Sex ratios at birth in populations of Eastern and Southern Africa

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Abstract
Sex ratios at birth vary across populations and over time. The study reviews evidence of very low sex ratios in Bantu populations using demographic survey data and vital registration data from Eastern and Southern Africa. Results based on a large number of births from 17 countries indicate that on average Bantu populations tend to have slightly more female births than male births (sex ratio = 0.989), contrary to populations of West Africa and to other populations in the world where more male births occur than female births.

Sir,
Sex ratios at birth, or the ratio of the number of male births to that of female births, have fascinated scholars for several centuries. John Graunt already noted that in London over the 1628–1662 period about 14 boys were born for 13 girls (SR= 1.07), and Süssmilch devoted a full chapter (§ 409) of his book the "Die Göttliche Ordnung" to sex ratios at births, where he first established the average of about 1.05 for European populations.

The more data were coming from outside Europe, the more complex became the picture of sex ratios at births. Classic studies conducted in the United States showed that populations from African and Indian descent had lower sex ratios (1.03 and 1.02 respectively), whereas populations from Asian descent had higher sex ratios (1.07 to 1.08). World record high sex ratios (1.13) were found in Korea, for the 1921–1929 period, based on more than 5 million births (Ciocco 1938; Visaria 1967).

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For African populations, an average sex ratio of 1.03 was assumed to be constant, since it was found in several places of West Africa and Madagascar and similar to that of African-Americans in the USA or in the United Kingdom (Visaria 1967; James 1984). However, recent data have shown a range of variations, with much higher values in Nigeria: 1.043 (95 per cent CI= 1.035–1.051) among the Igbos (Egwuatu 1984), and 1.071 (95 per cent CI= 1.067–1.075) among the Hausas in 1961–1980 (Rehan 1982). On the contrary, lower values have been reported for Eastern and Southern Africa, and often thought to be due to defective data or to discrimination against boys (Clark *et al*. 1995). We report here on various values of the sex ratio in Eastern and Southern Africa, and argue that populations in this area have much lower sex ratios than usually assumed.

First, we considered data from maternity histories collected in demographic sample surveys, part of the World Fertility Survey programme (WFS) and of the Demographic and Health Survey programme (DHS). Where several surveys had been conducted in the same country, birth histories were added up. Second, we considered other demographic sample surveys conducted in francophone Africa in the 1960s and 1970s for which the detail of births by sex was published, including an old analysis conducted in three countries of French Equatorial Africa in 1951–1954 (Central African Republic, Congo, Gabon), and the data from three October Household Surveys conducted in South Africa in 1995, 1997 and 1998. Third, we considered vital registration data published in the United Nations Demographic yearbooks since 1950. Last, we added the data of two prospective demographic studies conducted in Zambia (Tonga), and in South Africa (Agincourt).

Results clearly show that sex ratios in Eastern and Southern Africa are lower than the assumed value of 1.03 for African populations (Table 1). The unweighted average was 0.990, and the weighted average 0.966 due to the large size of the Angolan sample. About half the 21 data sets studied were slightly above 1.00, and the other half below 1.00, six of which being significantly lower than 1.00, the lowest values being found in Rwanda, Angola and Zambia. A log-normal distribution was fitted on this distribution of sex ratios with the expected standard error of 0.01285 computed from the sample size of the various samples: the mean value of the distribution was 1.0007, which can be taken as the underlying value of the sex ratio in these populations. If one excludes the two low outliers from Zambia (1956–1991) and Rwanda (1965–1967) and the high outlier from the South African DHS (1998) then the observed distribution is not statistically different from the expected log-normal distribution (Chi-square = 3.79; p = 0.803), which shows the homogeneity of these populations with respect to the sex ratio at birth. The case of the South Africa 1998 DHS remains puzzling and would require further investigation. The sex ratio for all births reported in the birth histories was 1.049, and the distribution of the sex ratios for birth cohorts grouped by two years (about 2000 deaths in each group) was consistent with a normal distribution. However, the sex ratio in the 15 most recent cohorts (1984–1998) was much lower (1.023), which might suggest some under-reporting of female births in the earlier cohorts.

It would be difficult to imagine that these different data sets, from different origin, collected with different methodologies, all have the same systematic bias. Furthermore, if compared with other populations, poor data quality in these areas would imply systematic under-reporting of male births, which has never been documented in Africa. A trend analysis was performed to investigate whether sex ratios had tended to diminish over time, and results showed no slope (p = 0.700), that is, no evidence of change over time.

