Spatial Analysis of Childhood Mortality in Mozambique

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Mozambique features prominently among the 28 or so countries identified as currently experiencing considerably high levels of child deaths and lagging behind in the progress towards MDG 4 target. However, there is considerable dearth of knowledge on the geographic differences that explain the high levels and disparities in childhood mortality. This paper uses data from the 1997 census in conjunction with GIS to investigate the magnitude of geographic disparities in child health in Mozambique and to highlight the implication for using global level results in monitoring MDG progress. The results show wide provincial differences and even huge district level disparities in childhood mortality. There is a geographic mortality gradient, with moderate levels in the Central and low levels in the South as opposed to the generally higher levels experienced in the Northern part of Mozambique. Proximity to major urban centers is apparently associated with a depressing effect on childhood mortality.

Introduction

Recent estimates suggest that the incidence and prevalence of non-communicable diseases (NCD) in Africa is rising. For instance, Gwatkin *et al.* (1999) estimated that by 2020, NCD in Sub-Saharan Africa will account for almost 50% of the burden of disease (BOD). Such global estimates seem to confirm the expectation of the epidemiologic transition theory which suggests a shift in cause-of-death patterns from communicable diseases especially prevalent at infancy and childhood to problems resulting from non communicable conditions at the advanced ages (Heuveline *et al.* 2002; Murray and Lopez 1997; Wilmoth 2000). It is on this basis that recent years have seen attempts to refocus health policies in Sub-Saharan Africa away from communicable towards non-communicable diseases. On the other hand, in spite of dramatic improvements in mortality in Africa during the second half of the twentieth century, Africa at the turn of the 21st century remains the world's region with the highest mortality levels. Both childhood and adult mortality remain generally high with wide disparities among and within groups in the population.

Among the notable features of African mortality trends over the last two or so decades has been remarkable stagnations and reversals of the post World War II (WWII) mortality gains. Infant and childhood mortality, which started declining in most African countries following WWII through the 1960s and 1970s, began to show signs of stagnation or reversal by the late 1980s (Walker 2002). Explaining these stagnations or reversals of mortality in several African countries is an ongoing subject of intensive scholarly research. These trends are partly linked to the poor performance of most African economies and further compounded by the continued prominence of infectious diseases and the emergence of new infections like HIV/AIDS (Hill 1993, Rutstein 2000, Zuberi *et al.* 2003). Because, these reversals coincided in most cases with the advent of the HIV/AIDS pandemic, this has taken precedence in the frequent explanations. Walker *et al.* (2002) have investigated that assumption that HIV/AIDS is linked to the reversing trends and concluded that the trends cannot be explained by HIV alone. Also, the stagnation or reversal does not seem to be uniform across countries or localities and population groups. Indeed wide disparities exist among and within groups even in the same country. As such global estimates have often been accused of frequently masking the "unfinished health agenda" in many countries. In this paper, we use a unique power of census data in conjunction with GIS to assess the magnitude of geographic differences in child health.

Almost 3 decades ago in Alma-Ata, African delegates along with their counterparts from other nations and representatives of key international organizations jointly endorsed the famous declaration that called attention to gross disparities in health and mortality around the world. The Alma-Ata Declaration stated that such disparities were *politically, socially and economically unacceptable* (WHO 1978) and committed all countries to the ambitious goal of achieving "health for all by the year 2000". As the famous year 2000 approached, only partial success on the declaration had been recorded. By the 22nd anniversary of Alma Ata in September 2000, the Millennium Declaration endorsed by 189 countries was adopted by the United Nations (UN 2000; 2005). The accompanying Millennium Development Goals (MDGs) are the current priorities of all member countries and commits all governments to the realization of 8 major goals and 18 targets by the year 2015. Of particular interest here is goal 4 that focuses on reducing child mortality. Allied to this goal is target 5 that recommends a reduction by two-thirds between 1990 and 2015. Progress towards this goal is assessed by tracking under-five mortality rates (U5MR) and the coverage of children immunized against measles, the leading cause of death among vaccine—preventable diseases (UN 2005). Unlike the Alma-Ata declaration, the

MDGs seem to emphasize global level results for monitoring progress than the reduction in gross disparities.

As Heuveline *et al.* (2002) rightly noted, global results are invaluable for enabling policy makers to better prepare for the emerging health needs of different populations but, they constitute an inappropriate guide for refocusing health priorities. According to current assessment (UN 2005) of the progress towards the target of reducing U5MR, progress remains uneven with Sub-Saharan African trailing behind. Among the 28 or so countries still experiencing high levels of child deaths, Mozambique features prominently. Mozambique in particular experienced prolonged period of unusually severe hardships with almost two decades of civil strife compounded by natural disasters. As a result, the country is one of the poorest in the world and until recently, there was little national data for an assessment of the demographic situation. In recent years following the end of civil war in 1992, the conduct of the 1997 census alongside several national surveys like the 1997 Demographic and Health Survey (DHS) has facilitated increasing attempts to understand the demographic picture of the country, particularly child mortality. There is considerable dearth of knowledge on the geographic differences that explain the high levels and disparities in childhood mortality in Mozambique.

