.5	27.9	28.3
Trinidad and Tobago	3.1	22.5	22.5	22.3	22.5	22.8	22.0	22.7
SOUTH AFRICA	3.2	33.8	33.1	32.3	31.9	32.3	31.7	32.9

Source: Hobcraft and McDonald (1984), except South Africa: own calculation from 1998 DHS

In all three instances, the quintum does not vary much by parity, while the trimeans in South Africa are somewhat higher than in those two countries. As mentioned in Section 4.2.3, though, a weakness of this approach is that by its very construction, women with long birth intervals are excluded from the analysis. As the quintums for South Africa show, this systematic bias against women with long birth intervals limits our ability to draw comparisons of birth spacing in South Africa with that in other countries.

4.3.2 Projected median birth intervals

The second approach to measuring median birth intervals is to calculate paired comparison median birth intervals. This approach, derived by Aoun (1989a; 1989b), is an extension of Brass and Juárez' truncated projected parity progression technique. Projected median birth intervals are calculated in the same manner as that used for calculating adjusted B_ts, but instead of using the proportion of women progressing from one parity to the next, the method uses truncated data to calculate the relative changes in median intervals between births. Thus, the approach uses the median interval between births for the untruncated and truncated cohorts (Table 4.8 and Table 4.9 respectively) to derive "indices of relative change", which are then applied to the untruncated median intervals to derive projected median birth intervals.

Table 4.8 Median birth intervals (months) by age group and parity progression, 1998 DHS and 1987-9 DHS

1998 DHS				*Parity progression*				
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*
20-24	71.3	58.4	38.8					
25-29	60.6	56.4	47.0	50.1	56.3	35.2		
30-34	53.8	55.9	56.1	53.2	51.9	44.0	48.6	
35-39	43.2	47.2	51.6	54.5	52.9	57.6	41.1	42.5
40-44	44.2	49.2	49.7	47.2	64.4	66.5	41.9	36.9
45-49	35.4	38.8	40.5	42.1	50.2	49.2	48.2	42.8

1987-9 DHS				*Parity progression*				
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*
20-24	57.6	50.8	43.0	37.4	31.6	45.3		
25-29	49.1	48.3	43.8	47.8	39.8	84.7		
30-34	41.4	42.3	43.2	38.8	41.6	39.7	44.7	27.6
35-39	38.2	39.6	41.1	42.3	47.7	52.9	50.5	56.0
40-44	33.3	33.9	34.8	37.9	45.1	51.9	46.2	45.5
45-49	33.3	32.9	34.5	37.1	45.4	44.9	55.2	50.9

Table 4.9 Truncated median birth intervals (months) by age group and parity progression, 1998 DHS and 1987-9 DHS

1998 DHS				*Parity progression*				
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*
20-24(t)								
25-29(t)	55.7	41.8	35.7					
30-34(t)	51.4	50.9	44.3	34.4	41.0	24.5		
35-39(t)	42.5	44.5	44.4	43.8	41.5	46.6	34.7	
40-44(t)	43.9	47.7	45.9	42.4	48.0	48.7	35.5	28.4
45-49(t)	35.3	38.5	40.1	40.1	45.0	42.2	40.6	40.0

1987-9 DHS				*Parity progression*				
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*
20-24(t)	49.4	44.8	30.8					
25-29(t)	43.7	41.4	38.0	47.1	41.3			
30-34(t)	39.7	39.6	37.7	33.5	44.4	30.2		
35-39(t)	37.7	38.1	37.3	38.6	41.5	47.7	50.7	35.8
40-44(t)	33.1	33.2	33.9	35.6	40.1	47.7	37.3	38.0
45-49(t)	33.2	32.8	34.2	36.3	41.6	41.3	44.6	39.5

The method produces reasonable results only where the proportion of women who have actually experienced the parity progression of interest is high. In other circumstances, where only a few women have done so, the projected median birth intervals are distorted by the magnitude of the adjustment made in respect of the indices of relative change. Hence, Table 4.10 and Table 4.11 present projected median birth intervals only for those combinations of age and parity where more than 80 percent of women have actually progressed to that parity. The data in italics reflect those combinations of age and parity where between 65 and 80 percent of women have undergone that progression. Clearly, these data are less reliable than those indicated in normal type.

Table 4.10 Projected median birth intervals (months) using the truncation approach, 1998 DHS

				Parity Progression			
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*
30-34	55.4						
35-39	43.7	*49.3*	*56.7*				
40-44	44.3	49.9	*50.4*	*50.2*			
45-49	35.4	39.0	40.5	*42.7*	*50.3*		

These data show very clearly that projected birth intervals are lengthening dramatically among younger women, irrespective of parity. A similar trend is exhibited in the earlier DHS data, with median birth intervals showing signs of lengthening for more recent births (i.e. earlier parities for younger women, later parities for older women).

Table 4.11 Projected median birth intervals (months) using the truncation approach, 1987-9 DHS

				Parity Progression			
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*
30-34	*42.3*	*45.0*					
35-39	38.4	40.5	*42.5*	*46.0*			
40-44	33.3	33.9	35.1	*38.8*	*49.2*		
45-49	33.3	32.9	34.5	*37.1*	*45.4*	*44.9*	*55.2*

From these data, it can be observed that the projected median birth intervals among older cohorts of women have lengthened dramatically in the 1998 DHS, while remaining virtually unchanged in the 1987-9 DHS. As with the investigation in the Projected Parity Progression Ratios, an examination of the untruncated and truncated data (presented in Table 4.8 and Table 4.9) indicates that among older women, as would be expected, the cohort effect far outweighs the truncation effect. In other words, the increase in birth intervals indicated by the application of this method is not a product of a distortion of the data introduced by the truncation procedure, but reflects significant changes in childbearing patterns between different cohorts of women.

4.3.2.1 Time location of projected median birth intervals

A further elaboration of Aoun's approach is to locate the median birth intervals in chronological time, so as to understand better the secular trend in birth intervals in South Africa over the last forty years. This is done by adding the projected median birth interval to the mean date of birth recorded for each parity by the mother's age group at the survey, and comparing this with the projected median birth interval (Figure 4.4).

Figure 4.4 Time location of births using projected median birth intervals, 1987-9 DHS and 1998 DHS

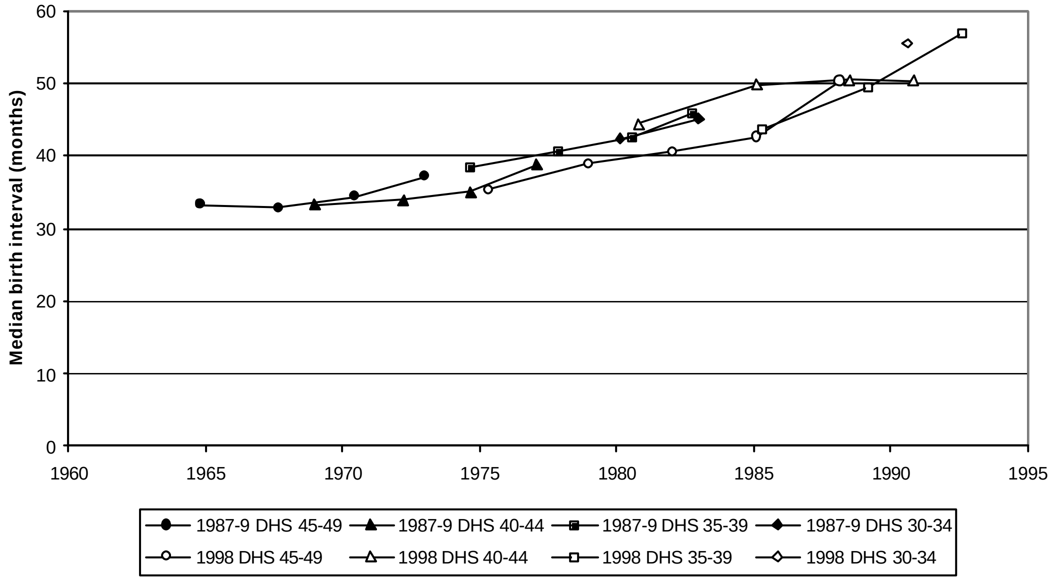


Figure 4.4 suggests that there is little significant variation in median birth interval length associated with age of mother or parity: the median birth intervals of women aged 45-49 in the 1987-9 DHS progressing to their fifth birth are very similar to those of women ten years younger who at the time were progressing to their second birth. Thus, birth intervals seem to have followed a secular trend, increasing with time, rather than being determined by mother's age or parity.

4.4 Univariate analyses of differentials in birth intervals

The method of analysing projected median birth intervals and their time location can be applied to assess differentials in median birth interval length according to background characteristics of the women being studied. Particular attention should be paid to those characteristics that are deemed to be the "proximate determinants" of birth intervals. Section 4.4.1 identifies these proximate determinants, and presents estimated projected birth intervals analysed according to them. Urban and rural differentials in median birth intervals are also assessed.

4.4.1 The proximate determinants of birth interval length

As with fertility rates, only a limited number of mechanisms directly affect the length of birth intervals. It is only through the operation of these mechanisms, or proximate determinants, that other variables (education and urbanisation, for example, as well as social and institutional effects) impact on birth intervals.