Further comparison was performed with the 1996 census conducted in South Africa, by projecting backwards the enumerated population to their birth. The sex-ratio of the African population under age 12 was 0.991 at time of census. Older cohorts could not be used because of the many biases associated with sex-selective migration, and possibly with sex selective errors on age at time of puberty. The first 12 surviving birth cohorts were projected backwards, using age and sex-specific survival rates derived from the 1998 DHS survey conducted in South Africa. The average sex ratio of survival rates was 0.985, and the implied sex ratio of birth cohorts was therefore 1.0062 (95 per cent CI = 1.0049–1.0075), again consistent with our previous estimates. All the yearly birth cohorts reconstructed from the census were also consistent with a low sex ratio, and the distribution of the sex ratios in these 12 cohorts was not significantly different (p = 0.354) from a normal distribution with mean of 1.006 and standard error of 0.005. This demonstrates that census data for recent birth cohorts are compatible with low sex ratio at birth for the black population of South Africa.

Populations from Eastern and Southern Africa, are in majority from Bantu origin, as indicated by their Bantu family language, although some ethnic groups are clearly not, such as populations of Northern Uganda and Northern

Kenya, the Tutsis and Twas in Rwanda and Burundi, the pygmies from the Congo, and the Bushmen in Southern Africa. However, these later groups account for only a small proportion of the total country populations. It seems therefore that Bantu populations of Eastern and Southern Africa have much lower sex ratios than other populations from West Africa, where DHS data sets reveal a much higher sex ratio (1.04 on the average), not counting the case of Nigeria and Ethiopia which had even higher values (1.09). The average value of 1.03 often taken for sub-Saharan Africa appears therefore as a mean of several subgroups, some with much lower sex ratios (1.00 or below), and others with much higher sex ratios. African populations appear as heterogeneous with respect to sex ratio at birth, as they are with respect to mean height and to body composition.

Since the prime determinant of the value of sex ratios seems to be genetic, the data suggest a biological origin to the low sex ratio of Bantu populations in Eastern and Southern Africa. Theoretical modelling developed by Kumm *et al*. (1994) showed that in the absence of sex differences in mortality, long term evolution leads toward a balanced sex ratio at birth and a balanced sex ratio in adult ages. This suggests that populations from Eastern and Southern Africa have evolved in an epidemiological environment where chances of surviving to adulthood were the same for men and women. Furthermore, it remains possible that sub-populations, such as those of Angola and Zambia might have evolved in situations of slightly higher female mortality, which led to even lower sex ratios in the long term.

Johann Süssmilch (1707–1767) considered the fact that 21 boys were born for 20 girls an illustration of the 'divine order', which produced approximately an equal number of marriage candidates, and therefore made impossible polygyny and polyandry and justified the Christian law of monogamy. Of course, at that time he had no data from Africa south of the Equator, where as many girls as boys are born, or even slightly more, and therefore more girls could potentially reach adulthood. However, different sex ratios at birth did not hamper neither polygyny (frequent in Africa) nor polyandry (such as in the Congo), and did not deter people from becoming Christian either.

Table 1 Sex ratios at birth in Eastern and Southern Africa

Source	*Country*	*Period*	*Number of births*	*Sex ratio at birth*	*95 per cent CI Min–Max*
WFS/DHS surveys					
	Botswana	1952–1988	10 670	0.981	0.944–1.019
	Kenya	1940–1998	102 805	1.013	1.001–1.026
	Lesotho	1943–1997	11 516	1.016	0.979–1.026
	Malawi	1954–1992	16 330	1.009	0.978–1.040
	Mozambique	1960–1997	25 752	1.010	0.985–1.035
	Namibia	1957–1992	13 372	0.985	0.952–1.019
	Rwanda	1946–1992	38 024	1.008	0.988–1.028
	South Africa	1961–1998	24 890	1.049	1.023–1.075
	Tanzania	1953–1996	54 033	1.029	1.012–1.047
	Uganda	1952–1995	38 826	0.988	0.969–1.008
	Zambia	1954–1996	46 921	0.997	0.979–1.015
	Zimbabwe	1950–1994	43 366	1.026	1.007–1.045
Other surveys					
	South Africa (OHS)	1956–1998	235 063	0.995	0.997–1.003
	Cameroon (West)	1960–1965	51 201	0.975	0.959–0.992
	Central African Republic	1959–1960	48 830	1.011	0.993–1.029
	Congo (Brazza)	1960–1961	24 595	1.009	0.984–1.035
	Congo (Zaire)	1955–1957	58 000	0.978	0.962–0.994
	French Equatorial Africa	1951–1954	40 151	1.010	0.991–1.030
Vital registration					
	Angola	1955–1970	1 756 666	0.943	0.940–0.946
	Kenya	1965–1973	1 135 882	0.991	0.987–0.995
	Rwanda	1965–1967	215 871	0.881	0.874–0.888
Demographic Surveillance Systems					
	Agincourt, South Africa	1992–2000	14 058	0.997	0.964–1.030
	Tonga, Zambia	1956–1991	5 058	0.924	0.874–0.976
	Mean (fitted with a log-normal model)			1.000	

Sources: WFS/DHS original data sets, INSEE sample surveys, United Nations Demographic Yearbook, Clark *et al*. (1995), unpublished results from the Agincourt DSS, October Household Surveys original data.

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