Assessing the reliability of the 1986 and 1996 Lesotho census data

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ABSTRACT

The present study attempts to assess the quality of reported age–sex distributions of Lesotho's 1986 and 1996 censuses using conventional demographic techniques. First, the data presented in single years are examined to identify patterns of digit preference and then Whipple's, Myers' and Bachi's indexes are computed in order to furnish a clear picture of the magnitude of deficiencies that might have occurred. The findings show that there is a tendency to prefer even numbers and avoid odd numbers in census enumeration in Lesotho. Also, the Whipple's index declined from 115 in 1986 to 106 in 1996, while the Myers' and Bachi's indexes respectively declined from 11 and 7 in 1986 to 9 and 6. These results suggest that there are deficiencies in the Lesotho data. A closer assessment of the data is undertaken by curtailing part of the erratic fluctuations in single year age distribution via grouping the data in quinary ages and applying the age–sex accuracy index. The index yields a value of 35 for the 1986 census and 32 for the 1996 census. The findings show that, though there are some distortions in the reported age–sex distributions of Lesotho, the data are fairly accurate and point to a modest improvement in quality over the decade.

Introduction

Demographic variables, like many social phenomena, are not easy to measure and control. This is mainly because of their continuous change and the statistical fluctuations arising from the unpredictability of human

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behaviour, together with the varied extraneous factors which may be physical, economic, social and cultural, that influence and often determine the levels, patterns and forms of demographic development and processes (Bachi 1951, Keyfitz and Flieger 1990, Swamy et al. 1992).

Furthermore, ease of measurement is hampered by the complex interrelationships among demographic variables that are also intricately related to other non-demographic factors. This situation normally complicates the difficulty with which planners and demographers are able to convince others of the importance of programmes aimed at achieving certain demographic targets. In addition, in the African context specifically there is the problem of the scarcity and quality of demographic data. Even with the recent progress in establishing and promoting survey programmes, notably under the World Fertility Survey and Demographic and Health Survey networks, gaps still remain (El-Attar 1998, Cleland 1996, Krotki 1978). Some countries have not had regular censuses and surveys; for example, Nigeria conducted a successful and acceptable national census only in 1991, a gap of 28 years after the officially-endorsed one of 1963 (National Population Commission 1998). Also the coverage of demographic variables during enumerations has not been entire and adequate and, more often than not, data collected in the African region have content as well as enumeration errors which mar their quality and reliability for planning purposes (Cleland 1996, Sembajwe 1990, Caldwell 1966).

One of the key questions that confront the social scientist using a particular data set for research is: what is the nature and magnitude of errors inherent in the data collected, with specific reference to the variables of interest? This question is consistent with the viewpoint of Spiegelman, who contends that one of the fundamental precautions that must be taken before embarking on the analysis and interpretation of demographic data is that "the quality of the observed data should be ascertained ...." (Spiegelman 1968:6). The thrust of this study is an attempt to answer this basic question with respect to the Kingdom of Lesotho, since the usefulness and reliability of demographic parameters derived from censuses depend on the quality of the data collected. Since age is critical to most demographic investigations, attention will

be focused primarily on the quality of age data. In this study, attention is primarily focused on the 1986 and 1996 censuses, chiefly because the data are available and recent and because they are comparable in terms of content and coverage.

Background information

Lesotho, formerly Basutoland, attained political independence from Britain in 1966. The country occupies an area of 30,355 square kilometres, of which less than one-fifth is arable (Kingdom of Lesotho 1966). It is landlocked and wholly enclosed by the Republic of South Africa. About two-thirds of Lesotho consists of rugged, mountainous terrain that is difficult to reach (Gill 1993, Kingdom of Lesotho 1966). The country is composed of ten administrative districts, with Maseru as the capital and 60 constituencies.

Although Lesotho is politically free, it is economically dependent on South Africa, perhaps due to historical, geographical and physical reasons. South Africa determines Lesotho's wages and prices, its interest rates and customs receipts and the exchange rate of its monetary unit, as well as controlling all trade and communication links between Lesotho and the rest of the world (Gill 1993, Johnston 1996).