This paper uses the 1997 census data from the African Census Analysis Project (ACAP) archive to assess the district level differentials in childhood mortality. More specifically, the levels of childhood mortality are estimated and the observed differences by province and place of residence (urban-rural) are examined. The probability of dying before reaching exact age 5 (Q5) is used.

Background on Mozambique

Mozambique presents a unique situation for understanding the demographic situation in Africa, especially the mortality situation associated with crisis or civil war. It went through prolonged periods of unusually severe hardships characterized by population displacements under precarious conditions before returning to normalcy over the last decade and half. Like many African countries in the early 1960s, Mozambique experienced the struggle for independence under the leadership of FRELIMO (Front for the Liberation of Mozambique), but unlike other countries, theirs lasted more than a decade. When independence finally came in 1975, it only provided a brief transition of less than a year into the prolonged civil war spearheaded by RENAMO (Mozambican National Resistance). This war consumed almost two decades of the country's independence (1976-1992). The war penalty on the population was further compounded by natural disaster including severe flood and drought in various parts (see Rutherford and Mahanjane 1985). Consequently, the country emerged as one of the poorest in the world.

Unlike other war-torn countries in Africa, the level of international attention and efforts was quite substantial due to the fact that Mozambique emerged from the war with country sides flooded by land mines. The attention and efforts were particularly focused on recovery and elimination of these mines. But absence of national level data during the prolonged periods of hardships limited knowledge on population dynamics in the country to small scale localized studies on the war effects, e.g. the Red Cross study in Maringue District (Garenne *et al.* 1997) and the study on disaster consequences in Gaza and Inhambane provinces (Rutherford and Mahanjane 1985). These small scale studies tended to cover mostly areas in the South and to some extent the Middle parts of the country to the neglect of areas in the North. Over the last decade, the National Statistical Institute (INE) has conducted the 1997 census alongside several national surveys like the 1997 Demographic and Health Survey (DHS). This has facilitated increasing attempts to understand the demographic picture of the country and in particular the childhood mortality situation. Consistent with the past experience, these data confirm that mortality is particularly high in Mozambique. A few recent attempts have also highlighted some inequalities in child mortality by parental education and occupation (Macassa *et al.* 2003) but the level of emphasis remains mostly at the national picture. This may be partly due to data restrictions since survey data are frequently used. Knowledge of geographic differences that explain the high levels and disparities in childhood mortality in Mozambique remains relatively scanty. Besides, such localized survey-based studies tend to provide little guidance to those concerned with formulating health programs.

While Mozambique is believed to have experienced a relatively high economic growth over the decade following end of civil war,[1] it would probably require considerable time to catch up with the combined effects of the civil war and natural disasters. Moreover, in the current context of mounting HIV/AIDS pandemic and its potential implications, full recovery from the civil war may well appear somewhat illusive. The HIV/AIDS situation in Mozambique may not seem as severe as compared to some of its close neighbors, there is great potential for a rapid

[1] See World Development Indicators of The World Bank. There are however suggestions that the reconstruction effort was somewhat misguided by the structural adjustment that gave no concessions to the post-conflict problems (Hanlon, 1996, 2005)

spread considering the proximity to the neighbors and frequent interaction of their populations (Gaspar 2002). Estimates for the late 1990s show somewhat moderate prevalence of 12.8% among adults age 15-49 compared to Botswana, Lesotho, South Africa, Zambia and Zimbabwe where prevalence approaches the neighborhood of 20% while latest data suggest a dramatically worsening epidemic (UNAIDS 2006, UN 2005). Meanwhile recent projections of the population under varying assumptions (Gaspar 2002) estimate that the prevalence is not likely to decline in the near future without dramatic behavioral changes.

The aim of this paper is to localize childhood mortality to the district level and thereby, highlight the magnitude and dimension of inequalities. We consider the levels of childhood mortality by province and place of residence (urban-rural) and highlight district level differentials. Furthermore, a number of socioeconomic and household environmental characteristics are considered in an attempt to explain the observed provincial differences in mortality. Identifying high risk areas where children are subject to increased risk of dying is important for health planners and policy makers to retarget intervention programs on such high risk communities and thereby ensure effective use of scarce resources. It is also important for future research since this will map out the healthy and unhealthy districts for children and hence, better focused in-depth health studies can be undertaken to assess the situation and identify the key factors responsible for poor health of children in such areas.

Data and Methods

Vital registration systems have remained incomplete across most of Africa. However, the past four decades or so have been associated with dramatic progress in the data collection environment in Africa. Thanks to the combined efforts of various United Nations organs, particularly the UNFPA and other international organizations, the continent has experienced an escalation of data collection efforts as well as availability, with most countries counting at least two censuses and several demographic surveys. The national surveys have been analyzed extensively while African censuses remain relatively underexploited. Although the various national surveys have been very useful in enhancing our understanding of national trends in fertility and mortality over the past two decades, their utility has been limited in part by the sample sizes and principally their unsuitability for analysis at lower levels of geography.

Census data has a unique power of allowing for analysis of differential mortality at the regional and lower levels of geography. Because of its coverage, the census offers an opportunity to examine some regional covariates and patterns of U5M, allowing for an understanding of the geographic diversity in childhood mortality experience. The relevance of regional level analyses of patterns trends and differentials of U5M cannot be overemphasized. One of the notable efforts to improve the data environment in Africa is the collaborative initiative by the African Census Analysis Project (ACAP). Indeed, this ACAP collaborative effort has complemented the data collection efforts of the various governments and international organizations by building a unique data archive that has helped prevent the disappearance of the 1970 and 1980 rounds of African censuses and these censuses. The 1997 Mozambique census used for this analysis comes from the ACAP data archive.