The proximate determinants of birth interval length are essentially those that determine fertility, since actions that delay or stop fertility have a direct influence on the length of birth intervals. From Davis and Blake's list of 11 proximate determinants of fertility published in the 1950s (Davis and Blake, 1956), Bongaarts (1982) distilled seven: proportion of women married; contraceptive use and effectiveness; prevalence of induced abortion; post-partum infecundability; fecundability, or frequency of intercourse; spontaneous intrauterine mortality; and permanent sterility. Of these, Bongaarts identified marriage, contraceptive use, postpartum infecundability and the prevalence of induced abortion as being the most significant in determining differences in fertility between populations.

Each of the intermediate fertility variables also affect (to greater or lesser extents) birth interval length. Of these, six hold the key to understanding the dynamics of changes in birth intervals in a given society over time. Longer birth intervals will be observed if one or more of the following occur:

1. Contraceptive techniques are used to space or limit childbearing;
2. Longer periods of postpartum abstinence are observed, suppressing fertility, since even if the woman is again fecund, abstinence restricts the possibility of conception;
3. Breastfeeding is continued for longer durations, resulting in extended lactational amenorrhoea and, *ceteris paribus*, longer birth intervals (Locoh, 1994);
4. Marital relations are disrupted (or, *in extremis*, the institution of marriage is itself undermined), resulting in reduced frequency of intercourse;
5. The prevalence of induced abortion rises; or
6. The prevalence of subfecundity and secondary sterility rises as a result of the spread of sexually transmitted infections (such as syphilis or HIV) which reduce the probability of conception occurring.

However, as with the proximate determinants of fertility themselves, not all of these factors will operate necessarily in the same direction. For example, modernisation frequently leads not only to shorter durations of breast-feeding and postpartum abstinence (indeed, this was suggested by the authors of the 1974 South Africa fertility study for the small observed differential in rural and urban fertility (Lötter and van Tonder, 1976)), but also often expands women's access to, and use of, modern methods of contraception.

It is unlikely that the second and third factors listed above would account for the increase in birth interval length observed in South Africa. If anything, in the absence of the operation of counterbalancing proximate determinants (such as use of contraception, or higher levels of abortion), one would expect birth intervals to shorten over time.

There is some evidence that induced abortion was (and remains) widespread in South Africa. Until 1975, abortion was prohibited under any circumstances. The Abortions and

Sterilisations Act of 1975 made legal abortion possible, but only on five highly restricted grounds. According to the Department of National Health and Population Development (1991) and Nash (1990), fewer than 1 000 legal abortions were performed each year after 1975. The fact that abortion was, to all intents and purposes, illegal until the mid-1990s, means that no survey data exist to corroborate an increase in the prevalence of induced abortion.

Recent research has estimated that around 45 000 women present at South African hospitals each year with incomplete abortion, with induced abortion being positively confirmed in 8 percent of the 803 cases studied (Rees, Katzenellenbogen, Shabodien *et al.*, 1997). From 1976 to 1987, the annual number of operations on women of all races for removal of residues of a pregnancy varied in a narrow range from 29 000 to 36 000 (Nash, 1990). Clearly many of these operations would have been the consequence of miscarriage, but the data presented by Rees *et al*. suggest that a non-trivial proportion of these would have been to complete an induced abortion. Indeed, according to Jewkes, Wood and Maforah (1997:418), "in many cases the role of the health services was perceived to be to 'finish the job'". Using data on maternal mortality, the Department of National Health and Population Development estimated the number of illegal abortions in 1989 as approximately 42 000 (Department of National Health and Population Development, 1991). Given that not all illegal abortions result in hospitalisation, this estimate seems credible.

Access to medically assisted termination of pregnancy was expanded with the 1996 Choice on Termination of Pregnancy Act, but delays in making this service widely available mean that few women in 1998 would have had access to the service. The evidence from the 1998 DHS bears this out. Approximately half of African women interviewed were aware that the law on abortion had been changed recently. Of all African women interviewed, 10.8 percent admitted to having at least one termination, though the question did not distinguish between early miscarriage and voluntary termination. Almost twice as many White women reported an abortion, reflecting their greater access to overseas termination facilities, and the greater likelihood of their being granted a legal abortion under the earlier legislation (Nash, 1990). While there has been a noticeable upswing in the proportion of women in the 1998 South Africa DHS reporting terminations after 1996, the absolute numbers are still small: fewer than 120 (out of almost 9000) African women interviewed reported a termination after 1996. However, despite this evidence of widespread illegal termination of pregnancy, no time-series data exist to confirm or deny an increase in the incidence of such terminations in South Africa. Thus, while it is quite plausible that the incidence of illegal abortion increased over the apartheid years, the effect of this intermediate variable on women's birth intervals in South Africa can not be ascertained or investigated.

The sixth route to longer birth intervals – rising infertility – also cannot be investigated, for reasons similar to those in respect of abortion, namely inadequate data collection or surveillance systems. Nevertheless, two points should be made. First, the incidence of sexually transmitted disease (STD) has been widespread for many years in South Africa. In the late 1940s, Kark (1949) commented that "few countries can have a higher incidence" of syphilis than South Africa, while a review article in 1957 described syphilis among Africans as "endemic" (Murray, 1957). A more recent review of the literature on sexually transmitted diseases in South Africa since 1980 concluded that

> The most compelling finding is undoubtedly that STDs are endemic in South Africa. Studies show that around 17% of antenatal clinic attenders harbour at least one urogenital tract infection, and between 49% and up to 90% of women attending family planning and antenatal clinics have at least one STD… up to 15% of family planning clinic and antenatal clinic attenders are seropositive for syphilis, 16% may be infected with chlamydia, 8% may be infected with gonorrhoea, and as many as 20-50% of women have vaginal infections. (Pham-Kanter, Steinberg and Ballard, 1996:168)

More recently, the results from an epidemiological surveillance centre in rural KwaZulu-Natal suggest that, in the late 1990s, approximately a quarter of African women of reproductive age (and more than half of pregnant women) were infected with at least one STD (Wilkinson, Abdool Karim, Harrison *et al.*, 1999).

It is likely then, that the level of secondary sterility as a result of infection with sexually transmitted disease is high (and possibly increasing) among African South African women.

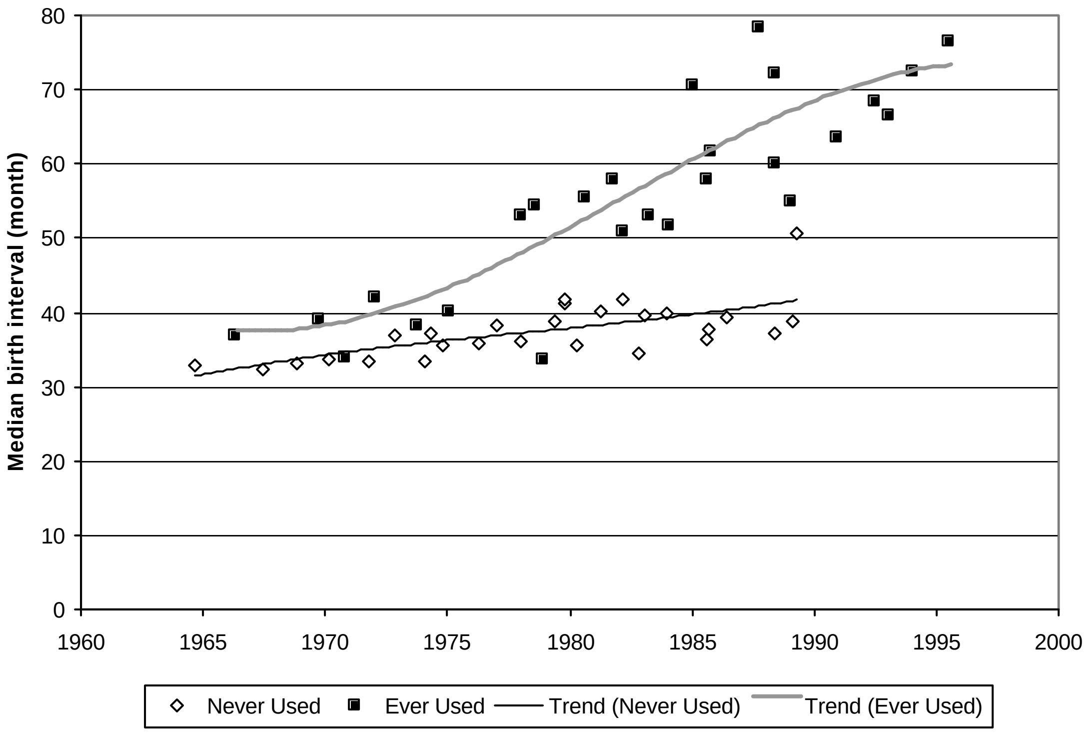
The second point is that the problem of secondary sterility will take on a hugely greater importance in future investigations of birth intervals in South Africa as a result of the spread of HIV/AIDS, since infection with the virus has been shown to inhibit women's ability to conceive (Zaba and Gregson, 1998).

Thus, from the initial list of the proximate determinants of birth interval length, two are left open to initial investigation: the potentially lengthening effects of the use of contraception and the impact of spousal separation and marital disruption on birth intervals.

