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**Maternal mortality in South Africa:
An update from the 2007 Community Survey**

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Abstract

The 2007 Community Survey conducted in South Africa included questions on maternal deaths in the previous 12 months (pregnancy-related deaths). The Maternal Mortality Ratio (MMR) was estimated at 700 per 100,000 live births, some 30% more than at the 2001 census. This high level occurred despite a low proportion of maternal deaths (4.3%) among deaths of women aged 15-49 years, which was even lower than the proportion of time spent in the maternal risk period (7.6%). The high level of MMR was due to the astonishingly high level of adult mortality, which increased by 46% since 2001. The main reasons for these excessive levels were HIV/AIDS and external causes of death (accidents and violence). Differentials in MMR were very marked, and similar to those found in 2001 with respect to urban residence, race, province, education, income, and wealth. Provincial levels of MMR correlated primarily with HIV/AIDS prevalence. Maternal mortality defined as 'pregnancy-related death' appears no longer as a proper indicator of 'safe motherhood' in this situation.

Key Words: Maternal Mortality; Pregnancy-related deaths; Case definition; Census; Socio-economic correlate; South Africa

Introduction

Some time ago, we completed an analysis of maternal mortality in South Africa using the 2001 census microdata available from IPUMS-International [Garenne et al., 2008; Minnesota Population Center, 2009]. The paper discussed the relevance of the demographic definition of maternal mortality (pregnancy-related deaths) in the context of a severe HIV/AIDS epidemic. The main findings were that the level of maternal mortality was much higher than previously estimated in South Africa, and that its relationship with obstetric care became very weak. Indeed, maternal mortality counted as any death during the maternal risk period (pregnancy, delivery, six weeks post-partum) included many deaths which were most likely due to chronic infectious diseases (HIV/AIDS and PTB) or to external causes (accident and violence), and had little to do with obstetric causes of death (medical definition of maternal mortality). This study also revealed very marked gradients of maternal mortality by area of residence, province, population group (race), education, income and wealth. At the provincial level, maternal mortality was primarily correlated with the prevalence of HIV/AIDS and with the proportion of external causes, and less with development indicators (income, wealth, urbanization). Surprisingly, the correlation with the proportion of home deliveries was negative. In this context, the “pregnancy-related death” case definition lacked specificity, and appeared misleading.

We repeated the analysis of maternal mortality using the 2007 Community Survey microdata also available from IPUMS-International. This survey included similar questions on maternal deaths and on external deaths in the past 12 months. This paper presents the new findings, and compares them with the findings from the 2001 census microdata. Here, we do not focus as much on case definitions and on the reliability of the estimates, but rather on the similarities with - and changes since - the 2001 census. Note that our estimates are not official estimates, and readers should refer to Statistics South Africa (Stat-SA) and to estimates made at CARE (University of Cape Town) for final values of mortality indicators.

Data and Methods

The 2007 Community Survey was a large scale demographic survey conducted in South Africa, from February 7 to March 7, 2007, by Statistics South Africa. It used a questionnaire similar to a census questionnaire, and was designed to substitute for the census

that had been scheduled to be conducted five years after the 2001 census. The sample size was very large, and corresponded to a 1 per 43 sample of a full census. Its methodology is described in detail in other documents [Stats SA, 2007]. In brief, a large nationally representative sample of households was drawn in two stages: enumeration areas (stratified by type of municipality) updated from the 2001 census, and dwelling units, also drawn from updated lists. Some 21.5% of enumeration areas and 10.9% of dwellings were selected, each dwelling having equal chances of being selected. Almost all enumeration areas were visited, and non-response rate among selected households was small (6.1%). The complete sample of both integrated and non-harmonized variables is available free of charge from the IPUMS-International website.

The questionnaire used for the 2007 Community Survey was very similar to that of the 2001 Census. In addition to classic census questions on individuals and housing, it included questions on past fertility and mortality. The fertility module focused on women aged 12-50 years, and included cohort fertility (children living in the household, children living elsewhere, and children who died, by sex), and questions on the last birth (date of last birth, sex of last birth, survival of last birth). The fertility module started with a question on whether the woman ever had a live birth, to avoid problems in coding infertile women as happened in previous censuses. The mortality module included questions on survival of mother and father, and a question on deaths in the past 12 months in the household, with date of death (month and year), sex and age at death, and whether the death was due to external causes (non natural), and for women aged 12-50 at time of death whether it occurred during the maternal risk period. The precise question was: “Was the deceased person pregnant at time of death, or died within six weeks after delivery?”, which is basically the same question as that asked at the 2001 census. This question defines maternal mortality as “pregnancy-related death”, and includes direct causes (obstetric conditions), indirect causes (infectious and non-communicable diseases) and fortuitous causes.