Lesotho is divided into four major ecological zones, namely; the lowlands, the foothills, the mountains and the Senqu River Valley. It has also four distinct seasons: the spring planting season occurs between August and October; the summer months of November to January experience the heaviest rainfall; autumn extends from February to April and the winter months of May to July bring frost and sometimes much snow (Stevens 1967). The country is relatively homogenous in terms of linguistic and cultural affiliation. Sesotho is the national language, while English language is the medium of instruction in tertiary institutions and it is used in government and business transactions.

Available records indicate that Lesotho has a long history of census-taking that dates back to 1875 when a *de facto* population of 128,000 persons were counted (Kingdom of Lesotho 1976, 1987). This was followed by the 1891 census that recorded a population of 219,000. It is remarkable that in the twentieth century, ten population censuses have

been conducted in Lesotho. Apart from the censuses of 1904, 1911 and 1921, the country has consistently held decennial censuses from 1936 to date (Ministry of Economic Planning 1996).

The population of Lesotho increased from 852,000 in 1966 to 1,064,000 in 1976 and then to 1,447,000 in 1986 and 1,880,146 in 1996. The country's population has been estimated to be 2.2 million in 2000 and is projected to be 3.2 million by 2020 (United Nations 1999). Thus, in terms of both density and size, Lesotho is small. However, the population growth rate has not been small. The intercensal (exponential) growth rates for the periods 1956–1966, 1966–1976, 1976–1986 and 1986–1996 have been respectively 2.9 per cent, 2.2 per cent, 3.1 per cent and 2.6 per cent.

World Bank (2000) estimates suggest that life expectancy at birth is 55 years for Lesotho, while the infant mortality rate is 93 deaths per 1,000 live births, which is slightly higher than the regional average of 92 deaths per 1,000 live births. About 49 per cent of the population live below the national poverty line, while the gross national product per capita is currently US$560. Only 25 per cent of the population of Lesotho live in urban areas (United Nations 1998a, Sembajwe 1985). Only about 17 per cent of the population aged 15 years and over are illiterate, as compared with 39 per cent for sub Saharan Africa (World Bank 2000). It is remarkable that in Lesotho both literacy and educational levels are higher for women than men. This is because more uneducated adult men migrate to South Africa to work as unskilled labourers in the country's diamond mines (Sembajwe and Makatsjane 1992). Furthermore, the predominantly rural cattle-rearers are composed of more males than females.

Data and methods

The data for this study are from the two most recent censuses of Lesotho. These are the 1986 and 1996 census data files that are archived by the African Census Analysis Project (ACAP) of the Population Studies Center of the University of Pennsylvania. One of the principal ways of identifying errors in age data is to examine the single year age distributions. In this regard, the single year age distributions of the two

censuses will be represented graphically to see whether they conform to standard. In addition, three conventional indices of appraising single year age data, namely, the Whipple's index; the Myers' blended index and the Bachi's index, will be applied to the two census data sets (Shryock and Siegel 1976, Bachi 1951, Myers 1940). The Whipple's index is used to measure age preferences for digits ending in 0 and 5 as compared with other digits. According to the scheme for estimating the reliability of the data, the index varies between a minimum of 100, indicating no concentration at all at digits 0 and 5 and a maximum of 500, if only digits 0 and 5 were selected. Between these extreme values, the data quality is regarded as highly accurate if the Whipple's index is less than 105; fairly accurate if the index lies between 105 and 109.9; approximate if it falls between 110 and 124.9; rough if it is located in the range of 125–174.9 and, finally, very rough if the index is 175 or more.

The Myers' blended index is the most widely used test of age accuracy for single year distributions. This is because it helps to identify whether there is a preference for ages ending in certain digits over others in the census enumeration. The index shows the preference for, or avoidance of , each of the ten digits between 0 and 9 inclusive. One could take the successive sums of numbers which end in each of these digits to determine preferences. However, this is not appropriate since, with advancing terminal digits of age, the sum would tend to increase. The Myers' index circumvents this problem by blending the population in such a way that each digit has almost an equal sum. The blended totals for each of the ten digits are expected to be nearly 10 per cent of the grand total. The extent, therefore, of the over-selection or avoidance of a particular digit shows up in the deviation from 10 per cent of the proportion of the total population reporting on the given digit. The deviations of each sum from 10 per cent of the grand total are added together, ignoring the signs. Their sum is the Myers' index. A summary index of preference for all terminal digits is derived as one-half of the sum of deviations from 10 per cent. The index is 0 where all terminal digits are equally chosen and 90 where a single terminal digit is chosen by everyone.