4.4.1.1 Use of contraception

The data collected in the South African Demographic and Health Surveys are not ideal for assessing changing patterns of contraceptive use (and differentials within these patterns) over time, as contraceptive use histories were not collected in either the 1987-9 or the 1998 survey. As a result, operationalisation of a contraceptive use variable is restricted to a simple binary: had a woman ever used any form of modern contraception prior to the birth of the index child. Such a variable does not distinguish between long-term regular, efficient use on the one hand, and short-term 'experimentation' on the other. However, even with these limitations, a clear difference exists in projected median birth intervals between women who had never used modern contraception before the birth of the index child, and women who had (Figure 4.5), although there is some selectivity at work here, by virtue of the expanded access to modern contraception methods as a result of the government's family planning programmes. Thus, the proportion of women in each group will not have remained constant over time.

Figure 4.5 Projected median birth intervals (months) of African women, by ever use of contraception prior to birth, 1998 DHS and 1987-9 DHS



Birth intervals among women who had used modern contraception before the birth of the index child have lengthened rapidly over time, while those among women who had not used modern contraception have drifted only upward gradually from around 35 to approximately 40 months. Thus, the overall increase in birth intervals in South Africa since 1960 is strongly associated with the uptake and increased use of modern contraception by an increasing proportion of the African population over time.

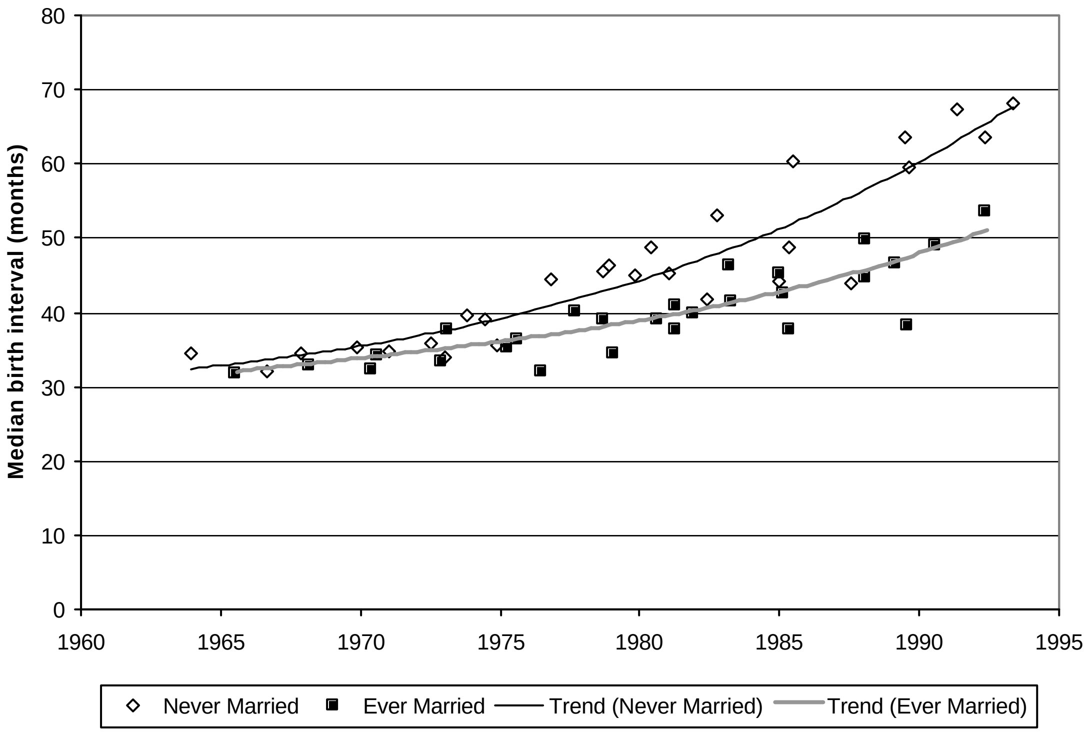
4.4.1.2 Marital disruption

The remaining proximate determinant, spousal separation and marital disruption, is of great importance in societies characterised by high levels of labour migration, as is the case in many Southern African countries. In these circumstances, men are frequently absent from their wives, thereby reducing the time available for conception to occur. However, the effect of spousal separation on fertility (and hence birth intervals) depends not only on the length of separation, but also on the ages of the partners while they are separated and "degree to which the separation coincides with fecundable periods rather than pregnancy or postpartum anovulation" (Millman and Potter, 1984:122). Based on an analysis of the Lesotho World Fertility Survey data, Timæus and Graham (1989) found that male labour migration reduced the level of marital fertility by around 9 percent. In another study of the same country, Timæus (1984a) observed that "birth intervals tend to be rather long in Lesotho". Similar factors are, and were, most probably at work in South Africa, too, since both countries are subject to similar forms and levels of labour migration.

However, in South Africa, the association of marital status with longer birth intervals is less obvious than the effect of contraceptive use. As with the contraception data in the South African DHS surveys, the absence of a full marital history means that a simple binary variable has to be deployed to assess the effect of marital status on women's birth intervals, namely whether or not the woman had ever been married at the time of the birth of the index child. Although there is no strong social sanction against pre-marital pregnancy in South Africa (Preston-Whyte, 1978), one would expect that birth intervals for never-married women would be somewhat longer than those among women who had ever been married (even if they were not necessarily married at the time of that particular birth).

As expected, Figure 4.6 shows that birth intervals for never-married women are longer than those for women who had been married at the time of birth. However, the trends in median birth intervals are broadly parallel, suggesting that the underlying forces on women's birth intervals operated more or less uniformly, regardless of the women's marital status at birth. One possible explanation is that marital relations in South Africa have become so disrupted that the situations in which many ever-married women bear children closely resembles that of women who have never been married. This may occur as a result of women bearing children from successively different fathers for example. No matter the explanation, Figure 4.6 suggests that having married is not a strong predictor of the trend in women's birth intervals.

Figure 4.6 Projected median birth intervals of African women, by ever married status prior to birth, 1998 DHS and 1987-9 DHS



4.4.2 Preceding intervals as a determinant of birth interval length

Several studies (see, for example, Gilks (1986) and Rodríguez, Hobcraft, McDonald *et al.* (1984)) have suggested that the single most significant variable in determining the duration between successive births is the duration of the woman's preceding birth interval.

This relationship, while interesting and intuitively obvious, should be treated with some circumspection as it is hard to conceptualise how the preceding birth interval acts on the proximate determinants in a directly causal fashion. More importantly, however, this relationship suggests that, in many respects, women's birth intervals are both path-dependent, and unaffected by structural changes in society. By intimating that women's maternity history determines their subsequent childbearing, this literature ignores the effect of secular changes in social perceptions and ideals. An analogy can be found in a woman's reported ideal number of births, which has been shown to be correlated strongly with her current parity – and is hence self-fulfilling. Indeed, Hobcraft and Murphy (1986:11) question whether the association between the length of the preceding interval and the current birth interval duration is "due to true state dependency, unobserved heterogeneity, or omitted explanatory variables, themselves correlated between intervals".

This is not to deny that women can exercise control over their childbearing: clearly, women who desire many children will tend to have shorter birth intervals. Similarly, women who do not use modern contraceptive methods when others do, will have shorter intervals. The essential point, however, is this: that over an individual woman's life-course, her own assessment of the number of children she would like to bear, and the desired interval between them, will be subject to change arising from changing social and cultural prescriptions and ideals, as well as her own experience. Taken together, this suggests that the immediately preceding birth interval cannot and should not be viewed as causally related to the subsequent interval. Rather, women's preceding birth intervals should be viewed as an indicator of their fecundity, and of unmeasured (and unmeasurable) social, economic and cultural traits.

4.4.3 Rural/urban differentials in birth interval length

The final univariate analysis of trends and differentials in birth intervals is that of current residence. This analysis is included not because residence is deemed to be a proximate determinant of birth interval length (it is not), but because other data exist relating to women's birth intervals in metropolitan areas in the early 1970s against which these more recent data can be compared. Since the DHS data do not provide a full residence history for women surveyed, current residential status is used instead. Median birth intervals among urban women are much longer than those among rural women (Table 4.12, Table 4.13 and Figure 4.7).

Table 4.12 Projected median birth intervals (months) using the truncation approach, urban and rural areas, 1998 DHS

				Parity			
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*
Urban							
30-34	66.9						
35-39	50.6	*64.3*					
40-44	49.9	65.8	*67.4*	*70.2*			
45-49	37.8	44.0	48.0	*53.3*	*66.0*		
Rural							
30-34	43.8						
35-39	37.8	*40.8*	*45.7*				
40-44	38.8	39.4	*37.3*	*40.6*			
45-49	33.2	35.7	36.5	*37.1*	*41.4*		

Note: Data in italics represent those projected median birth intervals calculated for women where between 65 and 80 percent of women of that combination of age and parity have progressed to a subsequent birth. Data in normal type represent birth intervals calculated for combinations of age and parity where more than 80 percent of such women have progressed to a subsequent birth.