The 2007 Community Survey microdata were analyzed with straightforward demographic methods, as done with the 2001 Census microdata. Fertility rates were calculated from births last year (February 2006 to January 2007), and corrected for twins with a coefficient = 1.014 since the census provided only the number of women who delivered last year, and not the total number of births. Mortality rates were calculated from deaths last year (since February 1, 2006): all deaths in the file were included, and a correction factor of 0.948 was applied to account for the inclusion of deaths during the month of the survey (February 2007). Person-years lived in the past 12 months were calculated from the population by single

year of age at time of survey, and included the person-years lived by those who died, assumed to have lived only half of the year. Life tables were constructed, by 1-year age groups and 5-year age groups, and compared with the United Nations General model life table for developing countries [United Nations, 1982]. Maternal mortality was calculated as the ratio of pregnancy-related deaths in the past 12 months to the number of births in the past 12 months, expressed per 100,000 births. Multivariate analysis was conducted the same way as for the 2001 census microdata, using a linear logistic model. Independent variables were the same: level of education (measured as the number of years of schooling), urban residence, population group (race) and province of residence. The boundaries of some provinces changed somewhat between 2001 and 2007, so we used the 2001 definition for analyzing the 2007 Community Survey. An absolute wealth index was computed the same way as in 2001, from housing characteristics and goods and amenities owned. [for more details see Garenne & Hohmann, 2003; and Hohmann & Garenne, 2009].

Results

Sample size

The 2007 Community Survey included a fairly large sample of 354,170 households, of which 246,618 were private households eligible for final analysis, after excluding institutions, recreational areas and other special cases. This represents about a quarter of the 10% sample of the 2001 Census: 949,105 persons, and 265,945 women age 15-49 [Table 1]. The crude birth rate calculated from births last year was 24.0 per 1000; the general fertility rate was slightly higher than that measured in 2001 by about 5%, suggesting a modest increase in fertility. The crude death rate calculated from deaths last year was 15.3 per 1000, a 64% increase from the 2001 estimate. Maternal mortality was based on 168 maternal deaths, a sample large enough for a number of detailed investigations, although smaller than the 508 maternal deaths in the 2001 census 10% sample.

Imputations

There were a number of issues with imputations in the 2001 sample, well detailed in our first paper. It did not seem to be the case in the 2007 Community Survey: only two maternal

deaths (1.2%) were imputed by Hot-Deck procedures, a percentage even lower than for non-maternal deaths of women age 15-49 (2.6%). Only a few deaths had a date imputed (1.8%) or an age imputed (0.8%), which indicates that the reliability of 2007 data was high.

Mortality level and pattern

The main feature of the 2007 sample was the major rise in overall mortality within the five years separating the two surveys [Table 2]. From life table estimates, the death rate for children under age 15 ($_{15}q_0$) increased by 26% in five years, and was 1.8 times higher than model life table values with the same life expectancy at age 60 (United Nations General Pattern for developing countries). The death rate for young adults from age 15 to 59 ($_{45}q_{15}$) increased by 46% for both sexes, and more so for women (+57%) than for men (+38%). In 2006, the death rate of young women was 4.5 times higher than that of model life tables, and that of men was 3.2 times higher. In contrast, mortality above age 60 hardly changed, with a life expectancy around 21 years for women and around 17 years for men, which correspond roughly to 73 and 67 years of life expectancy at birth in model life tables. This outstanding pattern of adult mortality is primarily due to HIV/AIDS and PTB, two raging epidemics in South Africa, and to the very high mortality from external causes.

Level of maternal mortality

The extremely high value of young adult mortality explains the very high value of maternal mortality, as already noted in our first paper, but with an even higher level due to the rise in mortality. The raw estimate of maternal mortality was 702 per 100,000 live birth (95% CI = 603-816), a value higher than any other estimate for South Africa and than most estimates for other developing countries [Boerma, 1988; Dorrington et al., 2005; Dickson-Tetteh & Rees, 1999; Fauveau et al., 1988; Fawcus et al. 2005; Khan et al. 2001; Koenig et al. 1988; Moodley & Pattinson, 2003; Moodley 2003; NCCEMD, 1988; Van Coeverden de Groot, 1979 & 1986)]. This estimate of maternal mortality was 29% higher than the value estimated from the 2001 census data ($P < 0.004$). However, from 2001 to 2007, the proportion of maternal deaths among deaths of women aged 15-49 decreased from 6.4% to 4.3%. The increase in maternal mortality ratio seems therefore primarily due to the increase in mortality from all causes combined.