The Bachi's index is another technique that is used to test accuracy in the reported single year–age data. This procedure is similar to the Myers' approach. But whereas the Myers' index is based on the sum of the absolute deviations of the values, the Bachi's index is based on the sum of the positive deviations only.

In assessing the accuracy of reporting by sex and five-year age groups, the age ratio score, the sex ratio score and the United Nations age–sex accuracy index will be used (United Nations 1952, Shryock and Siegel 1976). The United Nations joint score or the age–sex accuracy index quantifies the accuracy of the overall age–sex data when the data are arranged in five-year age groups. It uses both age and sex ratios to identify deviations from what might be expected. The index does not only identify digital preferences, but it is also sensitive to the omission of changes in the vital rates (Arriaga et al. 1994). The index is computed by simply adding the sum of the male age ratio score and the female age ratio score to three times the sex ratio score. In defining criteria for data quality, the United Nations (1983) stipulates that if the index is under 20, then data are accurate; if the index lies between 20 and 40, then data are inaccurate; and if the index is above 40, then the data are highly inaccurate.

Results

Patterns of digit preference

Evidence of distortions in reported census data is clearly shown when single year age distributions are considered. Table I indicates patterns of digit preference as derived from the 1986 and 1996 censuses of Lesotho. The table shows that in the 1986 enumeration exercise, digit 0 was most preferred by both males and females, followed by digits 8, 6 and 2, in that order. On the other hand, there was a relatively strong avoidance of digit 1, followed by digits 9, 7 and 3, in that order. In other words, there was a tendency for preference of even numbers and avoidance of odd numbers in the 1986 census of Lesotho. However, in 1996, while digit 6 was the most preferred by males, females preferred digit 0 more than any other digit. For both sexes, digit 0 was most preferred, followed closely by digit 6, while the most avoided digits

Table 1: Patterns of digit preference, Myers', Bachi's and Whipple's indexes by sex for Lesotho, 1986 and 1996 censuses

Terminal digit	1986 census			1996 census		
	Male	Female	Both	Male	Female	Both sexes
0	2.1 (3.0)	2.2 (3.1)	2.2 (3.0)	1.0 (1.5)	1.4 (1.9)	1.2 (1.7)
1	-1.9 (-2.8)	-1.8 (-2.8)	-1.8 (-2.8)	-1.0 (-1.6)	-1.1(-1.8)	-1.1 (-1.7)
2	0.6 (0.4)	0.8 (0.8)	0.7 (0.6)	0.6 (1.1)	0.9 (1.6)	0.8 (1.4)
3	-0.7 (-0.8)	-0.5 (-0.5)	-0.6 (-0.6)	-0.7 (-0.7)	-0.7(-0.6)	-0.7 (-0.6)
4	0.2 (0.3)	0.3 (0.4)	0.2 (0.3)	0.4 (0.9)	0.4 (1.0)	0.4 (0.9)
5	0.3 (0.3)	0.3 (0.3)	0.3 (0.3)	-0.1 (-0.3)	-0.3(-0.5)	-0.2 (-0.4)
6	1.1 (1.2)	0.9 (1.0)	1.0 (1.1)	1.3 (2.0)	1.0 (1.4)	1.1 (1.7)
7	-1.4 (-1.2)	-1.5 (-1.2)	-1.4 (-1.2)	-1.4 (-1.8)	-1.3(-1.6)	-1.4 (-1.7)
8	1.2 (1.5)	1.1 (1.3)	1.2 (1.4)	0.9 (0.9)	1.1 (1.0)	1.0 (1.0)
9	-1.5 (-1.6)	-1.8 (-2.1)	-1.7 (-1.9)	-0.9 (-1.3)	-1.4(-1.8)	-1.2 (-1.6)
Myers' index	10.9	11.3	11.1	8.5	9.7	9.1
Bachi's index	6.5	6.8	6.7	6.1	6.6	6.3
Whipple's index	115	115	115	105	107	106

SOURCE: COMPUTED FROM THE 1986 AND 1996 CENSUS DATA FILES OF LESOTHO.