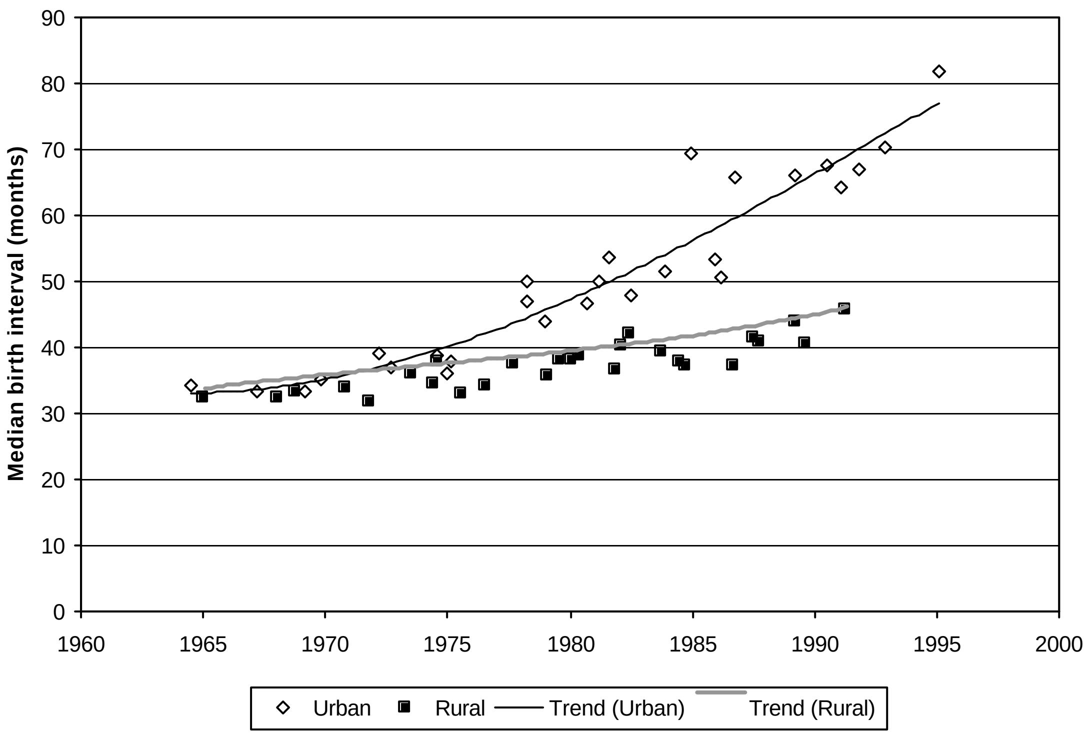
Interestingly, however, this differential was not apparent until after the implementation of the first National Family Planning Programme in 1974, suggesting that the pattern of increase in birth intervals is strongly associated with the availability of modern contraceptive methods in both urban and rural areas. As shown earlier, birth intervals among women who had not used modern contraceptive methods before the birth under investigation have hardly altered in the last thirty years, while birth intervals among women who had, have increased dramatically. In many respects, this finding is intuitive, since lengthening of birth intervals is made much easier with the use of modern contraception.

Table 4.13 Projected median birth intervals (months) using the truncation approach, urban and rural areas, 1987-9 DHS

	Parity						
Age group	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*
Urban							
30-34	*46.8*	*51.6*					
35-39	38.9	46.9	*53.5*	*69.5*			
40-44	33.3	37.0	36.1	*50.0*	*51.5*		
45-49	34.3	33.5	35.0	*39.2*	*48.8*	*46.3*	
Rural							
30-34	*38.1*	*42.1*					
35-39	37.7	37.7	*38.2*	*40.2*			
40-44	33.3	31.9	34.5	*34.3*	*45.5*		
45-49	32.3	32.4	34.0	*36.0*	*42.4*	*43.6*	*42.3*

Note: Data in italics represent those projected median birth intervals calculated for women where between 65 and 80 percent of women of that combination of age and parity have progressed to a subsequent birth. Data in normal type represent birth intervals calculated for combinations of age and parity where more than 80 percent of such women have progressed to a subsequent birth.

Figure 4.7 Projected median birth intervals (months) of African women, by place of residence, 1998 DHS and 1987-9 DHS



4.5 Unadjusted mean and median birth intervals

As a summary measure, mean birth intervals suffer from both truncation and censoring biases. They can only be calculated using those intervals that are closed. If open birth intervals are included, the invalid assumption is made that all open intervals are closed on the survey date. By restricting the calculation only to closed intervals, however, the measure is biased by the fact that "fast breeders" (i.e. women with shorter birth intervals) are likely to be disproportionately represented in the calculation, and hence the mean closed birth interval will tend to indicate somewhat shorter mean birth intervals than is actually the case.

The use of median closed birth intervals suffers from the same drawbacks. However, the use of the median is preferable to the use of the mean, since the distribution of closed birth intervals will tend to be strongly right tailed and hence the median provides a more robust summary measure of closed birth intervals, undistorted by the underlying distribution of birth intervals.

Due to the limitations of this summary measure, mean birth intervals are presented only for comparative purposes with other published data. The analysis of birth intervals in urban areas, and their time location presented in the preceding section gives a strong indication of the changes in birth intervals by cohort. Further evidence of the magnitude of this change can be gleaned from a series of reports issued by the Human Sciences Research Council (Mostert, 1972; Mostert and du Plessis, 1972; Mostert and Engelbrecht, 1972; Mostert and van Eeden, 1972). These surveys investigated fertility, contraceptive use and family formation among married (legally or otherwise) African women aged 15-44 living in four major urban areas in 1969-70. Unfortunately, a breakdown of these data by age of woman is not available, necessitating the presentation of data unstandardised by age.

Table 4.14 Mean (closed) birth intervals in months for married African women in major metropolitan areas, by parity

			Parity progression							
City & Year	*N*	*Mean age*	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*
Cape Town 1969-70	573	31.3	30.9	30.3	27.8	31.0	29.7	30.3	29.1	27.0
Durban 1969-70	1071	32.1	33.0	31.5	29.3	29.6	28.9	26.6	28.1	28.8
Pretoria 1969-70	978	32.6	37.6	33.1	32.2	32.2	30.5	30.3	30.9	28.5
Soweto 1969-70	1016	33.4	38.2	33.7	34.0	33.2	31.0	28.2	25.6	28.2
Weighted 1972	3638	32.5	35.4	32.4	31.2	31.5	30.0	28.6	28.3	28.3
DHS 1987-9	316	29.5	38.6	36.5	37.4	36.1	38.6	30.4	--	--
DHS 1998	633	33.5	52.7	51.5	49.5	44.1	49.1	41.7	23.3	27.5
Annual percent change (1972-1987/9)			0.5	0.8	1.2	0.9	1.6	0.4		
Annual percent change (1987/9-1998)			3.2	3.5	2.8	2.0	2.4	3.2		
Annual percent change (1972-1998)			1.5	1.8	1.8	1.3	1.9	1.5	-0.8	-0.1

Source: DHS 1998, DHS 1987-9, Mostert (1972), Mostert and du Plessis (1972), Mostert and Engelbrecht (1972), Mostert and van Eeden (1972).
Note: In order to compare these results with those from the 1987-9 and 1998 South Africa DHS, the data have been restricted to married or cohabiting African women living in cities aged between 15 and 44. While the equivalent sample sizes in the 1987-9 and 1998 Demographic and Health Surveys are much smaller than those of the 1969-70 studies, they are still sufficient to be of use.

The use of closed birth intervals biases the mean birth intervals downwards, as can be seen from a comparison between the data presented in Table 4.14 and the previous two tables. Moreover, while the results are not indicative of national trends in childbearing and birth intervals, they are nevertheless instructive. The results presented in the last three rows of Table 4.14 indicate that a major change has occurred in urban African fertility in South Africa over the last 30 years. While mean intervals at higher parities have changed little, at lower parities mean closed birth intervals have increased by between 40 and 60 percent. Furthermore, the data show a substantial increase in the annual rate at which closed birth intervals have lengthened over the time period covered by the three surveys.

These findings are both important and significant. Younger women in South Africa are less likely to progress to higher-order births than older women. At the same time, those that do progress are taking much longer to do so. The mean closed birth intervals at lower parities of married women of reproductive age have increased by more than a year over the last 30 years in South Africa's cities – from under 3 to over 4 years.

4.6 Conclusion

This section set out to investigate the pattern of childbearing and birth spacing among African South Africans using two DHS surveys. A number of highly important findings emerge from the investigations undertaken, and it is worth dwelling on these at some length.

First, African women's progression from one parity to the next shows that the South African fertility decline has not been characterised by parity-specific fertility limitation in order to conform to social norms relating to an ‘optimal’ number of children that women should bear. This confirms the findings presented in Section 3 that the South African fertility decline exhibits some similarities with that in other African countries.

Second, the values of B_{84} from two sets of DHS data reveal that the proportions of women progressing to a subsequent birth have been declining for all cohorts of women born after 1949. Since high levels of teenage pregnancy have prevailed in South Africa since the 1950s at least (see, for example, Eloff (1953a) and Nash (1990)), this suggests that parity progression ratios in South Africa probably started falling no later than the mid-1960s. This correlates well with the estimated timing of the onset of the African fertility decline in South Africa presented in the Section 3. Given that estimated onset of the fertility decline, it is not surprising that the general trend in parity progression has been downwards for all parities, across all the cohorts covered by the two DHS surveys. The B_{84} values decline roughly in parallel with the values of P_i. Thus, there is little evidence that the latter have been distorted by changes in the tempo of fertility.

The calculation of these Censored Parity Progression Ratios also provides the first intimation of the possibly unique length of birth intervals in South Africa. Previous research into birth intervals in the developing world found that the majority of women who will ever progress to a subsequent birth do so within five years of their previous one. In South Africa, a window of seven years was required for the values of the Censored Parity Progression Ratios to come close to the Projected Parity Progression Ratios.