This 1997 census estimated a total population of Mozambique at 15.5 millions with a huge majority (70.7%) residing in rural areas. Administratively, the country is subdivided into ten provinces (namely Niassa, Cabo Delgabo, Nampula, Zambesia, Tete, Manica, Sofala, Inhambane, Gaza and Maputo). But in terms of data presentation, the capital city Maputo is distinguished from the Maputo Province that contains it, giving it (Maputo City) a provincial status. In line with this data presentation, our analysis considers 11 provinces. The provinces are then subdivided into 146 districts (as at the 1997 census). Niassa, the largest in area, is the smallest in terms of population size with barely 5% of the total population as evaluated in 1997. At the upper end are Zambesia and Nampula provinces respectively supporting 18.8% and 19.4% of the population and as will be seen later, the two also occupy another extreme position in terms of child health. The rest of the provinces each hold below 10% of the population. A woman-work file was created containing about 3.9 million women of reproductive age (15-49) with the various differentials or characteristics assigned to the individual woman cases. On average, these women had borne about 3 children and had at least experienced an average of one child death. However, women at the end of their reproductive span had borne on average 6 (5.9) and had experienced the loss of close to two children (1.7). Besides province and districts the variables considered include rural or urban residence, educational attainment, marital status and household environmental condition variables like type of toilet facility, source of water, electricity and type of materials for housing.

The analysis focuses mainly on childhood mortality. The Brass-type information on children ever born (CEB) and children dead or surviving (CD-CS) included in the 1997 Mozambique census are used to estimate mortality.

Methods

Brass (1975) developed a technique whereby the proportions of children dead of CEB to women in conventional childbearing age groups are converted into estimates of probability of dying between birth and certain exact childhood ages. The technique uses a set of multipliers that depend on the shape of the fertility function. The main assumptions for the use of this technique are that of constancy of fertility (ASFRs) and mortality rates in the population in the recent past. It also assumes that the experience of surviving women reflects that of all mothers exposed to the risks of births and deaths of children. A full description of the technique is provided in UN (1983). The basic form of the estimation equation proposed by Brass (UN 1983) is:

$$Q(x) = k(i)D(i)$$

Where D(i) denotes the observed proportion dead among children ever born to women in successive 5-year age groups (i = 1,7), k(i) is the multiplier meant to adjust for non-mortality factors determining the value of D(i). Q(x), the resultant measure of mortality, is the probability that a child born in a specified year will die before reaching exact age x if subject to prevailing mortality conditions.

The Trussell variant of the Brass technique is estimated while adopting the North family model coefficients for the multipliers provided in Manual X (UN 1983). It is worth recognizing here that most of these model life tables are no longer (or have never been) appropriate for depicting the age pattern of mortality in Africa, but in the absence of a readily available life table for Mozambique, adopting the North was partly for convenience since it is generally thought to approach the mortality pattern in Africa compared to the other model families.[2] However, the choice was actually based on comparison of the estimated Q5's obtained for the four families. The estimate for the North model was found to be closest to the estimate from the 1997 DHS corresponding approximately to the same period (see Gaspar *et al.* 1998).

For the district level analysis, we employ the geographical information system (GIS) to depict the implication for childhood mortality of membership in a particular residential group. It must be noted that from a public health point of view and epidemiologic utility, it would have made more sense and logic to extend this mapping of the spatial distribution of mortality to some major specific causes. But as mentioned previously, data on causes of death are pretty difficult to

[2] Before adopting the family of model life tables, we first computed the multipliers and cumulative probabilities of dying for the 4 families provided in Manual X (UN 1983). The final decision is based on the comparison of the Q(5)'s with similar values estimated from birth histories in the 1997 DHS (Gaspar *et al.* 1998).

obtain than information on vital events. Map shapefiles corresponding to the 1997 census geography, produced by the National Statistics Institute (INE) are used. The shape files are defined as geographic using the WGS 1984 Datum and the Africa Albers Equal Conic Area System adopted for projecting the final maps. These options are available in the ArcGIS software used.

The conventional indirect techniques have several drawbacks for the study of specific groups, especially in terms of handling differentials and conducting multivariate analysis. A technique that allows for analysis beyond the mere estimation of levels and trends in mortality from aggregate census data is also employed. The technique for estimating covariates of childhood mortality was developed by Trussell and Preston (1982; see also Preston and Haines 1991) whereby a standardized index that combines child mortality experience of women can be computed and used for multivariate analysis. The more robust form of this index is supposed to use information categorized by mother's duration of marriage not available from census data but information categorized by mother's age can equally be used.[3] So, in addition to using Q(5) as the dependent variable for aggregate analysis, a mortality index (ratio of observed to expected deaths) is also used for analysis of differential at the individual level.