NOTES

1. A positive sign indicates preference of and a negative sign, avoidance of the digit
2. Figures in parentheses are results from Bachi method
3. Myers' index is based on the sum of the absolute values of the deviations; Bachi's index on the sum of the positive deviations; Whipple's index on the ages 23–62

were 7, 9 and 1, in that order. On the whole, the patterns of digit preference have remained largely the same over the decade. More importantly, the magnitude of digit preference and avoidance in Lesotho is very small by African standards and highly commendable.

Further proof of this low digit preference is shown by the computation of the evaluative indices employed in the study as revealed by Table I. Myers' index declined from 11 in 1986 to 9 in 1996, while Bachi's index fell very mildly from 7 to 6 over the decade. Similarly, the Whipple's index reduced from 115 in 1986 to 106 in 1996. Going by the assessment criteria highlighted in the preceding discussion, these findings reveal that there are deficiencies in the Lesotho data. However, the extent of age misreporting by sex in Lesotho censuses is not very substantial. This is a direct contrast to what obtains in many African populations. For example, an assessment of the most recent census age–sex distribution of Africa's most populous country, Nigeria, showed that the Myers', Bachi's and Whipple's indexes for the nation were respectively 62, 41 and 293 (National Population Commission 1998). The quality of the data has also improved over the decade.

Sex ratios

Table II presents the reported age and sex distributions, as well as the sex ratios derivable from the 1986 and 1996 censuses of Lesotho. Lesotho's age structure is characteristic of a young population and is typical of a developing country. However, variations in sex ratios (or the number of males per 100 females) provide an opportunity for assessing the extent of age misreporting in a population by five-year age groups. Under normal circumstances, it is a valid expectation in all populations to have a slightly higher number of males at young ages and a consistently greater number of females at older ages since females live longer than males (United Nations 1973, Bicego and Ahmad 1996). The table, however, indicates fluctuating sex ratios in both the 1986 and 1996 censuses. The sex ratio at birth has virtually remained at 101 over the decade. But to get a sex ratio of 102 at the age group 35–39 and sex ratio of 105 at the age group 45–49, whereas the intervening and preceding age groups have lower sex ratios in 1986 is an abnormality that point to errors in the age data. Similarly, to have sex ratio of 103 at the 45–49 age group in 1996 while the preceding age groups have lower sex ratios is indicative of data deficiency. In general, the two censuses reveal that there are significantly more females than males in the country.

Table II: Age and sex distributions and sex ratios from the 1986 and 1996 censuses of Lesotho

Age group	1986			1996		
	Male	Female	Sex ratio	Male	Female	Sex ratio
0–4	118388	116798	101.4	106765	105084	101.6
5–9	115187	114745	100.4	124466	121683	102.1
10–14	105775	106271	99.5	133533	131101	101.9
15–19	82973	89155	93.1	115843	121354	95.5
20–24	69450	82185	84.5	86977	97735	89.0
25–29	56551	64032	88.3	64195	69323	92.6
30–34	48036	51347	93.6	56015	61863	90.5
35–39	40590	39748	102.1	47004	51419	91.4
40–44	33373	33690	99.1	40166	42785	93.9
45–49	30681	29147	105.3	34681	33845	102.5
50–54	29851	31990	93.3	27101	28779	94.2
55–59	19814	20677	95.8	22165	23001	96.4
60–64	15666	17795	88.0	21169	26686	79.3
65–69	15168	18393	82.5	12041	15482	77.8
70–74	8221	11801	69.7	8699	12938	67.2
75+	11054	22216	49.8	12367	23681	52.2
All Ages	800778	849990	94.2	913187	966959	94.4

SOURCE: COMPUTED FROM THE 1986 AND 1996 CENSUS DATA FILES OF LESOTHO

NOTE: Overall, 0.14 per cent in 1986 and 3.60 per cent in 1996 of the population did not report their ages. In order to be consistent with the total population size, this proportion was distributed evenly (by prorating) across the various age groups on the assumption that equal number of "not reported" cases was found in each age group. Sex ratios are expressed as male per 100 female.