Furthermore, birth intervals in South Africa have lengthened enormously over the last thirty years, certainly by African standards and also in comparison with those observed elsewhere in the developing world. These birth intervals are exceptionally long by African standards. The median birth interval in thirteen sub-Saharan countries, presented by Greene (1998) are shown in Table 4.15. These statistics indicate that there is some variation in median birth intervals across the sub-continent. They range from 28 months in Madagascar and Uganda to 39 months in Zimbabwe. Countries in this sample that neighbour South Africa (Zimbabwe and Namibia) have longer intervals than countries further north. However, even in these countries, birth intervals are much shorter than in South Africa, where the equivalent median interval (for the same subpopulation) is 59 months.

Table 4.15 Median birth intervals (months) for births in the five years prior to the survey, non-sterilised married and cohabiting women, 13 sub-Saharan African countries

Country (Year)	Median birth interval (months)
Madagascar (1992)	28
Uganda (1995)	28
Kenya (1993)	31
Malawi (1992)	32
Rwanda (1992)	32
Senegal (1992-3)	32
Tanzania (1991-2)	32
Côte d'Ivoire (1994)	33
Namibia (1992)	33
Zambia (1996)	33
Benin (1996)	36
Ghana (1993)	36
Zimbabwe (1994)	39

Source: Greene (1998:32)

By this measure, then, the pattern of childbearing in South Africa is qualitatively different from that elsewhere in sub-Saharan Africa. Similarly, the quintums and trimeans calculated in this section indicate that the proportion of African South Africans progressing to a subsequent parity within five years of the last birth are much lower than those observed elsewhere in the developing world, even in countries with similar levels of fertility. Further, even for women who do have another child within five years, the trimean for African South Africans is appreciably higher than that generally observed. In this regard at least, the pattern of childbearing in South Africa is – and has been historically – qualitatively different from that seen elsewhere in the developing world. International comparisons are of little help in understanding or explaining why this pattern has emerged.

The South African fertility decline exhibits similarities with the decline in other sub-Saharan African countries insofar as the decline is less driven by parity-specific fertility limitation. In many respects, then, the South African fertility decline is occurring as Caldwell, Orubuloye and Caldwell (1992) hypothesised. Fertility decline is occurring at all ages and parities simultaneously. However, the South African fertility decline is also different in that birth intervals in South Africa are now substantially longer than in most other sub-Saharan African countries. The evidence presented above suggests that South Africa is following a new variant of the African fertility transition, characterised by both lengthening birth intervals and low parity progression ratios. In many respects, these findings confirm the results from the longitudinal study conducted by the University of Witwatersrand's Health Systems Development Unit at the Agincourt site in the Northern Province (Garenne, Tollman and Kahn, 2000). Whether other African countries are following this pattern might be a profitable direction for future research.

5 CONCLUSIONS

The 1996 South Africa Census and the 1998 South Africa Demographic and Health Survey (DHS) provide the first substantial data in more than a decade that allow the trends and patterns in South African fertility to be investigated in detail. Deficiencies and errors in both data sets notwithstanding, we have estimated current and past levels of fertility in the country, for all South African women, and for African South African women separately. In doing so we have uncovered important evidence that both the level of fertility and patterns of family formation have been changing.

The level of fertility has declined by about half between 1970 and 1996, to 3.2 children per woman nationally, and 3.5 children per woman among African South Africans. Most of this fall has occurred since the mid-1980s. Median birth intervals, by contrast, have almost doubled since the early 1970s.

Despite the differences in the sampled populations between the DHS and the 1996 census, the extremely strong correspondence between the estimates of women's cumulative fertility to age 34 from the DHS and from the back projections of the 1996 census leaves little scope for uncertainty in the past trends in South African fertility. Given the variability in past estimates of total fertility in South Africa, our estimates add to the knowledge of the trends in South African fertility over time.

In addition, the estimated trends in total fertility, and calculated parity progression ratios and projected median birth intervals all map on to each other, each reinforcing the conclusions drawn from the others.

The increase in birth intervals since the early 1970s and the trends in projected parity progression ratios, among African South Africans are the most significant findings arising from our investigations. Our results describe a pattern of fertility decline that is simultaneously both typically African and uniquely South African. The pattern of decline in parity progression is typically African insofar as it concurs with data from other African countries, that once the fertility transition gets under way in earnest, parity progression ratios decline for all women, of all achieved parities. African South African women's decision about whether to have another child seem less influenced by the exact number of children that they have already had, than by other considerations. This is the pattern described by Caldwell, Orubuloye and Caldwell (1992). In their paper, they argue that the African fertility transition will occur at all ages and all parities, in contrast to the European fertility transition where the fertility decline was accounted for largely by falling fertility at older ages. However, the trend in median birth intervals is uniquely South

African, as is the very low level of current fertility. In no other sub-Saharan African country are similarly long birth intervals and low levels of fertility found.

As with all fertility transitions, there is no monocausal explanation of the decline that has occurred. The South African population is more urbanised in 1998 than it was in 1970; contraceptive availability and use are high in 1998, while contraceptives were neither readily nor cheaply available in 1970; the social, political and economic fabric of South African society has changed beyond recognition over the last 30 years; and levels of education have increased. All these factors probably have contributed to the decline.

However, when the South African fertility transition is viewed through the prism of these changes, the apparent anomaly of South African demography (why did fertility remain so high, and why was it relatively unresponsive to the introduction of the first family planning programme in the 1970s) is resolved to a degree. The South African fertility transition has run a long course of gradual change. The slowness of the transition up until the 1980s is more a reflection of the structural constraints on African women, their mobility, livelihoods and access to reproductive health delivery systems under apartheid than of any recalcitrance or lack of desire on the part of women to limit their fertility. From this perspective, the increased pace of fertility decline from the mid-1980s probably reflects both the gradual freeing up of South African society since the mid-1970s, the extension of the government's family planning programme to Africans in 1974, and the introduction of the Population and Development Programme in 1984.

The spread of the HIV epidemic will accelerate the future decline in South African fertility. Recent evidence suggests that women infected with HIV have lower fertility as a result of secondary sterility and foetal loss brought on by the disease and its associated opportunistic infections (Zaba and Gregson, 1998). HIV/AIDS morbidity and mortality will be highest among women in their mid-30s, thus reducing the number of children borne by these women. In addition, long birth intervals raise the mean age of childbearing, thereby reducing the number of children borne by women by the time they reach their mid-30s. Indeed, the effects of HIV/AIDS on fertility can be observed from the fact that, according to a Department of Health report into maternal mortality, 82 out of 565 maternal deaths in 1998 were recorded as being due to AIDS[8], and of these women (nearly three quarters of whom were less than thirty) more than 87 percent had had fewer than three deliveries (Department of Health, 1999a).

8 Due to the manner in which deaths, and causes of deaths, in South Africa are reported, HIV/AIDS-related deaths are almost certainly underreported.

The high level of adolescent fertility and the length of birth intervals indicate that the majority of women do not use contraception before their first birth, while contraceptive usage after the first birth is high. In this regard, we agree with the conclusions drawn by Garenne, Tollman and Kahn (2000). Family planning and reproductive health strategies need to shift towards promoting safe sex and making barrier methods acceptable to young people before their first child is born, and away from providing contraception to women only after their first birth. By promoting barrier methods over other forms of contraception, the spread of HIV among South Africans may be mitigated.

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APPENDICES – TECHNICAL NOTES

APPENDIX 1 THE EL-BADRY ADJUSTMENT

A common enumeration error in censuses and surveys is for women of zero parity to be enumerated as "parity not stated" rather than as "parity zero".

El-Badry (1961) observed that – in the majority of cases, and especially at younger ages – women who are enumerated as "parity not stated" are, in fact, childless, and that the enumerator has omitted to write zero on the form. He proposed a method to adjust the non-responses to allow for this by apportioning the reported not stated cases between true not stated cases and women of zero parity, using the strongly linear correlation that exists between the proportion of childless women, and the proportion of women for whom parity was not recorded.

If $Z^*(i)$ is the true proportion of women in age group i who are childless, and $NS(i)$ is the reported proportion of women in age group i whose parity is not stated, then the correlation above can be described mathematically as

$$NS(i) = aZ^*(i) + ß, \qquad (1)$$

where a is the "true" proportion of childless women in age group i who were incorrectly recorded as parity not stated, and $ß$ is the true , constant across all age groups, proportion of women whose parity is not stated. Further, since $aZ^*(i)$ represents the proportion of childless women whose parity was misclassified, the reported proportion of childless women, $Z(i)$, can be found from

$$Z(i) = (1- a)Z^*(i). \qquad (2)$$

Rearranging (2) to make Z*(i) the subject of the formula, and substituting in (1) gives

$$NS(i) = ?Z(i) + ß, \text{ where } ? = \{a/1-a\} \qquad (3)$$

Thus an estimate of the true value of $Z^*(i)$ can be found by fitting a line to the reported points $\{Z(i), NS(i)\}$ for age groups 15-49, and estimating the parameters ? and $ß$ to give

$$Z^*(i) = Z(i)+(NS(i)-ß).$$

The table below shows the proportion of women 15-49 whose parity was not stated, and the values of a and ß, by population group, in the South Africa 1996 Census.