Attributable risk

We computed an expected number of maternal deaths assuming that there was no increased risk associated with pregnancy and delivery, in order to estimate a risk attributable to the maternal period. Details of the computations are displayed in Table 3. The maternal risk period is fixed at 46 weeks (40 weeks of pregnancy and 6 weeks post-partum), and the expected number of deaths during the maternal risk period is simply the product of population times the proportion of time spent in the maternal period times the death rate. Results show that a total of 294 deaths were expected during the maternal risk period, as compared with 168 observed at the survey. This means that, statistically speaking, there was no excess risk associated with the maternal risk period: on the contrary, the maternal risk period appeared as protective for survival. This is obviously due to a selection bias: the women who are in stable unions and deliver are not the same as the women who contract HIV/AIDS or die of external causes. It should be noted that this situation is very new, and due to the major demographic changes induced by HIV/AIDS. It differs markedly from the situation prevailing in the pre-AIDS era. For instance, in Niakhar, Senegal, in the 1980's, maternal deaths accounted for 25% of deaths of women aged 15-49, and the ratio of maternal deaths to that expected during the maternal period was 1.25 [Garenne and Fontaine, 1988]. In Matlab, Bangladesh, despite lower fertility, maternal deaths accounted for 26% of all deaths, and the ratio of maternal deaths to that expected during the maternal period was 1.77 [Khlat & Ronsmans, 2000]. Both values revealed the excess risk during the maternal period, and were very different from the 0.57 ratio found in South Africa.

Socio-economic correlates

We investigated maternal mortality differentials according to a variety of socio-economic correlates, by calculating a risk ratio of a given category to the national average, and compared the risk ratio with that found in 2001 [Table 4]. Results show a high consistency in the two differential analyses: higher risks for rural areas, for selected provinces (in particular Eastern Cape and Kwazulu-Natal), lower risk for selected population groups (Indian/Asian and White/European), decreasing risk with level of education, and a complex relationship with income and wealth, as already noted in the 2001 Census analysis (higher risks for the very poor and for middle classes). Only few differences in relative risks were

notable and statistically significant, in particular the lower risk associated with high education in 2007. Increases in maternal mortality from 2001 to 2007 were significant only for selected categories: rural areas (+47%), the Eastern-Cape (+74%), Black/African (+28%), middle income (4800-28800 ZAR) (+97%). These differences are probably related with increasing HIV/AIDS in high risk areas, and possibly with better treatment of HIV/AIDS among the more highly educated groups.

Provincial differences

Provincial differences in maternal mortality are large in South Africa. We compared the correlations of MMR with the provincial characteristics, and found correlations similar to those found in the 2001 census [Table 5]. Largest positive correlations were with overall level of mortality (+0.754), with death rate from external causes (+0.664), and with HIV prevalence (+0.592), and largest negative correlations were with education (-0.396), income (-0.458) and wealth (-0.638). No recent survey providing the proportion of deliveries in institutions at provincial level in 2007 was available to compare with results from the 2001 census.

Discussion

The level of maternal mortality measured by all deaths during the maternal risk period (the “pregnancy-related deaths” demographic definition) is abnormally high for a country like South Africa, and obviously due to a lack of specificity of the case definition. By including many deaths which are most likely due to HIV/AIDS, PTB, accidents and violence, it gives an exaggerated measure of the risk assumed to be due to obstetric conditions. However, even if a fraction of these pregnancy-related deaths is due to obstetric causes, maternal mortality in South Africa is probably still much higher than in developed countries, and deserves attention from health professionals.