The overall sex ratio in Lesotho is 94, which is lower than the model sex ratio range of 100–107 for Africa (United Nations 1983).

The persistence of such a low sex ratio over the decade may be attributed to a number of inter-related factors. These include under-

reporting of females; high male emigration and a low sex ratio at birth, modified progressively by high male mortality at subsequent ages. In particular, as highlighted in the background information, Lesotho is completely surrounded by South Africa and, as a result the migration of able-bodied men within the economically productive age category to South Africa is common. Therefore, some increase in the sex ratios might be expected at older ages (from age 45 and above) if males migrate back to Lesotho after having worked in South Africa for some time.

Age ratios and age accuracy indexes

Age ratio is computed in this study as the percentage of the population in a given five-year age group to the average of the preceding and following age groups (Shryock and Siegel 1976). According to the scheme of evaluation 100 is the point of balance; age ratios higher than 100 indicate an over-enumeration of the particular age group, while an age group is deemed under-enumerated if its age ratio goes below 100. The results presented in the first panel of Table III show that there are distortions in the reported census data of Lesotho. In 1986 over-enumeration took place at the 5–9, 10–14, 50–54 and 65–69 age groups for both males and females, while the other age groups were under-enumerated. In 1996, the age groups 5–9, 10–14, 15–19, 30–34, 45–49 and 60–64 were over-enumerated, while the other age groups were under-enumerated in case of males, At the same time, the age groups 5–9, 10–14, 15–19, 20–24, 30–34, 40–44, 50–54 and 60–64 were over-enumerated with respect to females. In all, the largest over-enumeration occurred at age group 65–69 for males and 50–54 for females in 1986, while the greatest under-enumeration was found in age group 55–59 for both sexes.

Similarly, in 1996, the highest over-enumeration occurred at age group 60–64 for both sexes, while the largest under-enumeration was found at age group 65–69 for both sexes. These findings reveal that the elderly persons in Lesotho are more likely to state their ages incorrectly than the younger ones, which, no doubt, is linked to poor levels of educational attainment on the part of the older population.

Table III: Age ratios and age-sex accuracy indexes for Lesotho, 1986 and 1996

Age group	1986 Male	Female	1996 Male	Female
0-4	NA	NA	NA	NA
5-9	102.8	102.9	103.6	103.2
10-14	106.8	104.2	111.1	107.8
15-19	94.7	94.6	105.1	106.1
20-24	99.6	107.3	96.6	102.5
25-29	96.3	95.9	89.8	86.9
30-34	98.9	99.0	100.7	102.5
35-39	99.7	93.5	97.7	98.3
40-44	93.7	97.8	98.3	100.4
45-49	97.1	88.8	103.1	94.6
50-54	118.2	128.4	95.3	101.3
55-59	87.1	83.1	91.8	82.9
60-64	89.6	91.1	123.8	138.7
65-69	127.0	124.3	80.6	78.1
70-74	NA	NA	NA	NA

1986 Age ratio score for males = 7.6; for females = 9.5
1986 Sex ratio score = 6.0; 1986 Age-sex accuracy index = 35.1
1996 Age ratio score for males = 7.5; for females = 9.3
1996 Sex ratio score = 5.1; 1996 Age-sex accuracy index = 32.0

SOURCE: Computed from the Lesotho 1986 and 1996 census data files.
NOTE: NA= not applicable.