Table A1 Summary statistics arising from the El-Badry correction, by population group

Population group	*% of women with parity not stated*	*% of childless women reported as parity not stated (a)*	*True % of women of not stated parity (ß)*
Africans	15.3	33.9	3.3
Coloureds	9.7	25.8	1.1
Asians/Indians	17.1	37.9	0.7
Whites	10.7	25.8	0.3

The numbers of women of parity zero in the census can then be estimated by adding the reported numbers of zero parity women and the estimated numbers of women of zero parity who were erroneously recorded as being of unstated parity.

The consequence of this adjustment is that estimated lifetime fertility, mean children ever borne, is adjusted downwards as well, as the table below shows.

Table A2 Effect of the El-Badry adjustment on mean children ever borne, by population group

	Africans		*Coloureds*		*Asians/Indians*		*Whites*	
Age	*Unadjusted*	*Adjusted*	*Unadjusted*	*Adjusted*	*Unadjusted*	*Adjusted*	*Unadjusted*	*Adjusted*
15-19	0.23	0.16	0.18	0.14	0.07	0.05	0.06	0.04
20-24	0.91	0.75	0.79	0.68	0.53	0.33	0.35	0.29
25-29	1.74	1.58	1.52	1.42	1.34	1.20	1.02	0.92
30-34	2.69	2.55	2.24	2.16	2.06	1.94	1.67	1.58
35-39	3.48	3.35	2.82	2.75	2.43	2.32	2.05	1.96
40-44	4.16	4.05	3.27	3.19	2.71	2.61	2.24	2.15
45-49	4.61	4.50	3.74	3.66	2.92	2.78	2.40	2.31

A further adjustment was made to the current fertility data in the census arising from the El-Badry adjustment. Clearly, if a woman has never had children, she will not have borne a child in the twelve months before the census. Hence, the reported numbers of women of zero parity reporting no births in the twelve months before the census were set to be equal to the adjusted numbers of childless women arising from the application of the El-Badry correction. The adjusted age-specific fertility rates by age and population group that result are shown in Table A3.

Table A3 Effect of the El-Badry adjustment on age-specific fertility rates, by population group

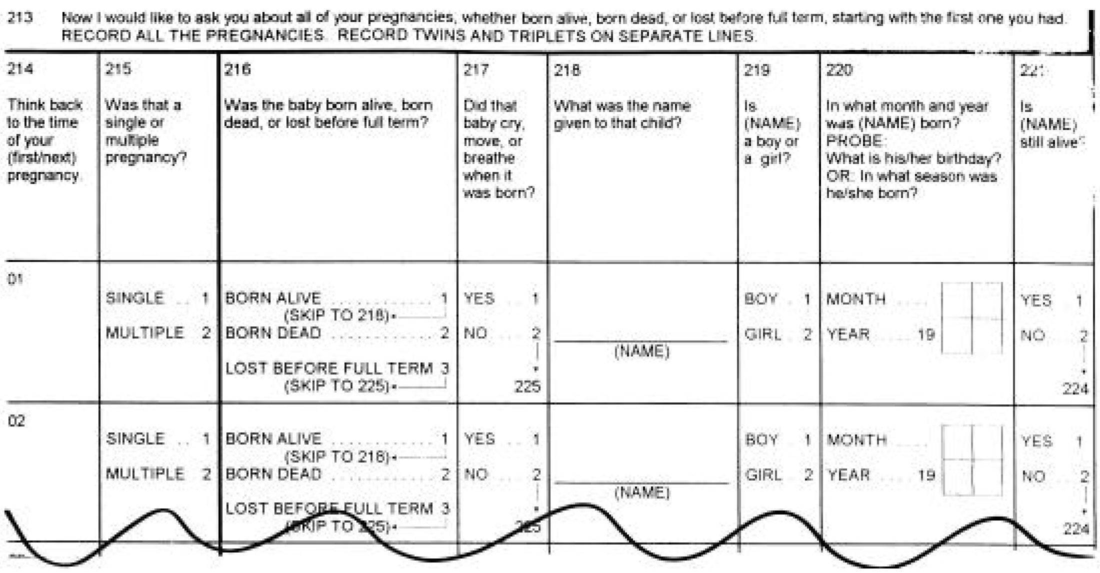
	Africans		*Coloureds*		*Asians/Indians*		*Whites*	
Age	*Unadjusted*	*Adjusted*	*Unadjusted*	*Adjusted*	*Unadjusted*	*Adjusted*	*Unadjusted*	*Adjusted*
15-19	0.050	0.036	0.048	0.037	0.013	0.009	0.013	0.009
20-24	0.104	0.086	0.105	0.092	0.087	0.055	0.063	0.052
25-29	0.117	0.107	0.121	0.113	0.112	0.101	0.110	0.099
30-34	0.127	0.120	0.095	0.091	0.086	0.081	0.082	0.078
35-39	0.113	0.108	0.066	0.064	0.048	0.046	0.046	0.044
40-44	0.096	0.094	0.050	0.049	0.035	0.034	0.035	0.033
45-49	0.080	0.078	0.035	0.035	0.035	0.033	0.033	0.031
TFR	3.44	3.14	2.60	2.40	2.09	1.80	1.91	1.73

APPENDIX 2 THE CORRECTION IN RESPECT OF STILLBIRTHS

As Figure 2.3 shows, while the mean numbers of children living by age of mother in the DHS and census are very similar, the reported mean number of dead children in the census is consistently higher than that reported in the DHS.

Although the census question on lifetime fertility[9] specifically requested that enumerators and respondents exclude stillbirths, the wording of the question was ambiguous, in that the final words in parentheses may have led enumerators to include stillbirths among the children that have died. The questionnaire used for the DHS, on the other hand, included a specific question on stillbirths, as is shown in Figure A1. In addition to Question 216, which enquired about the outcome of each pregnancy, Question 217 probed more deeply if the woman responded that her child had been born dead. Women reported a total of 24 464 pregnancies and that the foetus was lost before full-term in 1 198 of these, and “born dead” in another 407. Question 217 revealed that only 75 of the latter children showed any sign of life. The other 332 were stillbirths. However, as the mothers reported that these 332 pregnancies ended in a birth, it seems likely that in the census such stillbirths would have been reported as dead live births, inflating the actual number of children dying before age 5 by about 22 percent.

Figure A1 Extract from the South Africa DHS questionnaire, showing questions on stillbirths



213 Now I would like to ask you about all of your pregnancies, whether born alive, born dead, or lost before full term, starting with the first one you had.
RECORD ALL THE PREGNANCIES. RECORD TWINS AND TRIPLETS ON SEPARATE LINES.

214 Think back to the time of your (first/next) pregnancy.	215 Was that a single or multiple pregnancy?	216 Was the baby born alive, born dead, or lost before full term?	217 Did that baby cry, move, or breathe when it was born?	218 What was the name given to that child?	219 Is (NAME) a boy or a girl?	220 In what month and year was (NAME) born? PROBE: What is his/her birthday? OR: In what season was he/she born?	221 Is (NAME) still alive?
01	SINGLE ... 1 MULTIPLE 2	BORN ALIVE ... 1 (SKIP TO 218) BORN DEAD ... 2 LOST BEFORE FULL TERM 3 (SKIP TO 225)	YES ... 1 NO ... 2 → 225	(NAME)	BOY ... 1 GIRL ... 2	MONTH ... YEAR ... 19	YES ... 1 NO ... 2 → 224
02	SINGLE ... 1 MULTIPLE 2	BORN ALIVE ... 1 (SKIP TO 218) BORN DEAD ... 2 LOST BEFORE FULL TERM 3 (SKIP TO 225)	YES ... 1 NO ... 2 → 225	(NAME)	BOY ... 1 GIRL ... 2	MONTH ... YEAR ... 19	YES ... 1 NO ... 2 → 224

[9] The exact wording of the question (Question 15.1) was “How many children, if any, has the woman ever given birth to? (live births). (Please include her children, who are not living with her and those who have died).”

Based on the additional questions in the DHS, and the answers to them, it seems likely that the DHS reports of children ever borne successfully exclude stillbirths. Assuming this to be the case, an estimate of the number of stillbirths returned as live births in the census can be derived by fitting polynomial curves to the proportion of dead children in each set of data, and subtracting, giving a smoothed estimate of the inclusion of stillbirths in the census. Figure 2.3 shows the curves fitted to the national population (i.e. all races). The difference between the two curves suggests that, on average, about 0.1 stillbirths per woman were reported as live births at older ages in the census.

However, the scale of this problem varies markedly by population group. While clear evidence exists of the inclusion of stillbirths among Coloured and African women, the data for Whites and Asians/Indians (although the sample sizes of these two groups in the DHS was small) reveal no discernible evidence of inclusion of stillbirths in the census vis-à-vis the DHS. Thus, the adjustment for stillbirths was not applied to these groups.

After generating the smoothed estimates of the inclusion of stillbirths by individual year of age, a correction was made to the reported mean children ever borne (CEB) by individual age, by subtracting the smoothed estimate from the reported CEB, and aggregating (using the weights in the census) into quinquennial groups. Estimated numbers of stillbirths included in the census for Africans and Coloureds (by age of mother) are shown in Table A4.