Findings

The women included in the analysis are fairly well distributed by age and consistent with rural nature of Mozambique at the time. Aside from Maputo city, virtually all the women resided in rural settings except for those in Sofala and Maputo Provinces where at least one out of every three women considered was residing in an urban setting. There are indications of low educational attainment in Mozambique. This low level of educational attainment is evidently a reflection of the wide disparities in education attainment by Province. For instance, virtually every woman in the capital city was literate and had some minimal education whereas the next substantial levels were recorded only for three provinces: Gaza (43.5%), Inhambane (48.6%) and Maputo (65.8%). Otherwise, majority of those found in the other provinces have never had any formal education, partly reflecting the high propensity educated persons to move into the urban

[3] This was initially considered the more robust because marriage as was then defined closely approximated exposure to the risk of child bearing and in turn average exposure of the children to the risk of mortality. However, with progressive changes in patterns and in the process of family formation, age of mother should probably pass the test of robustness better than duration of marriage.

areas where they can expect to meet their aspirations. The distribution of the sub sample by select characteristics is presented in Appendix Table A1.

Mortality Estimates

The mortality levels (in the North family of the Coale and Demeny system) consistent with the estimated Q(x)s implies relatively high infant mortality rates (IMR). Calculated as an average for children age 1-5, it implies an IMR of 155 per thousand. However this measure is known to be erratic; the remaining estimates show a consistent increase in mortality with age of child (or mother's age) suggesting that child mortality has been decreasing over the years (since the early 1980s) with indications of a slight upturn in recent years. Based on this information the increase appears to have been huge over the recent years. The U5MR for the country is estimated at 236 per thousand. The corresponding level of mortality dropped from 11.1 around 1990 to 10.1 in 1992 and to 8.8 in 1994. The trend seems pretty consistent with the results of the 1997 DHS (Gaspar *et al.* 1998) which suggest that childhood mortality as measured by Q5 might have started increasing during the 10-14 years prior to the survey. Since Q5 is the cumulative probability of dying before age 5, it is an average that can be taken as depicting the prevailing mortality experience over the 5 years prior to the census we use this indicator to select the standard level of mortality. Moreover, the Q5 is used as the entry parameter because it is known to be least sensitive to time trends or to an error in the choice of a model life tables (Preston and Haines 1991). A conservative estimate consistent with results is on level 11 of the Coale and Demeny systems that correspond approximately to a combined live expectancy at birth of 41 years.

Table 1 presents the summary estimates of mortality levels by province and place of residence. The results based on Q5 suggest that children in the northern parts of the country experience higher mortality risk than their counterparts in the central and southern parts. In effect, there is an apparent mortality gradient by geographic regions with moderate mortality in the Central and the lowest to the South. Urban-rural differentials are pretty wide as well.

District level Analysis

As indicated previously, the next level of administrative geography after the province in Mozambique is the district (totaling 146). At the district level, three provinces, Zambesia, Nampula, and Cabo Delgado stand out as the high risk areas for child health. Estimates for probability of dying before reaching age five (U5MR) ranges from a low of about 100 deaths per thousand in the urban districts of Maputo city and Maxixe city of Inhambane province to a high of above 300 deaths per thousand births in Montepuez, Inhassunge and Murrupula districts respectively in the Cabo Delgado, Zambesia and Nampula provinces. Table 2 compares the top 11 high risk districts to the 11 best child health achievers. The estimated probabilities Q5 for all the districts are presented in a map (Figure 1). The most striking observation is the evidence of child mortality concentration in just a few provinces that are in the same geographic area of the country. The mapping shows that almost all the 11 districts topping the chart of high risk for child health are located in three provinces. Moreover, they are all in close proximity to each other sharing the common boundaries of these provinces. This is probably a partial reflection of some form of inequalities in resource allocation or access to health care. From this map however, it will appear that the southern tip of Mozambique is the healthiest area for child to be born. Most of the best health performers are Districts located in Maputo City and Inhambane.

Table 3 compares the mortality rates of the best child health achievers and that of the high risk districts within the same province. Ignoring Maputo city where children enjoy the best chances of surviving to age 5, the discrepancies between the high risk and the best health achievers are minimal for Maputo, Gaza, Inhambane and Tete provinces. Also, this table suggests that being in the urban area of any of the provinces is associated with increased survival to age 5 which is consistent with the urban-rural disparities already noted.

Socio-economic aspects of the mortality concentration

There is a wealth of scientific evidence pointing to the pervasiveness of socio-economic gradient in health (see Marmot 2002, Smith 1999) both between and within countries. Generally, the relationship between socio-economic status (SES) and health outcomes is observed to be inverse, with morbidity and mortality concentrated in those at the lowest spectrum of the socio-economic ladder. In a country like Mozambique with a long history of civil strife, it will sound logical to relate any observable mortality differentials to socio-economic inequalities among communities. Income is the most commonly mentioned measure of SES but difficulties in obtaining accurate data on income have resulted in the frequent use of numerous proxies like household expenditure, household assets, education and employment.

