

UNIVERSITY OF KWAZULU-NATAL

**ESTIMATION OF CHILDHOOD MORTALITY IN
KWAZULU-NATAL, 2001.**



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DECLARATION

This study represents the original work by the author and has not been submitted in any form to another University. Where use was made of the work of other it has been duly acknowledged in the text.

The research described in this study was carried out in the Department of Community Health, Nelson R. Mandela School of Medicine and the Province of KwaZulu -Natal.



AKM MONJURUL HOQUE

DEDICATION

DEDICATED TO MY PATENTS HASHEM ALI AND MOMTAZ BEGUM AND WIFE
SURIYA BIBI

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EXECUTIVE SUMMARY

Childhood Mortality Rates are key indicators used internationally as a sensitive but non-specific way of comparing health status and development. The aim of the study was to measure Childhood mortality for all districts of the province of KwaZulu-Natal.

Objectives of the study were to collect preceding pregnancy history of the first antenatal care (ANC) attendees to calculate the IMR and U5MR.

A cross sectional facility based survey was conducted using "Preceding Birth Technique" over the month of May 2001. Data was collected using the midwives administered questionnaire.

Six health districts of the total of 11 had low response rates (<50%) namely Durban Metro, DC 28, DC 26, DC 27, DC 29 and DC 43. The overall response rate of 49% for KwaZulu-Natal and the higher estimates of Infant Mortality and Under 5 Mortality Rates (98 and 142 per 1000 live births respectively) for KwaZulu-Natal were considered non-representative and high. The higher response rates (>72%) were obtained from 5 health districts namely DC 21, DC 22, DC 23, DC 24 and DC 25. IMR of 84 per 1000 live births (95% CI, 36-167) was the lowest for DC24 and 111 per 1000 live births (95% CI, 52-161) being the highest (DC 25). These estimates were considered the estimates of childhood mortality for the year 1999.

Further study is required to obtain better response rate to estimate Childhood mortality for KZN and its health districts.

ACRONYMS AND GLOSSARY

AIDS	:	Acquired Immune Deficiency Syndrome
CHC	:	Community Health Centre
CMR	:	Childhood Mortality Rate
HIV	:	Human Immunodeficiency Virus
IECM	:	Early Childhood Mortality Index
IMR	:	Infant Mortality Rate
KZN	:	KwaZulu-Natal
PBT	:	Preceding Birth Technique
PHC	:	Primary Health Care
REA	:	Rapid Epidemiological Assessment
RDP	:	Reconstruction and Development Programme
SA	:	South Africa
SADHS	:	South African Demographic and Health Survey
U5MR	:	Under 5 Mortality Rate
UNICEF	:	United Nations Children's Emergency Fund
UNAIDS	:	United Nations Programme on HIV and AIDS
95% CI	:	95% Confidence Interval

ESTIMATION OF CHILDHOOD MORTALITY IN KWAZULU-NATAL, 2001.

1. INTRODUCTION

According to Bradshaw¹ "Childhood Mortality Rates (CMR), including Infant Mortality Rates (IMR) and Under-5 Mortality Rates (U5MR) are key demographic indicators for assessing the health status of communities, districts and countries". These indicators are used internationally as a sensitive although non-specific way of measuring and comparing health status and development within and between districts, provinces and countries. IMR is an indicator not only of the health status of infants but also of the whole population, their socio-economic conditions and the availability, utilization and effectiveness of health services. The WHO has argued that it is both an indicator by which the health status of a population can be judged, and an important statistic for planning and evaluating health interventions.²

The U5MR is also considered a good reflection of the general well being of children in an area.² The IMR and U5MR of an area all have implications for local health provision, policy and resource allocation decisions.³ IMR is further divided into the neonatal mortality (less than 28 days of life) which is associated with quality of maternal health and access to care around the time of delivery and post neonatal mortality associated with poor socio-economic conditions, preventive and curative health services.²

Different factors are known to contribute to childhood mortality at different ages. The factors contributing to the death of infants include: socio-economic status of the family; level of community development and education; availability, access and quality of health services.² The under-five mortality rate is influenced by a variety of inputs: the child's nutrition and knowledge of caregivers; the level of immunization and oral rehydration therapy use; the availability of appropriate maternal and child health services; the availability of clean water and sanitation; the family income and the safety of the environment.³ Thus infant and other childhood mortality measures remain very important indicators of community development and health programme implementation.

The mortality rate among infants and children remain an emotion-laden issue in South Africa (SA), not only because of racial disparities but also due to urban-rural disparities.⁴ During 1981-1985, Yach⁵ reported that IMR for Whites in the urban and non-urban areas was identical (12/1000 live births). For Indians it was 17 & 20 per 1000 live births for urban and non-urban respectively; for urban Coloureds it was 26 and in non-urban areas, 66/1000 live births respectively. For Blacks it was 36 and 100-110 per 1000 live births for urban and non-urban inhabitants. Irwig and Ingle⁶ reported the IMR to be 130 per 1000 and the U5MR to be 190 /1000 live births in the rural Transkei based on household data collected during 1980. Between the years 1990 and 1995 the IMR in South Africa was estimated by various organizations. The national household surveys were conducted during these period reported substantial variations between 11 and 81 per 1000 live births.⁷ A similar trend was also reported in the 1998 South

African Demographic and Health Survey (SADHS) report. The national infant and under-5 mortality rates in 1998 was 45 and 59 per 1000 live births respectively, with the IMR being 33 in urban areas and 52 per 1000 live births in the non-urban population.⁸ The highest IMR in South Africa were reported in Coloured and Africans population.^{5,8,9}

Although the SADHS 1998 estimated an IMR of 45 per 1000⁸, later reports from United Nations Children's Emergency Fund (UNICEF)¹⁰ quoted the IMR for South Africa to be 54 per 1000 live births and U5MR of 69 per 1000 live births during 2000. The higher CMRs are not explained but could be due to real increase of rates or different data sources. Both figures are "estimates" and actually very similar.

A number of studies in South Africa have reported district level IMR. These include Ciskei (1987) and reported as 41 / 1000,¹¹ Khayalitsha (1987 – 1992) 30 / 1000,¹² Ingwavuma (1998) 62 / 1000¹³ and Hlabisa (1998) 53/ 1000 live births.¹⁴

The key child health problems in South Africa have been identified as malnutrition and preventable childhood infections such as diarrhoea and respiratory infections. Superimposed on these problems are the rapidly emerging epidemics of Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS) and the scourge of violence and trauma against children.⁹

The SADHS (1998)⁸ reported significant variation of IMR between provinces ranging from 30 (in the Western Cape) to 61/1000 live births in Eastern Cape. KwaZulu-Natal (KZN) was ranked the second highest with an IMR of 52 per 1000 live births. The SADHS 1998 report⁸ also showed that the IMR was higher in rural areas; babies born to mothers with no formal education; families with 4 or more children; and families where the birth interval between children was less than two years. This report further documented that 75% of poor people lived in rural areas and two thirds lived in the predominantly rural provinces of Eastern Cape, KZN and Northern Province. Although both national and provincial CMR indicators may appear to be low, this masks the very high CMRs in some health districts.