We further validated the results from the 2007 Community Survey by comparing with vital registration data. In 2006, there were 145,381 deaths of women aged 12-50 registered in South Africa, which is consistent with the extrapolated census estimates, given the possible undercount. Among those, the pregnancy status of the deceased woman was known in 25% of the cases, and among those whose status was known, 6.5% occurred in the maternal risk period. Assuming that this number is representative of the whole population would lead to an

MMR even higher than that found in the 2007 Community Survey. However, if one assumes that, among the remaining 75% of women, 3.6% were pregnant, then the numbers provided by the two sources become compatible. Furthermore, according to vital registration data, some 1.1% of deaths of women aged 12-50 were obstetric deaths (medical definition of maternal mortality), defined by an underlying cause in the “pregnancy, childbirth and puerperium” category (ICD-10 code O00 to O99). This leads to about 1800 obstetric deaths in 2006, which is about 1 in 4 pregnancy-related deaths. These numbers appear compatible with the excess mortality among young adults found in South Africa, and suggest that obstetric deaths are not much in excess given the underlying level of mortality discounting for outstanding causes (HIV/AIDS, PTB, external causes). However, compared with 1950 Sweden, a country with similar female life expectancy at that time, the obstetric MMR appears at least twice as high in South Africa, although hardly higher than in the United States at a similar level of mortality.

The fact that maternal mortality increased rapidly from 2001 to 2007 is not surprising given the major rise in mortality over this period. This is mostly due to HIV/AIDS and PTB, and to external causes, which continue to account for a large and constant proportion of all deaths (about 14%).

Emerging diseases and conditions such as HIV/AIDS and external causes are changing mortality patterns to an extent never seen before. At a given level of mortality, regional model life tables provide a range of variations which is largely exceeded by emerging patterns such as those seen in South Africa. And this is reflected here in the abnormally high level of maternal mortality.

Furthermore, HIV/AIDS may be an underlying cause of maternal deaths, especially in the post-partum period. Numerous accounts of unexpected deaths during the few weeks following delivery have been reported among HIV-positive women in South Africa. A cohort study of HIV positive women and their children reported a very high post-partum death rate of 2265 per 100,000 in South Africa within 36 weeks of delivery [Chopra, 2008].

HIV/AIDS is also changing the relationship of mortality differentials with socio-economic status. If the relationship with education remains as expected, the relationship with income or wealth is not monotonic: it reveals two modes, one for the very poor, and one for the middle income classes. This is probably due to the fact that the risk of sexually transmitted infections is due to a balance between sexual behavior (more partners associated with higher socio-economic status), and prevention (more care associated with higher socio-economic

status). These relations deserve more investigation, and require more specific data than those provided by a census.

The lower risk of mortality associated with the maternal risk period is counter-intuitive. Even if the result is a balance between genuine obstetric risks and differential attitudes and behaviors associated with pregnancy, our findings suggest that the selection for pregnancy is very high in South Africa. This point deserves more research. It could be in part associated with the lower fertility of HIV infected women, but is most likely due to differential behavior. Women who choose to have a baby must behave very differently from the others in order to have such a lower risk of dying.

There is no doubt that the census is the best tool to measure maternal mortality in the absence of complete vital registration, at least because of the large sample size required to reach statistical significance [Graham, 2002; Hill et al., 2006; Ronsmans & Graham 2006; Stanton et al. 2001, United Nations, 2001, 2008a, 2008b]. However, in the context of HIV/AIDS and high death rates from external causes, it is necessary to include causes of death in order to focus on obstetric causes. This is the only way to measure progress in “safe motherhood”. This can be done by doing verbal autopsies, whether full-scale or simplified to focus on obstetric causes [Fortney et al., 1986; Fottrell et al., 2007; Garenne & Fontaine, 1988; Fauveau et al. 1988].

The increasing level of maternal mortality is a matter of serious concern, especially when compared with international public health targets such as the “millennium development goals”. [United Nations, 2000; Rosenfield et al. 2006] Even if this increase has probably little to do with obstetric care, it deserves more research, and calls for specific actions to reduce overall mortality, with the main focus on treatment of HIV/AIDS and PTB, and on the prevention of external causes.