It was then necessary to adjust the El-Badry –corrected stillbirths (for African and Coloured women) to compensate for the inclusion of these stillbirths. A revised estimate of the number of women at each parity in each age group was derived by subtracting the estimated stillbirths from each parity and interpolating, assuming a constant inclusion of stillbirths across all parities. This adjustment, then, has the effect of further reducing the estimated mean children ever borne, as is shown in Table A4.

Table A4 Estimated number of stillbirths reported as live births in the census, and corrected estimates of mean children ever borne, African and Coloured women

	Africans			*Coloureds*		
Age	*Number*	*CEB El-Badry*	*CEB El-Badry + Stillbirth*	*Number*	*CEB El-Badry*	*CEB El-Badry + Stillbirth*
15-19	0.003	0.16	0.16	0	0.14	0.14
20-24	0.017	0.75	0.74	0.010	0.68	0.68
25-29	0.038	1.58	1.55	0.038	1.42	1.39
30-34	0.065	2.55	2.50	0.059	2.16	2.11
35-39	0.098	3.35	3.27	0.071	2.75	2.68
40-44	0.137	4.05	3.92	0.075	3.19	3.12
45-49	0.183	4.50	4.33	0.071	3.66	3.60

APPENDIX 3 CORRECTIONS TO THE CURRENT FERTILITY DATA IN THE CENSUS

Appendix 3.1 Corrections arising from the El-Badry and stillbirth adjustments

The first correction made to the current fertility data arises from the application of the El-Badry correction to the numbers of women of zero parity (and hence zero births in the last year), and is described in the last paragraph of Appendix 1.

Working only with the data where there was a numeric response to both fertility questions in the census, the reported numbers of women at each parity after application of the El-Badry correction (and correcting for the inclusion of stillbirths in the case of African and Coloured women) were then distributed across reported births in the last year in the same proportions as in the unadjusted data. From these, we were able to derive tabulations of births in the last year and children ever borne, by population group for each age group.

The stillbirths adjustment has a small effect on the estimated age-specific fertility rates for African and Coloured women. The estimated age-specific fertility rates for Asians and Whites remain unchanged, since the stillbirths adjustment was not applied, but are shown in Table A5 for completeness' sake.

Table A5 Age-specific fertility rates after correction for reporting stillbirths as live births, by population group

Age	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	0.036	0.037	0.009	0.009
20-24	0.085	0.091	0.055	0.052
25-29	0.105	0.111	0.101	0.099
30-34	0.118	0.090	0.081	0.078
35-39	0.106	0.063	0.046	0.044
40-44	0.091	0.048	0.034	0.033
45-49	0.076	0.034	0.033	0.031
TFR	3.08	2.37	1.80	1.73

Appendix 3.2 Correction for errors resulting from births in the last year being recorded as children ever borne

All women of parity two or greater who reported the same number of births in the last year as in their lifetime were treated as "not stated" births in the last year, since these responses are likely to have arisen either from misinterpretations of the two fertility questions or through errors in the cleaning of the data by Statistics South Africa. The effect of this adjustment is significant, for all population groups, and especially at older ages, as can be seen from Table A6.

Table A6 Percent reduction in estimated age-specific fertility rates after correcting for reporting of children ever borne as births in the last year, by and population group

Age	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	2.3	2.5	0.0	3.1
20-24	8.8	4.1	3.0	6.6
25-29	19.7	9.3	6.4	6.6
30-34	29.9	17.2	23.9	15.9
35-39	35.2	27.8	35.4	36.1
40-44	43.9	45.4	47.4	57.1
45-49	51.1	61.2	61.6	66.5

The effect of the adjustment on the estimated age-specific fertility rates is shown in Table A7.

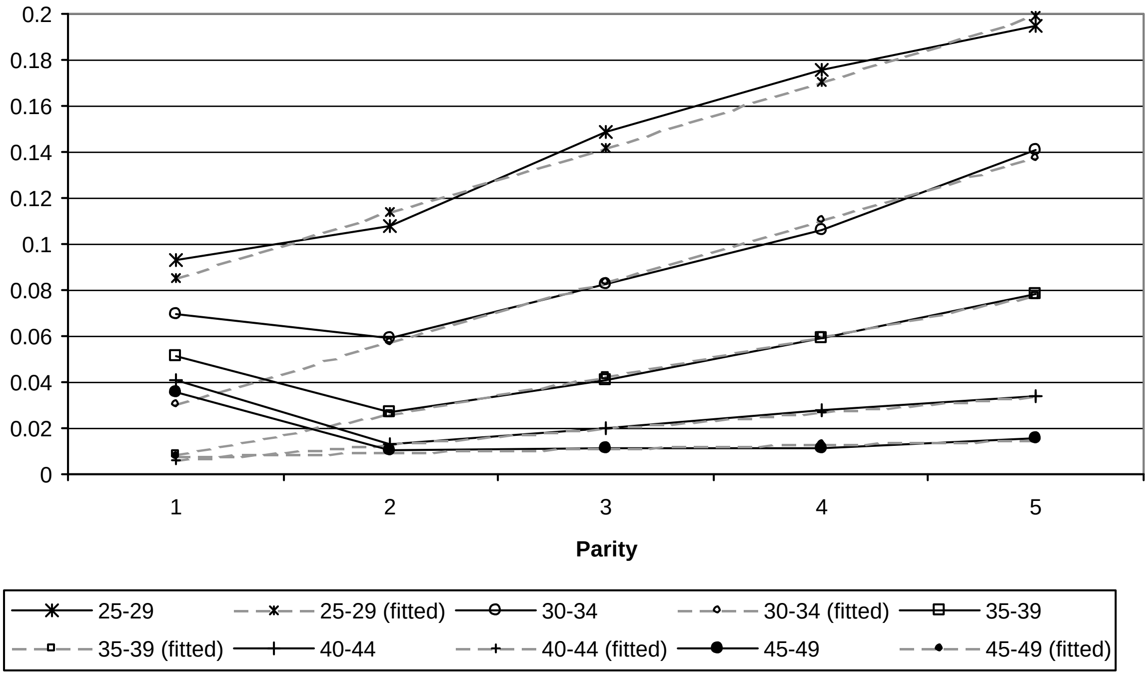
Table A7 Age-specific fertility rates after correcting for reporting of births in the last year as children ever borne, by population group

Age	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	0.035	0.036	0.009	0.009
20-24	0.078	0.087	0.053	0.048
25-29	0.084	0.100	0.094	0.092
30-34	0.083	0.074	0.062	0.065
35-39	0.069	0.045	0.030	0.028
40-44	0.051	0.026	0.018	0.014
45-49	0.037	0.013	0.013	0.011
TFR	2.18	1.91	1.39	1.34

Appendix 3.3 Correction for women of parity one reporting one birth in the last year

Further examination of the data showed that the proportion of women of parity one who reported a single birth in the 12 months prior to the census was also improbably high relative to women of other parities who reported a single birth in the same year. For women aged 25-29 and older, a clear linear trend by parity exists in the proportion of women having a birth in the 12 months prior to the census (Figure A2).

Figure A2 Actual, and estimated, proportions of South African women reporting a single birth in the 12 months prior to the census, by parity and age group



By extrapolating these trends in the age-group specific data, revised estimates of the numbers of women of parity one in each of these age groups who had a birth in 12 months before the census were derived. The excess number of births in the last year were assumed to represent women of parity one, but who had not given birth in the 12 months before the census.

Appendix 3.4 Pro-rating of women reporting more than one birth in the year before the census

It is impossible for women to have more than two maternities in any given 12 month period, and the DHS showed very low levels (around 1 percent) of multiple births in the 12 months before the survey. Accordingly, the census data were adjusted further by prorating all births in excess of one reported in the 12 months before the census to 0 and 1 births in the period. This reduces the estimated level of total fertility slightly further.

The estimated age-specific fertility rates resulting from the last two adjustments are shown in Table A8.

Table A8 Age-specific fertility rates after correcting for misreporting of recent births by older women of parity one, and after prorating births in the last year of more than one, by population group

Age	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	0.035	0.036	0.009	0.009
20-24	0.077	0.087	0.053	0.048
25-29	0.077	0.098	0.094	0.091
30-34	0.067	0.067	0.046	0.059
35-39	0.052	0.041	0.023	0.020
40-44	0.031	0.018	0.012	0.010
45-49	0.016	0.009	0.005	0.007
TFR	1.77	1.78	1.21	1.23

For all population group groups, once the data has been adjusted to allow for women who report impossibly large numbers of births in the last year and childless women who are coded as parity not stated, the estimated levels of total fertility are implausibly low. Thus, these data are affected by other reporting errors. Accordingly, two further adjustments were made to the data to produce reasonable estimates of South African fertility. First the Relational Gompertz model is used to correct the shape of the fertility distribution for African and Coloured women (Appendix 3.5), while second, a re-interpretation of the Brass P/F method, suggested by Feeney (1998) is applied to each population group separately to correct the estimated level of fertility (Appendix 3.7).