“Children have been given priority in the process of South Africa’s transformation”. The rights of the child are included in the constitution. “South Africa has thus committed itself to protecting children as a vulnerable group and ensuring that all government policies, laws, programmes, budgetary decisions and executive actions will prioritize children”.⁹ In order for the Government’s commitment to be translated into a tangible benefit, supportive policies at the national level must be reflected through comprehensive and integrated planning targeting the children at provincial and eventually district level.

- “Childhood mortality levels and trends are good summary measures of health and mortality and the overall welfare of the population”.

- “Childhood mortality rates capture the gross effects of both health interventions and other factors (positive and negative), which affect child survival”.
- “Childhood mortality differentials can provide valuable insights into the pattern and distribution of disparities in family and community health”.¹⁵

It is thus important that area or district specific childhood mortality indicators are measured regularly to compare and monitor progress towards the Government's development objectives.

2. LITERATURE REVIEW

2.1 Background

Since 1994, the Democratic Government of South Africa has been implementing the Reconstruction and Development Programme (RDP), which is its framework for socio-economic development. The RDP sets out broad principles and strategies for development in all key areas and sectors in order to effectively address the various problems facing the majority of the population of SA. The other major thrust of the RDP is to build the economy, and thus address poverty in the country. The RDP also proposes a restructuring of the health services so that all citizens of SA can achieve the optimal level of health and well being through Primary Health Care (PHC) principles, decentralization (District Health System) and community participation.

Furthermore to enhance the utilization of services, national policy decision was taken to remove the user's fee for pregnant women and children under-5 years of age. The KZN provincial Department of Health, introduced an extensive Clinic Upgrading and Building programme to improve the access of the health facilities to the communities they seek to serve. The District Health System would be to implement the national and provincial policies through comprehensive planning and promoting the well-being and health of children. The strong decentralization policy ensures that services including health will need to base their strategic plans on prevailing health status in order to address the true burden of disease and thus set realistic goals. A true estimate of the

health and developmental problems needs to be measured on a regular basis according to the geographic and manageable administrative areas, such as health districts.

It is reported that Infant mortality is increasing due to HIV/AIDS.^{16, 17} The United Nations Programme on HIV and AIDS (UNAIDS), reported in 2000 that by 2010, a doubling in child mortality is expected in regions with an already high prevalence of HIV infection.¹⁰ Every year the National Department of Health carries out an anonymous antenatal HIV prevalence survey. In KZN, the HIV prevalence amongst the pregnant women attending antenatal clinics was 36.5% (95% CI, 33.8-39.2%) for the year 2002, the province with the highest prevalence in South Africa.¹⁸ Between 25-48% of the children of HIV infected mothers are infected with HIV and more than 90% of the children acquired their infection from their mothers (mother-to-child transmission).^{10,16}

Immunization against childhood infections can prevent childhood deaths. In 1998, only 62% of children in the first year of life were fully immunized in SA. There was an urban-rural difference with 67% immunized in urban areas and 59% in rural areas.⁸ One in three children in SA was Vitamin A deficient in 1999.¹⁹

The estimated mid-year population of KZN for 2001 was 9070475, which constitutes 21% of total population of South Africa although confined to 8% of the land area of SA. Females constitute 53% of the population.²⁰ The population

pyramid of KZN (Figure 1) shows features of a developing country in transition, with declining infant numbers that may indicate higher childhood mortality and declining fertility. The majority (82%) is Africans and 57% live in the rural areas of the province.²¹

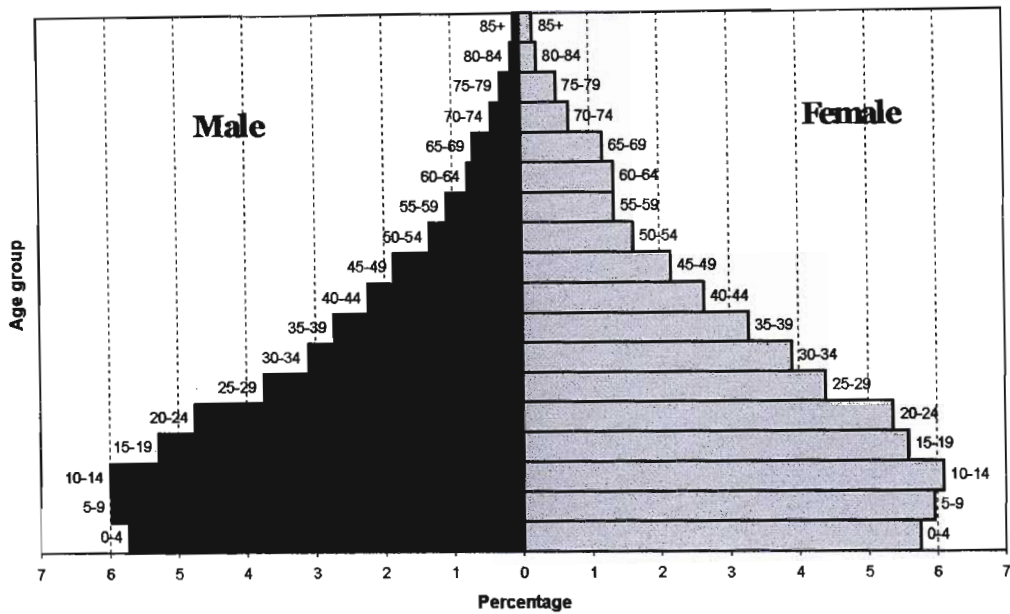


Figure 1: Population pyramid for KwaZulu-Natal: 2001 (N= 9070475)

Source: Statistics South Africa 2001²¹

Half (52%) of the population of KZN in the year 2001 were illiterate or had no schooling. There was a high unemployment rate (39%) and low average per capita income of R1140 per annum. Nearly a third (29%) of the population is economically dependent with 6% being physically disabled. Forty eight percent of the population lives in formal dwellings, 32% in traditional type of dwellings and the rest (20%) live in informal dwellings. Only 71% of the population has access to safe water supply.²¹ About 42% of households have flush or chemical

toilets, 41% uses pit latrine whereas 17% do not have toilets. Access to basic facilities also has rural-urban differences in KZN.²¹

2.2 Concepts of childhood mortality and definitions

“The central index for studying child survival and mortality is to measure the probability that a newly born child will live to a certain age or, conversely, die before a certain age. The “certain ages” are commonly chosen as one, two, and five, although any age can be used”.¹⁵

The general definitions of IMR and U5MR come from demography. As stated by United Nations Population Information Network (POPIN);²²

“Under 5 mortality rate (U5MR): The probability of dying between birth and the fifth birthday (exact age 5 years), expressed per 1000 live births.”