Available census data on housing condition by provinces provide potential insights on socio-economic environment in relation to the observed mortality differences. In effect, differing material living conditions in the household are highly associated with social class, which affect childhood survival. The Mozambican census provide a number of such variables including home ownership or tenancy, materials for roofing, type of home, etc. but due to the fact that a number of these variables were unimodal, only the essential ones that showed some variation are considered in this analysis. Living conditions, especially water supply and availability of toilet facilities, directly influence mortality through contamination of the household environment and thereby facilitate the spread and incidence of infectious diseases. The quality or nature of housing (in terms of material used for construction) on the other hand is more a reflection of economic status of the family or household in which the child lives. In general, the variables presented in our analysis show that the housing environment or condition is relatively unhealthy in the provinces where U5M is high. Better housing conditions (sanitary conditions, water, electricity) are concentrated in the capital city and to some extent the three Southern provinces where mortality is considerably lower. Table 4 compares the households' environmental conditions by province.

Comparing observed vs. expected mortality: Use of Mortality Index

The mortality index (ratio of observed to expected deaths) is also used for analysis of differential at the individual level. The index has the advantage of presenting on a single scale the child mortality experience of a whole group of women of varying ages and parities (Preston and Haines 1991, UN 1991). It has been investigated and found to be robust and econometrically well-behaved when used as a dependent variable in a regression model (Trussell and Preston 1982). Moreover, it is readily interpretable. A value of unity means that a woman or group of women experienced child mortality similar to national average, while a value below unity implies child mortality below the national average and vice versa. Moreover, while it is not exactly a conventional measure of mortality, it can be easily converted into the probability of dying by age 5 (Q5). A full description of this technique and its basic application is provided in UN (1991).

The index takes the form of the ratio of observed child deaths to expected child deaths. The expected child deaths are calculated from a standard model life table by inverting the Brass equation. In the current analysis it is computed for each woman age 15-34, who had borne at least a child. The restriction to young women among other issues allows for child mortality estimates that refer to periods close to the date of the census. The index represents the mortality of each woman's children with respect to the national mortality level, standardized by the duration of exposure to risk. In the model, women are weighted by the number of children ever born so that the child and not the mother becomes the unit of analysis.

We focus here on province and place of residence (urban vs. rural). The results based on the index (Table 5) are pretty consistent with previous picture depicted by the estimated Brass-type probability of dying. It shows that the risk for children is substantially higher towards the Northern part of the country (particularly Niassa, Cabo Delgado, Nampula and Zambesia) than in the South and Central regions. The mean value of the index suggests highest mortality than expected for the Cabo Delgado and Zambesia provinces. Children in these provinces experience over 20% higher mortality than in the expected standard. It suggests that mortality is 17% and 6% higher in Nampula and Niassa provinces respectively. For the rest, observed childhood mortality as implied by the index seems to be lower that expected except for Manica and Sofala where observed childhood mortality is similar to that implied by the standard. Also, there are indication children of uneducated mothers, who live in households with poor toilet conditions, poor water source and lack of electricity experience higher than expected mortality.

Discussion and Conclusion

The results indicate that childhood mortality in Mozambique is very high even by Sub-Saharan African standards. The higher mortality than expected is consistent with the history of country where the population has undergone severe hardships. The small scale studies have confirmed that during the civil war, health care facilities and schools were either destroyed or closed down, immunizations stopped in many areas (Garenne *et al.* 1997, Cliff and Noormohamed 1988). These combined with malnutrition, drought, famine and epidemic outbreaks had a major effect on childhood morbidity and mortality (Rutherford and Mahanjane 1985). There are wide provincial differences and even huge district level differences in Childhood mortality. The differences in childhood mortality by geographic or administrative regions of a country are a very important factor for regional planning. While reasons for such differences may vary (from natural climatic conditions and the prevalence of infectious and parasitic diseases to economic and social conditions), it appears proximity to the capital city, Maputo or the Southern part of the country is associated with a depressing effect on childhood mortality.

The results confirm that provincial level indicators mask wide disparities in adverse health conditions experienced by certain segments of the population. In particular, they suggest that children born in districts such as Montepuez, Inhassunge, Murrupula and several others respectively in the north provinces Cabo Delgado, Zambesia and Nampula, in general are the most threatened early in life. It was not possible to get readily available economic data that may offer an explanation for the relatively poor health in these districts. In the case of the best child health districts, they all seem to be the major cities in the provinces suggesting that amenities may be over concentrated in the urban areas. This seems logical considering that throughout the war, the Mozambique government retained control of all cities and nearly all towns. Though all these facilities were attacked by the Guerrillas (Renamo) during the government (Frelimo) had an operating administration and reasonably well-functioning health and education systems (Hanlon 2005, 1996). Furthermore, Hanlon (1996) asserts that the post-conflict reconstruction effort was thwarted by the strict form of structural adjustment imposed by the IMF, which by implication favored the urban areas and the south with reasonably functional facilities. Otherwise, the case of Zambesia known to be richest agricultural province is unexpected.

For these districts where childhood mortality remains a major problem, it may be helpful to identify the leading causes of child deaths in these high risk areas. Availability of causes of death data will enhance the assessment of factors underlying the high risk. It also makes sense and intuitive logic for health policies to target these districts and combining this with poverty alleviation program will obviously yield positive results.