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Web sites:

- CARe (Center for Actuarial Research): www.commerce.uct.ac.za/care
- IPUMS-International: <https://international.ipums.org/international>
- Millenium Development Goals: www.un.org/millenniumgoals/maternal.shtml
- Stat-SA (Statistics South Africa): www.statssa.gov.za

Table 1: Main characteristics of the two samples, South Africa

| Characteristics | | Census 2001 10% sample | Community survey 2007 | Ratio 2007/2001 |
|------------------|---------------------------|---------------------------|--------------------------|--------------------|
| Population | Mean date | 2001.8 | 2007.1 | |
| | Nb households | 991 543 | 246 618 | |
| | Nb persons | 3 725 655 | 949 105 | |
| | Mean household size | 3.76 | 3.85 | 1.02 |
| Fertility | NB women 15-49 | 1 048 824 | 265 945 | |
| | Nb births last year | 84 520 | 22 397 | |
| | GFR | 0.081 | 0.085 | 1.06 |
| | Time in maternal period % | 7.1% | 7.6% | 1.06 |
| Mortality | Nb deaths last year | 36267 | 15304 | |
| | Nb female deaths 15-49 | 7934 | 3924 | |
| | Nb maternal deaths | 508 | 168 | |
| | Proportion maternal (%) | 6.4% | 4.3% | 0.67 |
| Raw estimates | Death rate 15-49 | 0.0076 | 0.0140 | 1.85 |
| | MMR (per 100,000) | 542 | 702 | 1.29 |
| | CBR (per 1000) | 0.0228 | 0.0240 | 1.05 |
| | CDR (per 1000) | 0.0093 | 0.0153 | 1.64 |

Note: Community survey: private households only; births rates and deaths rates corrected for minor errors (see text for details).

Table 2: Changes in mortality from 2001 to 2007, South Africa

| Age group | Indicator | Community Survey 2007 | Census- 2001 | Model Life table | Mortality increase 2007/2001 | Ratio CS-20007 /MLT |
|-------------------|-----------------|-----------------------------|-----------------|---------------------|------------------------------------|---------------------------|
| <i>Both sexes</i> | | | | | | |
| 0-14 | $_{15}q_0$ | 0.099 | 0.079 | 0.055 | 1.26 | 1.8 |
| 15-59 | $_{45}q_{15}$ | 0.553 | 0.380 | 0.151 | 1.46 | 3.7 |
| 60+ | $e^{\circ}(60)$ | 18.3 | 19.8 | 18.6 | | |
| <i>Males</i> | | | | | | |
| 0-14 | $_{15}q_0$ | 0.100 | 0.086 | 0.063 | 1.17 | 1.6 |
| 15-59 | $_{45}q_{15}$ | 0.606 | 0.440 | 0.190 | 1.38 | 3.2 |
| 60+ | $e^{\circ}(60)$ | 15.5 | 17.3 | 17.0 | | |
| <i>Females</i> | | | | | | |
| 0-14 | $_{15}q_0$ | 0.099 | 0.072 | 0.047 | 1.38 | 2.1 |
| 15-59 | $_{45}q_{15}$ | 0.501 | 0.320 | 0.112 | 1.57 | 4.5 |
| 60+ | $e^{\circ}(60)$ | 20.5 | 21.8 | 20.1 | | |

Note: Model life table: General model for developing countries; life expectancy: 67 for males and 73 for females (approximately same life expectancy at age 60).

Table 3: Estimation of mortality risks attributable to the maternal period, South Africa,
Community Survey 2007 (events of past 12 months)

| Age group | Population | Fertility | Percent | Mortality | Percent | Pregnancy-related | |
|--------------|-----------------------------|-----------------|-------------------------------------|-----------------|--------------------|-------------------|----------|
| | (Person- years lived) | rates (ASFR) | time spent in maternal period | rates (ASDR) | maternal deaths | Expected | Observed |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 12-14 | 31593 | 0.0040 | 0.4 | 0.0015 | 0.0 | 0 | 0 |
| 15-19 | 51674 | 0.0729 | 6.5 | 0.0032 | 7.3 | 11 | 12 |
| 20-24 | 48358 | 0.1329 | 11.8 | 0.0093 | 7.6 | 53 | 34 |
| 25-29 | 39333 | 0.1315 | 11.6 | 0.0187 | 5.8 | 86 | 43 |
| 30-34 | 35898 | 0.1091 | 9.7 | 0.0242 | 4.6 | 84 | 40 |
| 35-39 | 33048 | 0.0701 | 6.2 | 0.0209 | 3.6 | 43 | 25 |
| 40-44 | 30463 | 0.0292 | 2.6 | 0.0192 | 1.5 | 15 | 9 |
| 45-49 | 26163 | 0.0065 | 0.6 | 0.0164 | 1.2 | 2 | 5 |
| Total | 296529 | 0.0768 | 6.8 | 0.0134 | 4.2 | 294 | 168 |

Note: Expected number of deaths (7) = product of population (2) by time spent in maternal period (4) by death rate (5). Observed number of deaths (8) = product of population (2) by death rate (5) by proportion maternal (6).