“Infant mortality rate (IMR): The probability of dying between birth and the first birthday (exact age 1 year), expressed per 1000 live births.”

Probability of death can be defined as the “number of individuals dying during a period divided by the number of individuals alive at the beginning of that period and exposed to the risk of deaths”.¹⁵

A risk or probability measures the relative frequency with which an event occurs during a period among all those who have a chance of experiencing it.¹⁵

Age specific death rates can be converted to these probabilities, or risks of dying. Thus IMR refers to the probability of dying between birth and age one. The U5MR

measures the chance that a newborn child will die before reaching his or her fifth birthday.¹⁵

There is some confusion about the precise meaning of some of the measures of childhood mortality. The term **rates and risks or probabilities of dying** are often used interchangeably. A rate relates the number of deaths during a specified period of time to the average population during that period of time. A ratio is simply one number divided by another (number). However, the IMR, the conventional Infant Mortality Rate, which is the frequency used to measure risk of dying, is actually a ratio:

Deaths under age one in the year

Live births in the year

“Infant Mortality Rate is defined as the number of infant (children under 1 year) deaths in a year over the number of births in that particular year”.¹⁵

The formula for IMR thus:

$$\text{IMR (t)} = \text{D (t)} / \text{B(t)}$$

IMR (t) is the crude IMR for year t, D (t) is the number of deaths to infant in year t, and B (t) is the number of births in t year.

The count of total live births (denominator) and total deaths (numerator) for the specific time period usually for one year are used to calculate IMR.

“While the IMR is not the pure probability, in the absence of exceptional conditions it is usually accepted as measuring the probability of death before exact age one.

The IMR can be specific for sex, residence, education of the mother etc., always depending on whether the requisite data are available".²³

2.3 Data Sources for Estimating Childhood Mortality

2.3.1 Ideal data sources: Vital Registration

The two main items of data are needed to calculate mortality rates and these are to “(1) count the population (census) to establish the size of the denominator population at risk and (2) the count the event (deaths) from (vital) registration for the numerator. With such data one can calculate death rates and convert them to probabilities of death and survival by using life tables”.¹⁵

To calculate the IMR or CMR, continuous registration of births and deaths are the richest source of data. The IMR can be calculated in the conventional manner directly from the vital registration data. Few less-developed countries or developing countries have complete vital registration systems and adequate census data. Some countries even with good vital registration coverage have delays with getting the data collated delaying the availability of childhood mortality measures.¹⁵ Vital registration data is usually collated at country or provincial level. It is seldom available at district or local level where it is needed for management decisions. This is a major limitation of conventional vital registration systems.

2.3.2 Alternative data sources

Attempts have been made to collect vital data from health services. This method results in a selection bias. Deaths and births occur at home and may not be



recorded at health facilities. Thus alternate methods have been devised to enable the estimation of the infant and child mortality measures.

- a) Census: Census can be used to gather some data on mortality. Information is collected from women on the number of children born who survive. Indirect techniques are used to convert the proportion of children surviving into standard life tables to determine the probabilities of dying. Child mortality estimates obtained from census data generally refer to the period about 5-15 years before the date of the census.¹⁵
- b) Sample registration: Due to lack of vital registration system in many countries, attempts have been made in different part of the world to introduce a new or improved registration system in a small number of sample areas. "A successful example of this strategy is the Indian Sample Registration System, which provides apparently satisfactory estimates of vital rates for almost all states of the country. In this system, specific representative areas of a country are chosen and efforts are made to establish a complete and accurate registration system".¹⁵ This system is not always successful. In this system it is imperative that representative samples of the population are considered. Data from these sample areas are then extrapolated to the areas which they represent. Sample registration system may be an "important step toward the creation of a nationwide registration system".¹⁵
- c) Sentinel Sites / Population Laboratories: A geographically defined population is kept under detailed study for an extended period"¹⁵. The population of the

defined population is visited frequently to inquire about demographic events to collect data including on morbidity, contraceptive use and mortality.

“The best-known population laboratory is Matlab in Bangladesh. The Matlab demographic surveillance system (DSS) maintains a record of vital events of over 200,000 people (1993 census) since 1963. Directly measured mortality and migration rates are available from the continuous recording system. Pregnancies are also systematically followed to avoid omission of birth and deaths. Exact age of birth and death data is collected so birth intervals are measured. It is a unique system to collect detailed information in the developing population”.²⁴ A similar initiative in South Africa, the Africa Centre, has been operational in the Northern part of KwaZulu-Natal since 2000.

- d) Multi-round surveys and surveillance system: Repeated visits to households in sample areas are considered to capture or record demographic events. Follow-up rounds are usually six monthly or annually. Availability of resources is the limiting factor for the amount of collecting background information.²³

These surveys “can generate excellent measures of levels, age patterns and differentials of child mortality for the study population”.²³ Multi round surveys are found to be extremely expensive and are unable to provide quick measures because time is needed to build up sufficient events and exposure to risk to calculate stable rates. “It is also considered that it becomes less and less representative as time goes by”.²³

e) Sample Surveys: "The most widely used substitute for a complete and timely vital registration system is the incorporation of questions in a cross-sectional data collection procedure asking women about the survival of some or all of the children they have had".²³ These "surveys are similar to a census as they collect data at a point in time, rather than continuously as is done in a vital registration system". In case of "child mortality, sample surveys collect full birth or maternity histories from mothers". Data from such studies enable the use of direct calculation of child mortality from life tables.

Sample surveys are usually taken with the aim of obtaining a good representation of the population "whether small-scale (at district or sub-district level) or at a larger scale (national level)". "Survey sample populations are chosen to be representative of the larger populations". Because it requires small samples of the total population and because they are single efforts (or repeated efforts), sample surveys "requires major efforts in preparation, fieldwork, data processing and analysis".¹⁵

2.4 Methods for calculating child Mortality Rates

“There are two basic methods that infant and child mortality rates are measured, direct or indirect methods”.²⁶

2.4. 1 Direct Method

This method is based on the vital registration or on the dated vital events from retrospective birth histories. Women are asked about each of their live births and whether the child is currently alive or not.²⁶ This data allows relatively accurate estimates of child mortality by time period and the age of the child.²³ This technique does not use life table models.