Because the indicators for monitoring the MDGs are based mostly on available national sample surveys, it is difficult to compute and assess how progress with the indicator translates to better health at the lower level of geography in the country. Unfortunately, it is usually at these lower levels that inequalities tend to be apparent and sometimes may reach alarming proportions as seen in this study. It is therefore important that census taking be maintained more regularly and encouraged as part of the process since it provides the needed data for monitoring progress and especially facilitates computations of the basic health indicators at the lower level of geography. Based on these findings we also believe that MDGs should equally target for goal 4 the need for countries to reduce current within-country disparities in child health. Monitoring the reduction in within-country disparities sounds more logical and any progress in this direction will count towards saving more child deaths than would be the case of just reducing the global level by two-thirds. Just focusing on reducing these disparities could actually be a faster way of achieving the reduction in global level by two-thirds. In this light a similar baseline assessment of the spatial distribution of mortality in each of the member countries may also be in order so as to serve as basis for future comparison.

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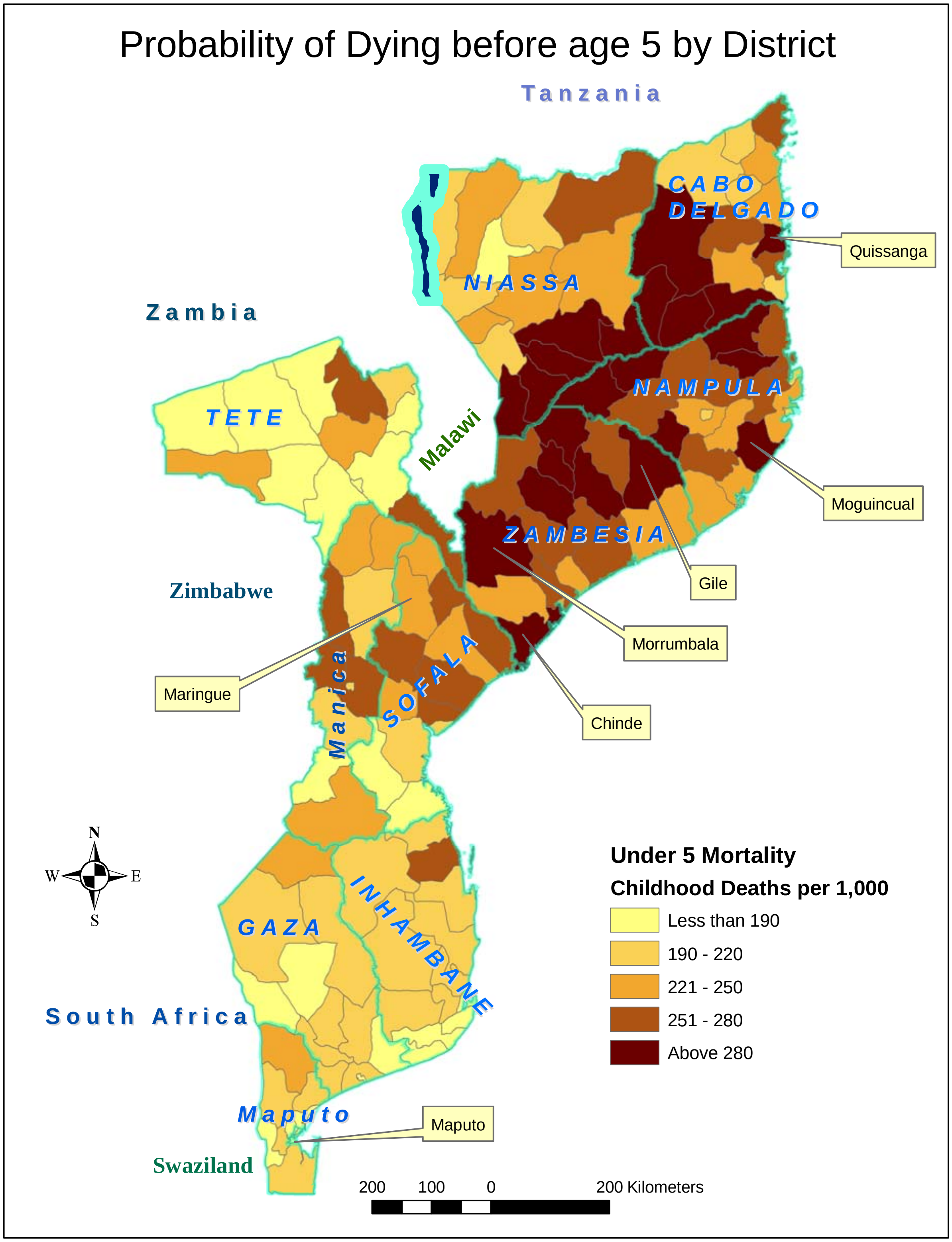
Figure 1: Mapping of Childhood Mortality by Districts



Source: Computations using the 1997 Mozambique census

Table 1: Estimates of Infant and Childhood Mortality and corresponding Life Expectancy at Birth by Province and Place of Residence, Mozambique 1997