Table 4: Comparison of risk factors between 2001 Census and 2007 Community Survey, South Africa.

| Variable | Category | Community Survey 2007 | | Census 2001 | | |
|----------------|---------------|-----------------------|------|-------------|------|------|
| | | Nb deaths | RR | Nb deaths | RR | |
| Residence | Total | 168 | 1.00 | 508 | 1.00 | |
| | Urban | 69 | 0.77 | 249 | 0.92 | |
| | Rural | 99 | 1.27 | 259 | 1.10 | |
| Province | Western Cape | 4 | 0.25 | 22 | 0.44 | |
| | Eastern Cape | 47 | 1.76 | 88 | 1.29 | |
| | Northern Cape | 5 | 0.73 | 7 | 0.75 | |
| | Free State | 11 | 1.23 | 34 | 1.19 | |
| | Kwazulu Natal | 46 | 1.30 | 152 | 1.40 | |
| | North-West | 13 | 0.91 | 57 | 1.36 | |
| | Gauteng | 23 | 0.79 | 70 | 0.72 | |
| | Mpumalanga | 7 | 0.59 | 37 | 0.94 | |
| | Limpopo | 12 | 0.63 | 41 | 0.63 | |
| | Race | Black/African | 161 | 1.12 | 478 | 1.11 |
| | | Coloured | 7 | 0.44 | 24 | 0.52 |
| Indian/Asian | | 0 | 0.00 | 3 | 0.36 | |
| White/European | | 0 | 0.00 | 3 | 0.12 | |
| Education | 0-4 years | 79 | 1.42 | 52 | 1.63 | |
| | 5-8 years | 44 | 1.00 | 121 | 1.37 | |
| | 9-11 years | 31 | 0.85 | 183 | 1.09 | |
| | 12+ years | 11 | 0.37 | 152 | 0.69 | |
| Income | None | 15 | 1.26 | 142 | 1.18 | |
| | < 2400 Rd | 43 | 0.91 | 181 | 1.07 | |
| | < 4800 Rd | 54 | 1.10 | 96 | 1.22 | |
| | < 9600 Rd | 34 | 1.18 | 52 | 0.87 | |
| | < 28800 Rd | 20 | 1.01 | 25 | 0.52 | |
| | > 28800 Rd | 2 | 0.18 | 12 | 0.38 | |
| Wealth | 0 | 5 | 1.88 | 12 | 1.63 | |
| | 1 | 9 | 1.23 | 23 | 0.95 | |
| | 2 | 11 | 0.96 | 37 | 0.97 | |
| | 3 | 17 | 1.32 | 38 | 0.90 | |
| | 4 | 14 | 1.22 | 51 | 1.22 | |
| | 5 | 16 | 1.39 | 46 | 1.18 | |
| | 6 | 18 | 1.53 | 49 | 1.36 | |
| | 7 | 13 | 1.05 | 43 | 1.26 | |
| | 8 | 18 | 1.39 | 40 | 1.19 | |
| | 9 | 8 | 0.58 | 41 | 1.20 | |
| | 10 | 16 | 1.05 | 29 | 0.87 | |
| 11 | 7 | 0.39 | 29 | 0.82 | | |

| | | | | |
|----|----|------|----|------|
| 12 | 11 | 0.74 | 36 | 0.92 |
| 13 | 5 | 0.79 | 23 | 0.64 |
| 14 | 0 | 0.00 | 10 | 0.45 |
| 15 | 0 | 0.00 | 1 | 0.09 |

Note: Risk ratios (RR) are computed as the ratio of the maternal mortality in a category to the national average, for each survey.

Table 5: Comparison of correlation coefficients between maternal mortality level and selected indicators at provincial level, South Africa

| Indicator | CS-2007 | Census-2001 |
|--|---------|-------------|
| Crude death rate | +0.754 | +0.892 |
| Violence death rate | +0.664 | +0.798 |
| HIV seroprevalence | +0.592 | +0.730 |
| Household size | +0.308 | +0.368 |
| Birth rate | +0.240 | +0.240 |
| Urbanization | -0.254 | -0.315 |
| Education | -0.396 | -0.400 |
| Average income | -0.458 | -0.495 |
| Average wealth | -0.638 | -0.490 |
| Proportion of deliveries in institutions | NA | +0.293 |