2.4. 2 Indirect Method

The indirect technique for calculating child mortality requires fewer and simpler questions resulting in substantial cost savings.

Indirect methods use the proportion of children ever born who have died classified by five-year groups of mothers.²³ Although based on different forms of data and underlying assumptions that both the methods give estimates of infant and child mortality that approximate the true level, provided the calculations are based on good quality data.

The indirect method is based on six questions per woman, while direct method requires a full birth history including about six questions per child of each woman. Birth histories include dates of birth and deaths (where applicable), which can be difficult and time consuming and result in significant recall bias. The interviewer training required for the indirect methods is also substantially less for a number of reasons. Indirect method interviewers are required to calculate dates from ages or ages from dates where applicable.²²

“Both methods are based on the assumption that women’s mortality is not calculated with their children’s mortality. If the two are correlated than as women died, and were not captured in the household survey, there would be a bias in the child mortality estimates”.²⁵

2.4. 3 Limitations of Direct and Indirect Methods

Although the data sources are different for two methods, the assumption for both direct and indirect methods are that both methods should estimate true childhood mortality rates, levels and trends. Thus, childhood mortality rates are measured by either using direct or indirect methods. Adetunji²⁶ had shown that “indirect method produces significantly higher IMRs in Africa compared to direct method estimations. The possible explanations included are: (i) combination of data errors, (ii) lack of conformity to method assumptions and (iii) intrinsic biases in the method. He also proved that the use of combination of both

methods in IMR studies in Africa could create artificial increase or decrease in mortality measures over time”.

Both methods require good quality data and can be biased if this is not available. “While neither the direct nor the indirect method is immune to poor data, other assumptions made in indirect methods can further bias its estimations”.²⁴ There is also an ongoing debate between those who favour the use of the indirect methods and those who see them as obsolete and inferior to the direct methods for estimating childhood mortality.^{23,27}

Some literature uses childhood mortality rates without reference to the method used to obtain the level. At times estimates have been calculated from mixing both direct and indirect approaches in the studies to estimate the levels of infant and child mortality. These estimates use the two approaches as the same and others have combined mortality estimates from both methods to derive a trend line.^{26, 28}

In Demographic and Health Surveys, the source of the mortality information is generally the full birth or maternity history with child mortality calculated by ordinary life table methods.

The difference in findings observed between Demographic Health surveys and Census data in SA are marked (Figure 2). The Census estimation is usually higher than the Demographic estimation. These observed differences could be due to the use of different methods of estimation or calculation. The census is

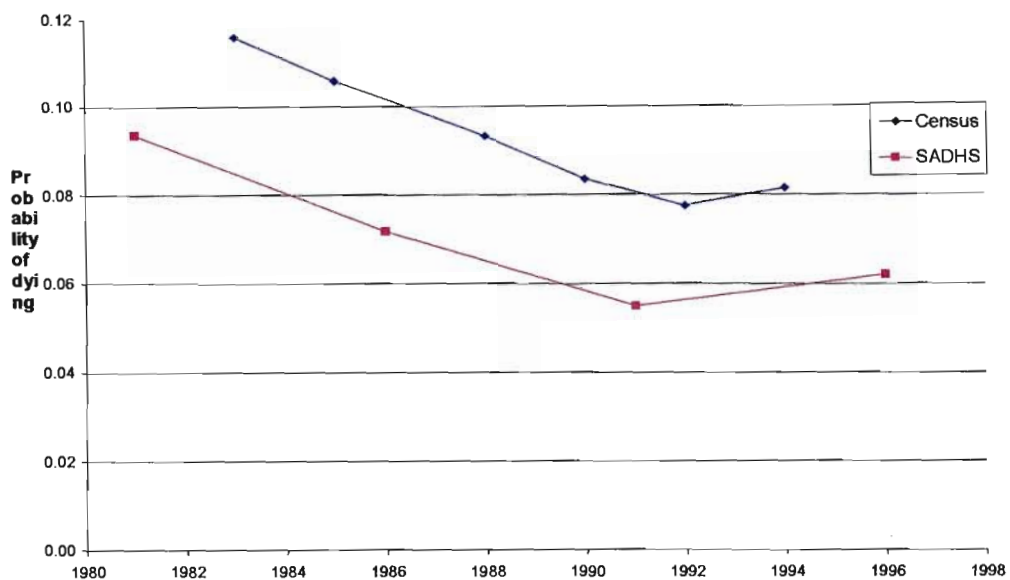


Figure 2: Comparison between the national under-five mortality estimates reported in the Census and the SA Demographic Health Survey.

Source: Department of Health, Pretoria 2000

known to use the Brass Indirect Method and DHS uses direct methods. These are similar to other findings in regards to estimation method (indirect method is likely to estimate higher childhood mortality).²⁷

Demographic and Health Surveys were conducted in SA during 1993, 1995 and 1998.^{7,8} The CMR results obtained from these surveys were disaggregated to give an estimate for each province. Estimates were also presented for rural-urban and different racial groups. District level estimations of CMR are not available. The SADHS results of under-5 mortality in also gave different CMR estimates from those obtained from the Census (Figure 2). There was a good correlation between the Census and SADHS Surveys but the CMR level observed in the SADHS was consistently lower than that from the Census. This

was probably due to the methods used to calculate the rates and the data collection tool.²⁶ Census data may have inflated by stillbirths that could have been reported as dead live births.²⁹ Demographic and Health Surveys and Census are also very costly exercise for the province to conduct on a regular basis at the district level.

While point estimates of mortality rates serve some purpose, a consistent trend over time gives a clearer indicator of change in an area, which might then be linked to changes in risk factors, socio-economic or health service changes.³⁰

The various approaches used to measure childhood mortality have strengths and weaknesses.²³ Generally the estimates using these methods are used to describe levels, trends and differentials in childhood mortality

Surveys provide useful childhood mortality information, but often, owing to their cost and limited sample size, give only aggregated estimates, which may span a number of years.² For health planning and monitoring purposes ideally one want to have the most recent data, for the most disaggregated areas, so that one can correlate the data with other variables and interventions.

The current lack of reliable vital statistics in South Africa makes it essential to use alternative methods for estimating CMR in order to be able to monitor health status at a district level. The options that could be utilized in a Primary Health Care setting need to be explored.