	Probability of dying before ages x & life expectancy				
Province	IMR	Q(2)	Q(3)	Q(5)	e_0
Niassa	0.155	0.215	0.225	0.246	41.0
Cabo Delgado	0.176	0.247	0.259	0.274	37.4
Nampula	0.164	0.229	0.240	0.259	39.3
Zambesia	0.185	0.260	0.269	0.292	36.0
Tete	0.140	0.195	0.200	0.224	43.7
Manica	0.145	0.208	0.208	0.224	42.8
Sofala	0.148	0.206	0.213	0.234	42.3
Inhambane	0.125	0.181	0.177	0.190	46.5
Gaza	0.132	0.194	0.186	0.196	45.3
Maputo Province	0.101	0.154	0.138	0.141	51.6
Maputo City	0.078	0.124	0.101	0.101	56.9
Place of Residence					
Rural	0.169	0.238	0.247	0.266	38.5
Urban	0.114	0.174	0.157	0.160	48.9
Overall	0.155	0.223	0.225	0.236	41.0

Source: Computations using the 1997 census

Table 2: Estimated mortality rates for top Best Child Health and the top High Risk Districts

Best child health achievers (deaths per 1,000)				*High Risk for Child health (deaths per 1,000)*			
District	*Province*	*Estimated size (1997)*	*Q5*	*District*	*Province*	*Estimated size (1997)*	*Q5*
Urban District 5	Maputo City	214,835	138.5	Montepuez	Cabo D.	151,571	324.9
Maxixe City	Inhambane	96,193	139.1	Inhassunge	Zambesia	88,058	322.4
Urban District 3	MC	214,160	140.0	Murrupula	Nampula	102,884	320.2
Urban District 2	MC	166,423	144.9	Namarroi	Zambesia	96,009	316.8
Matola City	MP	430,700	146.6	Balama	Cabo D.	99,827	311.6
Urban District 1	MC	159,989	146.7	Erati-Namapa	Nampula	212,211	310.2
Inhambane City	Inhambane	53,932	149.8	Chiure	Cabo D.	187,953	307.0
Urban District 4	MC	231,904	152.5	Namuno	Cabo D.	139,431	304.8
Zavala	Inhambane	128,892	153.1	Mecanhelas	Niassa	77,035	298.6
Xai-Xai City	Gaza	102,053	163.4	Moguincual	Nampula	93,989	297.4
Tete City	Tete	103,550	165.6	Gil	Zambesia	128,476	296.7

Notes: MC (Maputo City), MP (Maputo Province), Cabo D. (Cabo Delgado).

Source: Computations using the 1997 Mozambique census

Table 3: Comparing disparities in child health between best health and high risk districts within same province

Province		*Best Health*		*High Risk*		*Disparities*	
Name	*Q5*	*District Name*	*Q5*	*District Name*	*Q5*	*Range*	*Ratio*
Niassa	246.9	Lichinga City	195.8	Mecanhelas	298.6	102.8	1.53
Cabo Delgado	269.6	Muidumbe	192.0	Montepuez	324.9	132.9	1.69
Nampula	258.7	Nacala-Porto City	197.9	Murrupula	320.2	122.3	1.62
Zambesia	271.1	Quelimane City	238.9	Inhassunge	322.4	83.5	1.35
Tete	200.2	Tete City	165.6	Mutarara	269.0	103.4	1.62
Manica	230.1	Mossurize	180.1	Barue &	257.5	77.4	1.43
Sofala	228.3	Chibabava	175.5	Caia	274.6	99.1	1.56
Inhambane	187.9	Maxixe City	139.1	Morrumbienne	213.6	74.5	1.54
Gaza	196.4	Xai-Xai City	163.4	Bilene	212.8	49.4	1.30
Maputo Province	169.4	Matola City	146.6	Magude	245.6	99.0	1.68
Maputo City	144.2	Urban District 5	138.5	Urban District 4	152.5	14.0	1.10

Source: Computations using the 1997 Mozambique census

Table 5: Child Mortality Index by Province and Housing Conditions for Mothers aged 15-34

Province	*Mean*	*Std dev*	*Number*
Niassa	1.062	1.58	95466
Cabo Delgado	1.239	1.67	167920
Nampula	1.173	1.64	393664
Zambesia	1.230	1.66	384011
Tete	0.875	1.44	129946
Manica	0.987	1.59	116153
Sofala	0.981	1.59	155685
Inhambane	0.888	1.57	130932
Gaza	0.885	1.56	114441
Maputo Province	0.708	1.47	88378
Maputo City	0.559	1.39	111397
Place of Residence			
Rural	1.139	1.63	1354476
Urban	0.795	1.52	533517