The results displayed in the second panel of Table III show that there has been a modest improvement in the age–sex accuracy index of Lesotho during the study period (from 35 in 1986 to 32 in 1996). Judging by the scheme of assessment of data quality, however, the values indicate that the Lesotho data are not accurate. But both the 1986 and 1996 values are significantly lower than what is found in many African populations. For instance, the age–sex accuracy index from the 1991

census of Nigeria yielded a value of 81 (National Population Commission 1998).The corresponding value for the 1983 census of the Gambia was 85 (Makannah 1990). On the other hand, the 1984 census of Tunisia, the 1981 census of Botswana and the 1979 census of Kenya yielded the age–sex accuracy indexes of 25, 26 and 26, respectively (Makannah 1990), indicating that the quality of these data is good, just as that of Lesotho. In fact, in a more recent assessment of the 1991 census of Batswana, Udjo (1994) argues that the data are good and concludes that the estimates of levels and trends in childhood mortality derived from the 1991 census appear to be plausible.

Discussion and policy issues

In general, demographic data derivable from age distributions are known to have various kinds of errors that ultimately affect the derived estimates. The most salient of these errors includes misreporting of the dates of birth, or incorrect reporting of the ages of the respondents. The present study seems to suggest that the reported age–sex distributions of Lesotho's population are fraught with distortions. Unfortunately, the true extent and degree of these biases cannot be readily determined because of complexities in the patterns of these errors. If women, for example, misreported their ages but reported their fertility experiences accurately, the estimated fertility rates and implied trends in fertility will definitely be biased in some way.

If, in addition to age misstatement, children ever born were underreported or if births were not accurately declared, this will result in the confounding of the biases of the fertility estimates. These assessment situations could not be addressed in the present study. However, within the limits of the evaluative tools employed here, it can be argued that the magnitude of the reported distortions is not significant enough to warrant the invalidation of demographic estimates based on the two data sets of Lesotho. In fact, going by African standards, the quality of Lesotho's census data is high and it has improved with the passage of time. Moreover, the fact that the results from both censuses are similar is also a major consistency check and heightens confidence in the reported age-sex distributions of Lesotho.

A major contributory factor to the good quality data from Lesotho is the influence of education. The latest available empirical evidence indicates that, as at 1995, the adult female literacy rate is 92 per cent (which is high by world standards), the adult male literacy rate is 69 per cent and overall net primary school enrolment for both sexes is 71 per cent (World Bank, 2000). Because females are more educated than males, they are more likely than males to report their ages accurately. Furthermore, the present analysis has shown that the older people are more likely to specify their ages incorrectly than the younger ones, a condition that has a direct correlation with low levels of education. The government should, therefore, do more to encourage more educational attainment, especially for males.

The impact of migration could not be addressed in this study due to data availability constraints. It is conceded that migration, as a major component of population change, could play a significant role in the reported sex–age distributions of Lesotho since available evidence shows that there is pronounced out migration of Lesotho indigenes, particularly adult males, to neighbouring countries, especially South Africa, in search of employment opportunities (Gill 1993, Sembajwe and Makatsjane 1992). However, it is doubtful that the volume of emigration is the sole contributory factor resulting in the low sex ratios at all ages in both censuses. This is because the present analysis has revealed that there are considerable low sex ratios at almost all ages in Lesotho.

On the other hand, if male emigration is negligible, then a low overall sex ratio is a product of female under-reporting and/or a low sex ratio at birth, modified progressively by high male mortality at all ages since, in all human populations, the force of mortality is generally higher for males than females (United Nations 1998b, 1991). It should be stated that in Lesotho and in other countries of Africa, civil registration and vital statistics systems are still developing (Obonyo and Bauni 1999, Sembajwe 1990, Moriyama 1982). As a result, it is impossible to determine the true age distribution of Lesotho without verifiable birth certificates, even when migration is taken into account.

Thus, it is suggested that the government of Lesotho should pay more attention to the issue of registration of births and deaths (the vital

registration system). This is because the records produced by this registration process serve two crucial purposes. In the first instance, the individual records establish a person's civil status and the facts on which it is based. Proof of these facts such as age, place of birth or death, circumstances of death and so on, are essential documents required for many official purposes in the society in which a person lives or has lived. Secondly, the information on the registration records collectively form the data for vital statistics which are the computed indices of fertility, mortality and migration, among others, showing changes in population size and composition and important features regarding the health of a population. Above all, they furnish an empirical platform on which decennial census results can be matched and assessed.

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