Considering the limitations of the two methods to estimate childhood mortality, a technique (rapid epidemiological tool – “extension of Preceding Birth Technique”) is considered to apply in our study to measure a general level of childhood mortality.

2.5 Rapid Epidemiological Assessment Tools

Rapid Epidemiological Assessment (REA) tools are a collection of methods, which provide health information more rapidly and simply, at a lower cost than standard methods of data collection and yet yield reliable results for use primarily at the district and sub-district level. One REA method is the Previous Birth Technique (PBT)

2.5.1 Preceding Birth Technique

PBT is an indirect method used for measuring CMR.^{15, 23-27, 30} It is an alternative but well recognized simple clinic-based approach to measure IMR and U5MR.¹ PBT is an extension of the method invented by Brass and Macrae³¹ in 1984 and modified again by Aguirre and Hill³² in 1990. It is an indirect method, where the CMR estimation is a hybrid measure calculated by averaging births and deaths over the period preceding the survey. PBT requires very simple data. Mothers are asked about the survival of their preceding live-born child at the time of a visit to a health facility, at the time of antenatal care or for a subsequent delivery or just after a subsequent delivery. Mothers are asked three simple key questions:

- Have you ever been pregnant before this present pregnancy or delivery?
 - If yes, what was the outcome of this pregnancy (live birth, still birth, miscarriage or abortion)?
 - If it was a live birth, is the child alive today?
- (These questions can be seen in Annexure A.)

An **early childhood mortality index (IECM)** is then calculated by counting all the preceding born live births that died before the inquiry (the numerator), and dividing by the total number of live births including babies that died immediately after birth (the denominator). Using six different model live birth to live birth interval distributions in conjunction with the Brass-General and African standard mortality schedules, Brass and Macrae show that the proportion of immediately preceding births dying before the index birth date approximates the probability of dying before the second birthday, $q(2yr)$. On the basis of a suitable model life table, this can be converted to an estimate of the IMR or an U5MR.¹ The CMR calculated by this indirect method is particularly suited for following mortality trends over time rather than estimating absolute levels of mortality.

2.5.2 Strength and weaknesses of PBT

One of the limitations of the PBT is that it is facility-based and may not measure true overall childhood mortality in the surrounding population due to a selection bias. In order to reduce this selection bias the survey needs to be conducted at

the time where most women attend the health service for care. In most developing countries only a small proportion of women deliver in hospitals and maternity clinics, whereas the majority of women worldwide seek some antenatal care and even higher proportion bring their young children for immunization.³³

The representativeness of the sample is one bias that should be corrected by using women seen at a time either before or after the birth of their children when most attend the health service in the area being surveyed. Aguirre and Hill³² have shown from models that the mortality estimates obtained at exactly the time of birth or before or after birth vary slightly. It is important to know and to standardize in a country or province when the data is collected from the mother. The time span from conception to when child is brought for immunization at 6 to 12 weeks is nearly 12 months. The mortality estimates obtained from the proportion of preceding children dead among women seen 3 months before delivery, slightly under estimates $q(2)$ CMR, but the difference is small, especially if the women are seen in the last trimester of pregnancy.¹⁵

When a mother is seen after a birth, provided the delay between delivery and in the post-natal interview is not more than a few months, the proportions of preceding children dead will only be slightly affected.

The PBT method is susceptible to the consideration of **“mean length of birth intervals.”** If all the birth intervals between the current births and the preceding

births are the same length (l), then P , the proportion of preceding births which had died before the next birth, will be equal to $q(l)$, the probability of dying from birth to the exact age l . Brass & Macrae³¹ and Acquire & Hill³² described this concept in their literatures. Because the birth intervals are not all the same length but “clustered around a point roughly equivalent to the length of the mean birth interval” and because this “distribution is not symmetrical (there is a very long “tail” on the birth distribution), the value for P is not equal to $q(l)$, but equal to $q(x)$ where x is less than l . Brass and Macrae³¹ calculated a factor which l is multiplied with to give an approximation of x . The value is usually set at 0.8, although some researchers have suggested that it may be closer to 0.9 in African countries”.^{24, 34} In some published studies the mean birth interval is usually taken as 30 months, thus equating to $q(2 \text{ yrs})$ (the probability of dying between birth and exact age 2 years).²⁴

Further studies conducted in Bangladesh showed that with birth intervals as long as 40 months, the proportion of preceding children dead, whether at birth, before delivery (ante-natally) or 3 months after, was a better estimation of $q(3)$ than $q(2)$.²⁴ Aguirre and Hill³² also showed that $q(2)$ is generally around 90% of $q(3)$ so the one can be readily estimated from the other. The mean birth interval in South Africa for rural African population is 42.4 months which is close to 40 months.⁸

In KwaZulu-Natal there are still a high proportion of women who deliver at home and the coverage of post-natal check-up is also low. Surveys however, have

shown that antenatal coverage is high. This is the reason this survey was done on women attending ANC for the first visit. Considering all the above factors we decided to use PBT at our health facilities to collect data from mothers who attend antenatal clinics for antenatal care and estimate district specific childhood mortality.

2.6 Model Life Tables

The use of Model Life Tables is required to estimate the IMR and U5MR from IECM calculated from the data collected from a PBT survey. There are different Model Life Tables available. These tables enabled us to estimate the mortality for any age. Underlying the PBT is an assumption about the relationship between infant, childhood and adult mortality. There are several models, which could be selected, and it is not known which one would be correct to use for South Africa and in particular to KZN.

The aim of developing a life table is to describe the summary statistics or mortality, survivorship, and to measure life expectancy for a specified population and according to age and sex. Age and sex-specific death rates of a population is the basis for the development of a life table.^{36,37} Vital registration and census data are two important sources in this regard. It is reported that in many developing countries, these basic data sets required for construction of life tables either do not exist or are not usable because of incompleteness of coverage or errors in reporting of vital events.³⁶ In such situations, demographers have applied variety

of techniques for adjustments to develop reasonably suitable Life Tables. In cases of unusable or non-existent vital registration data, demographers are seen to use indirect techniques for obtaining mortality rates for construction of Life Tables.³⁶ Therefore, Model Life tables are considered essential demographic tools for mortality measures.