Appendix 3.5 Use of Relational Gompertz models

Relational Gompertz models provide a useful way of evaluating the extent of age reporting errors and underreporting of births in census and survey data, and for correcting distortions in the shape of the fertility distribution arising from these errors. The technique, developed by Zaba (1981), is a variant of the P/F method insofar as it uses reported lifetime fertility (i.e. parities) to adjust for biases in the reported current level of fertility (the age-specific fertility rates). However, the model relies on the applicability of a standard fertility distribution, which is inappropriate for use with the White and Asian populations. Hence the technique was not applied to them. Additionally, while the technique can correct for distortions in both the level and the shape of the fertility distribution, the correction of the fertility level requires the assumption that there has been no time trend in fertility. Thus, the model was used simply to correct the shape of the fertility distribution for African and Coloured women.

Age-specific fertility rates based on the adjusted census data (Table A8), and the estimated mean children ever borne by age group (adjusted using the El-Badry technique, and corrected for the inclusion of stillbirths, as shown in Table A4) were used as inputs into the model. It was fitted using the F-points only (since the intention is only to correct the shape of the fertility distribution) using data on the 15-19 through 35-39 age groups as evaluation of the data against the standard distribution revealed significant age reporting errors for women in their forties. The estimated age-specific fertility rates are shown in below, for all population group groups, although those for Whites and Asians remain unchanged from Table A8, and are shown solely for completeness' sake.

Table A9 Age-specific fertility rates after application of the Relational Gompertz model, by population group

Age	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	0.036	0.037	0.009	0.009
20-24	0.076	0.093	0.053	0.048
25-29	0.078	0.089	0.094	0.091
30-34	0.067	0.066	0.046	0.059
35-39	0.051	0.042	0.023	0.020
40-44	0.027	0.017	0.012	0.010
45-49	0.005	0.002	0.005	0.007
TFR	1.70	1.73	1.21	1.23

Appendix 3.6 Analysis of the effects of the adjustments applied to the census data

Table A10 shows the percent contribution that each of the adjustments discussed so far makes to the reduction in fertility by population group. It is immediately apparent that, for all population group groups, the two single biggest contributors to the reduction in the estimated total fertility are the adjustments arising in respect of women's lifetime fertility being enumerated as current fertility, and the El-Badry correction. For all groups, these two effects account for between 68 and 83 percent of the reduction in the level of total fertility from the unadjusted census data to the estimates presented in Table A9.

Table A10 Percent contribution to the reduction in estimated fertility of each of the adjustments to the census fertility data, by population group

Correction	*Africans*	*Coloureds*	*Asians*	*Whites*
Unadjusted total fertility	3.44	2.60	2.09	1.91
El-Badry correction	16.8	22.9	33.5	26.0
Stillbirths correction	3.6	4.0	N/A	N/A
Correction for births in the last year equal to children ever borne	51.8	51.9	45.7	57.2
Correction in respect of parity 1 women	5.3	6.8	12.2	12.5
Restriction to 1 birth in the last year	18.2	8.8	8.5	4.2
Gompertz model	4.2	5.7	N/A	N/A
Adjusted total fertility	1.70	1.73	1.21	1.23

Appendix 3.7 Adjustment of the level of fertility using Feeney's approach

While the shape of the adjusted fertility distributions for each population group are reasonable, the level of fertility implicit in the fertility rates presented in Table A9 is clearly not. One final adjustment was to the data to correct the level of fertility using a variant of the Brass P/F ratio method suggested by Feeney (1998).

The Brass P/F ratio method uses reported average parities, P(i) – derived from Table A4 – and the period fertility rate (Table A9) to calculate the P/F ratio, where F is the estimated parity equivalent (i.e. the parity that, according to a model schedule, is associated with the reported period fertility rate, after adjustment for the six month difference between age of mother at survey and age of mother at birth).

The values of the P/F ratio by population group and age group are shown in Table A11.

Table A11 P/F ratios, by population group

Age	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	2.06	1.71	2.99	2.65
20-24	1.87	1.50	1.94	1.83
25-29	1.96	1.51	1.97	1.62
30-34	2.17	1.62	2.09	1.68
35-39	2.27	1.72	2.15	1.78
40-44	2.40	1.85	2.25	1.86
45-49	2.56	2.09	2.31	1.90

The P/F ratios measure the difference between the reported parities, and the estimated parity equivalents based on reported current fertility, and it is not readily clear how to apply them when fertility is declining. Feeney (1998) argues that, under conditions of declining fertility, the optimal estimate of current fertility is obtained by multiplying the fertility schedule by the P/F ratio applicable at the mean age of childbearing. The latter is obtained by interpolation between the relevant values of Table A11. The scaling factors shown in Table A12 apply.

Table A12 Mean of the fertility schedule and Feeney's scaling factor, by population group

	Africans	*Coloureds*	*Asians/Indians*	*Whites*
Mean age of fertility schedule	28.8	27.6	28.6	28.9
Feeney's factor	2.05	1.53	2.02	1.65

Multiplying these (shifted) fertility schedules by the factors shown in Table A12, gives rise to the population group-specific age-specific fertility rates and total fertility shown in Table 3.2, which are applicable at the census date.

APPENDIX 4 CALCULATION OF FERTILITY RATES FROM THE DHS DATA

Fertility rates were calculated from the DHS data using the method suggested by Macro International. A general description of the approach is set out on the Macro International website (http://www.measuredhs.com/data/trouble.cfm#5), and a set of SPSS programmes (also available from the website: www.measuredhs.com/zip/frspss.zip) have been made available to users that automatically generates age-specific fertility rates from DHS data.

These SPSS files were downloaded, and the approach applied (using Stata) to the DHS data. Verification that the methodology was correctly applied was done by producing estimates of the 3-year age-specific fertility rates (based on age of mother at birth) for all South Africans and African South Africans in both SPSS (using the downloaded routines) and Stata, and checking that the results were the same.

Conveniently, the DHS data were collected about 18 months after the census, so the resultant fertility estimates from the DHS, and the (Brass P/F and Feeney-adjusted) census rates apply to the same time period, i.e. October 1996.

In general terms, the method of deriving the number of births in the three year period before the survey, using the child record file, is

a) generate a new variable, age of mother at birth, from the subtraction of the mothers date of birth (in CMC format, **V011**) from the child's date of birth (**B3**)

    agembm = B3 – V011.

b) group this variable into quinquennial groups, 1 through 7, corresponding to ages 15-19 through 45-49

    agemb5 = int(agembm/60) -2

c) to get 3-year age-specific fertility rates, select births in the last 36 months before the interview date (**V008**):

    0 < V008-B3 <= 36, where V008 is the date of interview

d) tabulate these by age of mother, ***agemb5***, to get the numbers of births to women in each age group, weighting by ***V005*** (divided by 1 000 000)

To calculate the women's exposure, using the women's record file:

a) Calculate the age of the woman, and her 5-year age group, such that 15-19 is coded as 3, 20-24 as 4 and so on:

    age= V008 –1 –V011
    age5 = int(age/60)

b) Calculate the exposure in months in the current age group (***higexp***), and exposure in previous age group (***lowexp***) during the 36 months before the survey:

higexp= min(age –(age5*60)+1,36)

lowexp=(36-higexp), if higexp<36

c) Generate two new weight variables to weight the exposure

hig_wt = higexp * V005/ 1 000 000

low_wt = lowexp * V005/ 1 000 000

d) Calculate exposure for the current age group by tabulating ***age5***, weighted by ***hig_wt*** , noting that group 3 refers to ages 15-19.

e) Do the same for the exposure in the previous age group, tabulating ***age5***, weighted by ***low_wt***, noting that group 4 now refers to ages 15-19 and that there is no exposure for the 45-49 age group.

f) Add the two measures of exposure referring to the same age group and divide by 12 to get the number of person-years exposed to risk in each age group.

Age-specific fertility rates (according to age of mother at time of birth) can then be calculated by dividing the number of births by the exposure for each age group.

APPENDIX 5 WEIGHTS USED IN THE CALCULATION OF NATIONAL AGE-SPECIFIC FERTILITY RATES

For the reasons set out in Section 3.3.2, suitable weights need to be derived in order to estimate the national age-specific fertility rates. Since the intention is to first calculate age-specific rates, and thence the Total Fertility Rate, the weights chosen for use with the census estimates were the racial distribution of women, by age group, excluding women whose population group was not stated (Table A13).

Table A13 Weights used in the estimation of national age-specific fertility rates from the 1996 census

Age	*Africans*	*Coloureds*	*Indians/Asians*	*Whites*
15-19	0.815	0.083	0.023	0.078
20-24	0.803	0.086	0.026	0.086
25-29	0.777	0.094	0.027	0.102
30-34	0.765	0.100	0.028	0.107
35-39	0.741	0.100	0.030	0.128
40-44	0.720	0.099	0.034	0.147
45-49	0.689	0.101	0.037	0.173

Note: Estimates in the table may not sum to 1 due to rounding error

In the case of the DHS, the weights chosen were not the racial distributions of the weighted sample of women interviewed, but the racial distribution (again by age group) of women's exposure to risk in the calculation of the age-specific fertility rates from the census (described in Appendix 4). The weights are shown in Table A14.

Table A14 Weights used in the estimation of national age-specific fertility rates from the DHS

Age	*Africans*	*Coloureds*	*Asians/Indians*	*Whites*
15-19	0.819	0.094	0.028	0.059
20-24	0.838	0.090	0.028	0.044
25-29	0.777	0.115	0.031	0.078
30-34	0.770	0.111	0.043	0.076
35-39	0.751	0.114	0.035	0.100
40-44	0.738	0.101	0.044	0.116
45-49	0.703	0.113	0.051	0.133