Source: Computations using the 1997 Mozambique census

Table 4: Household environmental conditions by province, Mozambique 1997 Census

Variable	Niassa	Cabo Delgado	Nampula	Zambesia	Tete	Manica	Sofala	Inhambane	Gaza	Maputo Pr	Maputo City	Total
	1	2	3	4	5	6	7	8	9	10	11	
Water												
Tap within House	2.9	3.5	6.8	1.6	4.3	3.6	15.2	3.8	10.4	32.0	49.8	8.9
Public Fountain	2.7	5.0	4.8	3.7	7.5	6.3	7.9	3.7	10.1	18.1	26.4	7.0
Well	63.4	76.1	74.9	76.4	53.4	56.9	55.9	80.9	63.8	36.7	23.2	66.0
River/Lake	31.0	15.3	13.5	18.4	34.9	33.2	21.0	11.6	15.6	13.3	0.6	18.1
Toilet												
Within unit	0.9	1.4	1.6	1.1	1.9	2.4	6.5	1.4	2.9	7.7	25.9	3.4
Latrine	54.0	36.3	14.7	9.8	33.4	26.1	15.2	55.5	58.4	69.8	70.0	30.9
None/	45.1	62.3	83.8	89.1	64.7	71.5	78.3	43.1	38.7	22.4	4.1	65.7
Radio*												
Yes	22.0	20.8	20.3	20.3	25.5	32.7	34.7	31.6	36.3	47.9	71.0	28.3
No	75.5	76.9	77.3	76.7	71.4	64.5	61.6	66.8	61.0	49.6	26.9	69.1
Electricity*												
Yes	1.9	1.7	3.9	1.5	3.0	3.3	6.6	1.8	4.9	12.6	38.0	5.3
No	94.9	95.2	93.1	94.3	93.1	93.4	89.1	96.4	92.1	84.8	60.0	91.5
Housing Material												
Floor												
Cement/concrete/T	2.7	4.5	6.1	2.6	4.8	8.0	23.7	18.5	27.3	45.6	83.7	14.4
Mud floor	22.4	5.8	13.7	18.3	37.1	26.5	29.7	16.1	15.4	13.6	1.4	17.7
Dirt plain	74.9	89.7	80.2	79.1	58.1	65.4	46.7	65.4	57.3	40.8	14.9	67.9
Walls												
Cement/brick	3.4	1.6	3.4	3.7	6.1	7.2	15.5	11.8	19.1	41.3	73.9	11.6
Mud brick	30.3	9.2	40.6	22.8	15.7	25.2	2.6	0.5	1.0	0.7	0.1	18.7
Palm/Bamboo	9.6	5.8	4.7	15.1	13.1	14.1	30.2	58.8	55.3	47.2	24.7	20.4
Wood (Maticados)	54.1	82.9	50.7	57.1	62.2	52.2	48.7	25.4	21.2	6.0	0.4	47.5
Cardboard/Paper	2.6	0.4	0.7	1.3	2.9	1.3	3.0	3.5	3.4	4.8	0.9	1.8
Total Households	190,165	341,951	800,537	731,521	269,633	206,048	278,664	264,617	235,220	181,761	182,122	3,682,239

Source: Computations using the 1997 Mozambique census

Table A1: Distribution of women aged 15-49 by Province of residence and by select characteristics, Mozambique 1997 Census

Variable	Niassa	Cabo Delgado	Nampula	Zambesia	Tete	Manica	Sofala	Inhambane	Gaza	Maputo Province	Maputo City	Total
	1	2	3	4	5	6	7	8	9	10	11	
Literacy												
Read & Write	15.75	11.14	13.27	13.56	18.65	27.70	26.55	40.57	44.20	61.80	80.88	27.22
Read only	0.96	0.87	1.08	1.04	1.35	1.07	0.86	0.83	0.87	0.94	0.86	0.99
Illiterate	82.10	86.78	84.20	83.59	78.09	70.21	71.42	57.93	54.12	36.51	17.66	70.52
Not Stated	1.19	1.20	1.46	1.80	1.91	1.03	1.16	0.67	0.81	0.75	0.61	1.26
Schooling												
Some School	23.71	22.62	25.41	23.56	22.38	31.36	30.44	43.55	48.58	65.79	83.57	34.54
No Schooling	76.29	77.38	74.59	76.44	77.62	68.64	69.56	56.45	51.42	34.21	16.43	65.46
Place of Residence												
Rural	77.25	82.90	75.41	87.06	84.95	72.63	59.73	80.04	74.73	35.95	0.00	70.56
Urban	22.75	17.10	24.59	12.94	15.05	27.37	40.27	19.96	25.27	64.05	100.00	29.44
Marital Status												
Single	14.47	15.55	12.52	16.17	18.45	17.13	20.05	27.44	27.22	34.56	41.58	20.28
Cohabiting	28.55	27.62	23.39	19.86	18.58	7.12	9.85	7.08	5.79	6.65	10.80	16.54
Married	46.59	48.08	55.31	53.69	54.33	66.77	61.47	55.06	56.38	50.47	40.65	53.94
Divorced/Widowed	10.40	8.76	8.77	10.28	8.64	8.98	8.63	10.42	10.61	8.32	6.97	9.24
Age Group												
15-19	21.68	19.18	19.86	21.56	23.03	24.60	23.70	24.07	25.04	24.89	26.23	22.46
20-24	21.74	21.73	22.93	23.3	20.78	21.18	20.73	19.96	20.75	20.38	21.00	21.72
25-29	18.03	18.07	18.76	17.88	16.98	16.78	17.34	15.35	13.62	15.14	15.44	17.07
30-34	11.87	12.64	12.08	12.63	12.79	12.53	12.78	12.15	11.77	12.67	12.94	12.43
35-39	11.67	12.2	11.02	10.86	11.17	11.04	10.96	10.67	11.25	10.97	11.20	11.13
40-44	7.55	8.08	7.92	7.27	7.85	7.31	7.71	8.64	9.10	8.35	7.52	7.87
45-49	7.47	8.10	7.43	6.50	7.40	6.56	6.78	9.43	8.47	7.61	5.67	7.32
Total Number	180,546	332,459	733,484	740,849	268,437	242,645	329,898	301,787	287,160	206,892	266,355	3,890,512

Source: Computations using the 1997 Mozambique census