There are two known forms of life tables (a) cohort table and the (b) current or period tables. When life tables are constructed from monitoring a population longitudinally from a determining event such as birth cohort is known as cohort tables. While transversal view of mortality and survival experiences are used to construct current life tables.³⁷

Based on different data sets, geographic areas, population and techniques, demographers have developed different Model Life Tables and the best known ones are (i) the UN Model Life Tables, (ii) The Coale-Demeny Model Life Tables, (iii) the UN Model Life Tables for Developing countries, (iv) the Ledermann System of Model Life Tables (v) the Brass Logit System and (vi) WHO system of Model Life Tables.

2.6.1 Brief descriptions of different model life tables

i) UN model life tables: The UN published the first set of Model Life Tables in 1955. The principles underlying the construction of these Life Tables were the use of statistical techniques to relate mortality at one age to the mortality of another

age for a range of mortality levels. Thus, knowledge of only one mortality parameter determines a complete life table. For this reason, these life tables are considered to be a one-parameter system.³⁶ Subsequently UN had developed a new model life tables based on reliable data (census, surveys etc.) from less developed countries.³⁸

ii) **The Coale and Demeny regional model life tables:** These model life tables were first published in 1966. The construction of these Life Tables considered different geographical regions of the world and different time period and mostly from developed countries.^{36,38} All of these selected regional life tables were derived from vital registration data, and were subjected to very stringent standards of accuracy.”³⁶

One of the key findings from these Life Tables was “the four typical age patterns of mortality, determined largely by the geographical (areas) of the population”. “Those patterns were called: **North, South, East and West Model Life Tables**. Each pattern had a characteristic of child mortality. The **East model** came mainly from the Eastern European countries, and is characterized by high child mortality in relation to infant mortality. The **North model** was based largely on the Nordic countries, and characterized by comparatively low infant mortality, high child mortality and low old age mortality beyond age 50. The **South model** is based on life tables from the countries of Southern Europe (Spain, Portugal, and southern Italy), and has a mortality pattern characterized by (a) high child mortality in relation to infant mortality *at high overall mortality*, and (b) low child relative to

infant mortality *at low overall mortality*. The **West model** is based on the residual tables not used in the other regional sets (i.e., countries of Western Europe and most of the non-European populations). It is characterized by a pattern intermediate between North and the East patterns. Because this model is derived from the largest number and broadest variety of cases, it is believed to represent the most general mortality pattern.³⁶

iii) The Ledermann's system of model life tables: The construction of these tables relied on the mortality experiences of the developing countries and the method of selection was less rigid than in the Coale-Demeny tables.³⁹

iv) Brass Logit system: "The basic principles to construct this system was the assumption that two distinct age-patterns of mortality on any population can be related to each other by a linear transformation of the Logit of their respective survivorship probabilities. However, the approximation is close enough to warrant the use of the model to study and fit observed mortality schedules."⁴⁰

v) The UN model life table for developing countries: The underlying principles were to cover the experiences of wide range of mortality levels from developing countries. With the advent of new demographic techniques of data evaluation and data sources (surveys, census and vital registration) from developing countries, it was possible to construct new UN model life tables.³⁸

These life tables have shown a series of mortality patterns such as Latin American, Chilean, South Asian, Far Eastern and overall average or general patterns based on the geographic regions.³⁸

vi) WHO system of Model Life Tables: A wide range of mortality experiences are used based on the modification of the Brass Logit life table to develop a reasonably accurate and representative standard Model Life Tables.^{36,41} Therefore, country-specific, global and standard Life Tables were developed.^{36,41}

2.6.2 Shortcomings of the Model Life Tables

The age specific mortality rates from a broad range of countries had been studied extensively and the application of statistical methods had enabled the creation of Model Life Tables for each of the different age patterns of mortality.^{1,37} For each pattern of mortality (model), extensive tables had been generated that give the mortality (or survival) at each age for a range of levels of mortality. For example one model might had shown a pattern of relatively high childhood mortality while another might reflect much lower childhood mortality but have a high mortality for young adults.

Among the shortcomings of mortality and or survival (Life Tables) measures, it is noted that some models (UN Models) have single parameter which cannot describe adequately the complex mortality experience.³⁶

It is clear, therefore, that there are serious technical issues that complicate the use of models in describing childhood mortality in developing countries due the

use of data. These are further compounded by the emergence of HIV/AIDS as a major cause of death in Africa and parts of Asia.^{36,42} The construction of conventional life tables for less developed countries is not always a straightforward procedure. These are due to the limitations in the mortality and fertility data.³⁷

2.6.3 Selection of Model Life Tables

There are no hard and fast rules for selection of Model Life Tables. Any life table can potentially be used as a standard in the logit system. The usefulness of relational Model Life Tables for indirect estimation of child and adult mortality, however, depends on whether the model standard can be chosen judiciously. If the model standard is chosen correctly, the derived estimates of childhood and adult mortality are less likely to be in error.

The Human Research Council and the Department of Health and Population Development have used the West Model Life Table, which has the very general age pattern of mortality being high for infants, declining during childhood and rising during adulthood.¹

2.7 Purpose of the Research

The purpose of this survey was to estimate the CMR at District level using easy, quick and reliable Preceding Birth Technique (PBT) in order to compare the IMR and U5MR in KZN health districts.

3. SPECIFIC OBJECTIVES:

- To obtain previous birth data from the pregnant women who attended health facilities for antenatal care during the month of May 2001
- To estimate the IMR and U5MR for each health district and the province of KwaZulu-Natal using Model Life Table.

4. MATERIALS AND METHODS

4.1 Setting and Population

Public sector antenatal services in KwaZulu-Natal are provided in 429 primary level health facilities, which include fixed clinics, mobile points, community health centers (CHC) and district hospitals (Annexure, Map 1).¹⁹ These health facilities are distributed among the 11 health districts. The name of the districts and the number of health facilities are shown in table 1. When high risk factors in pregnancy are identified then the mother is referred to a higher level of health care facilities (Regional and Tertiary Hospitals). All public health facilities providing primary level antenatal care made up the study population. All pregnant women attending these facilities for their first antenatal visit during the study period were the sample population. Mothers who attended the health care facility for repeat or follow up visits were excluded.

4.2 Sampling frame, data collection and analysis

All provincial and local authority primary level health facilities providing antenatal services were requested to participate. A one-day training workshop was held in each health district with the District Clinic Coordinators, PHC Supervisors and Midwives to inform them of the purpose of the study and to explain the data collection method. Data collection was done using the data capture form (Annexure A). All preceding births including multiple (e.g., twins) births were recorded using clearly defined terms. Training of Health Care

Workers (HCWs) was done during the month of February 2001. Thereafter the HCWs providing antenatal care were requested to participate in conducting the study during the month of May 2001.

The midwives completed the preceding birth outcome questionnaire from pregnant women who visited the facilities for their first ANC visit during the month of May 2001. The month of May was chosen arbitrarily. The midwives collected data at the time of patient history taking on the customized questionnaire (Annexure A), which addressed the issue of outcome of previous pregnancies. Adequate numbers of data collection forms were supplied to each health care facility. Primigravidas (First time pregnant women) and repeat ANC attendees were excluded from the study. Data gathered from each health facility was then entered into a spreadsheet and a district summary of total live births, babies still alive, live births who are now dead and the proportion of dead to all preceding live births were calculated. The proportion of dead of preceding live births was calculated and then matched with the West Model Life Table to estimate the IMR and U5MR. The 95% confidence interval (95% CI) for the estimate was also calculated for each health district and the Province (KZN).

4.3 Ethical consideration

Permission was sought from the Provincial Department of Health, KwaZulu-Natal to conduct the study in public health facilities. Ethical permission from the Research Ethics Committee of the University of KwaZulu-Natal was requested.

Data from health facilities were collected before the ethical approval for the study was granted. Patient information leaflets and Informed consent forms in Zulu were handed to mothers who participated in the survey, as well as an explanation of the purpose of the study. Confidentiality was explained to all relevant parties. No names were used in the data collection, collation, analysis, results or discussion.

4.4 Statistical analysis

The formula used for calculation of 95 % Confidence Interval for the proportion was $95\% \text{ CI} = p \pm 1.96 \sqrt{[p(1 - p)/n]}$

p= Proportion (using proportion of live babies died over all live births)

n= Sample size

Pearson correlation test was conducted to measure the relationship between two variables.

5. RESULTS

5.1 Response rate

Only 212 (49%) of health facilities of the total of 429 providing primary antenatal care collected and submitted the relevant data from the first antenatal attendees to the KZN Provincial Epidemiology Unit. The response rates per district and for the Province are shown in Table 1 and Map 1.

The response rate ranged from 7% (Durban Metro and Uthungulu) to 92% in Umgungundlovu. This difference is statistically significant ($p= 0.005$).

Table 1: Response rate (number and percentage) of health facilities providing antenatal care that collected data for the PBT study (per district) in KwaZulu-Natal for 2001.

Health Districts	No. of facilities	Response rate (No. & %) in 2001
Durban Metro	77	5 (7%)
DC 21 Ugu	49	44 (90%)
DC22 Umgungundlovu	38	34 (90%)
DC 23 Uthukela	35	32 (92%)
DC 24 Amajuba	32	23 (72%)
DC 25 Umzinyathi	19	14 (74%)
DC 26 Usuthu/Zululand	41	17 (42%)
DC 27 Umkhanyakude	51	27 (53%)
DC 28 Uthungulu	45	3 (7%)
DC 29 Ilembe	23	5 (22%)
DC 43 Griqualand	23	8 (35%)
TOTAL	429	212 (49%)

Table 2: Number of pregnant women attending clinics for antenatal care and those having a preceding birth surveyed per health district in KwaZulu-Natal during May 2001.

Health Districts	Women attending for first ANC	Pregnant Women (No. & %) having preceding live births
Durban Metropolitan	640	404 (63%)
DC 21 Ugu	1304	826 (63%)
DC22 Umgungundlovu	841	482 (57%)
DC 23 Uthukela	923	611 (66%)
DC 24 Amajuba	604	369 (61%)
DC 25 Umzinyathi	379	262 (69%)
DC 26 Usuthu/Zululand	934	652 (60%)
DC27 Umkhanyakude	518	352 (67%)
DC 28 Uthungulu	301	246 (81%)
DC 29 Ilembe	530	430 (81%)
DC 43 Griqualand	512	356 (69%)
Total	7486	4990 (66%)

A total of 7486 pregnant women attended for first antenatal bookings at the participating health facilities (Table 2) during May 2001. Of the women attending for the first visit, 4990 (66%) pregnant women had preceding live births. There was no statistically significant difference in the proportion of pregnant women having had a preceding live birth in the different health district ($p>0.05$). The outcomes of these preceding live births were analyzed to estimate the IMR and U5MR (Table 3, Map 2 & Map 3) using the West Model Life Table.

5.2 Estimation of IMR and U5MR

Table 3: IMR and U5MR (95% Confidence Interval) from 2001 PBT data in KwaZulu-Natal (per district).

Health Districts	Last baby alive (A)	Last baby dead (D)	Proportion Dead $\frac{D}{A+D}$	IMR / 1 000 live births* (95% CI)	U5MR / 1000 Live births* (95% CI)
Durban Metro	369	35	0.086	74 (30-115)	103 (32-148)
DC 21 Ugu	728	98	0.118	95 (60-130)	136 (81-191)
DC 22 Umgungun dlovu	417	65	0.134	107 (64-149)	156 (82-220)
DC 23 Uthukela	548	63	0.103	86 (52-115)	122 (67-168)
DC 24 Amajuba	331	38	0.101	84 (36-167)	120 (48-246)
DC 25 Umzinyathi	226	36	0.137	111 (52-161)	162 (78-246)
DC 26 Usuthu/Zululand	566	86	0.127	100 (62-136)	145 (81-203)
DC 27 Umkhanyakude	307	45	0.127	100 (51-147)	145 (72-222)
DC 28 Uthungulu	212	34	0.138	112 (52-161)	164 (71-245)
DC 29 Ilembe	379	51	0.130	102 (85-129)	148 (120-191)
DC 43 Griqualand	308	48	0.134	107 (54-157)	156 (72-234)
Total	4391	599	0.121	98 (91-105)	142 (128-152)

*Using West model life table

The crude IMR for KZN based on the 2001 data is estimated 98 (95% CI, 91-105) and the U5MR of 142 (95% CI, 128-152) per 1000 live births. The district IMR ranged from 74 (Durban Metro) to 112 (Uthungulu) per 1000 live births. The U5MRs ranged from 103 to 164 per 1000 live births (Table 3). These differences are statistically significant ($p < 0.05$).

6. DISCUSSION

Ideally, all childhood births and deaths should be recorded through the vital registration system. Since vital registration is incomplete in KZN, alternative methods of measuring CMR can be used. PBT is an easy, alternative and reliable survey method used to measure IMR and U5MR for the province of KZN and its health districts. This survey is the first estimate of IMR and U5MR for all the health districts of the province of KwaZulu-Natal.

6.1 Response rate

The overall response rate obtained from health facilities of KZN was low (49%). The districts had low response rates are namely Durban Metro and DC 28 (7%), DC 26 (42%), DC 27 (53%), DC 29 (22%) and DC 43 (35%) would not be considered representative or reliable. Higher response rates were obtained from other 5 health districts namely DC 21 (90%), DC 22 (90%), DC 23 (92%), DC 24 (72%) and DC 25 (74%) considered better representative and reliable. As a result of poor response rates for the provincial and its health districts the estimation of CMR would have different interpretations. Thus the CMR of these districts would be further discussed later. The poor responses obtained from the districts could be due to a number of factors. Possible factors include:

- The burden of the cholera epidemic: The cholera epidemic persisted in KZN from August 2000 till November 2001. According to the Department of health

press release dated 4 December 2001 the attack rates of reported symptomatic cholera cases for different health districts were shown in Table 4. Pearson correlation test result of correlation (r) = 0.5122 for district facility response rate and cholera attack rate. This means, response rate and cholera attack rate are negatively correlated. Low response rate is likely to be associated with High cholera attack rate. This could explain the poor response obtained from some health districts of KZN.

- Midwives from almost all rural health facilities had to work at rehydration centers of cholera stricken districts. This could have meant that they were too pre-occupied to carry out the survey. Although no cholera cases or very minimum numbers of cases reported from Durban Metro and DC 43 health districts, the PHC workers from these health districts volunteered to work at cholera stricken areas of KZN. Health workers from other Provinces of South Africa and South African National Defense Force Medical Unit were also deployed at cholera areas of KZN (personal communication and experience).

Table 4. Cholera attack rates for KwaZulu-Natal for 2000/01 per district

Health Districts	Attack Rate during 2000/01 per 100,000 population
Durban	5
Metro	
DC 21	1192
Ugu	
DC 22	384
Umgungundlovu	
DC 23	77
Uthukela	
DC 24	368
Amajuba	
DC 25	31
Umzinyathi	
DC 26	3453
Usuthu	
DC 27	113
Umkhanyakude	
DC 28	5216
Uthungulu	
DC 29	2890
Ilembe	
DC 43	0
Griqualand	
TOTAL	1257

Source: Department of Health, KwaZulu-Natal 2001

- Support, supervision and monitoring of the study (data collection) for the wide area of the province were inadequate due to the fact that the researcher underestimated the problem of poor participation.

It is not unlikely that the pregnant women who did not attend health care facility or women from those non participating clinics were experiencing different childhood mortality. If the childhood mortality experience of those women from non participatory clinics were higher than those who participated then the estimated crude CMR would be underestimated in our study. Conversely, if the childhood mortality experience of those women from non participatory clinics were lower than those who participated then the estimated crude CMR would be overestimated in our study. Thus it is probable that the results of the study had been influenced (lower/higher) by the poor response rates.

6.2 PBT Method

In the absence of good vital registration data, this alternative, easy, quick and reliable "Preceding Birth Technique" used to measure childhood mortality in KwaZulu-Natal showed strengths and promises. The method was easily understood by the Primary Health care workers especially the staff looking after pregnant women, implement able and required minimum data on a spreadsheet. Analysis of PBT data was also required simple calculation to measure IECM. Thereafter, use of model life table for look up value for IMR and U5MR were less difficult.

6.3 Considerations of PBT

One of the limitations of the PBT method is that the data is collected from health facilities, not from communities or households. This selection bias may lead to a measure of childhood mortality for the district population that is not true, unless most pregnant women attend health care facilities at the time the previous birth outcome is evaluated. In this study we considered only public health facilities and excluded women attending private antenatal care who may represent people of high socio-economic group and those who did not attend health facility at all. This may limit the representativeness of the study and influence the results. Not including women from the private sector of the population is likely to result in an over estimation of the CMR for the districts and province. Excluding those who do not attend the public sector antenatal clinics could either result in an over or under representation of the CMR estimate.

Not all women deliver their babies at in the health services. Studies conducted in rural KZN showed that the percentage of pregnant women who attended public health clinics for antenatal check-up was higher than the percentages that delivered in the health services.⁴³ Most women (99%) in rural districts (DC 27) during 1998 and 95% of pregnant women in Hlabisa health district (part of previous DC 28) were found to attend antenatal care on one or more occasions during their pregnancies.^{43,44} This finding is likely to be generalized to the other health districts in the province of KZN. High antenatal coverage was considered likely for all health districts in KZN as the PHC services and facilities were improved through the national and provincial effort. Further studies would be necessary and required to establish the antenatal care service utilization at

different health districts and different types of health services (such as public, private and traditional or not using service) at the province of KZN and its' health districts.

Mean Length of Birth Interval

The method was considered susceptible to the changes in the "mean length of birth intervals" as described in the literature review. The mean birth interval in South Africa for rural African population was 42.4 months.⁸ This equates to approximately $q(3 \text{ yr})$. If the value for $q(x)$ were then used to look up $q(1 \text{ yr})$, IMR or $q(5) \text{ U5MR}$, assuming incorrectly that is equivalent to $q(2\text{yr})$ a higher value for IMR and U5MR would be obtained. We used $q(1 \text{ yr})$ to estimate the CMR from the West Model Life Table. Thus our estimation could have been over estimation for CMR for KZN and its health districts.

The **absence of last child from the sample** is seen as a limitation of the PBT method. Information is not gathered from a mother if her previous pregnancy was also her last pregnancy. If last births had a different mortality than the other births, then their absence from the sample would have caused a bias. However, if last births were only a small proportion of all births, as it was considered true in countries with high fertility, then any bias would be minimized. Total Fertility Rate in South Africa is relatively low, even in the case of rural African populations. It was 4 (urban 2.4), implying that a higher proportion of all last births could be excluded by this technique especially in urban areas but in rural areas as well.⁸

Preceding birth histories were obtained from mothers during their antenatal first visits could have led to recall bias. But recall bias could be considered minimum, as mothers are unlikely to forget their recent past history of childbirth and outcome.

Use of Model Life Tables is also considered susceptible to bias in CMR estimation. The West Model Life Table used, considered the very general mortality pattern of being high for infants, declining during childhood and rising during adulthood.¹ Using this pattern may result in an overestimation of CMR.

Another bias of using life tables was the “lumping” of estimates depending on the 2 or 3 decimal places for the IECM. The estimation of IMR and U5MR for Durban Metro using a proportion with three decimal places is 0.086, which gives IMR of 74 and U5MR of 103 per 1000 live births (Table 5). If the proportion of dead children to live children was recorded as 0.09 instead of 0.086, the IMR become 79 and U5MR of 110 per 1000 live births respectively. The range changes from 74 to 79 per 100 live births for IMR. These differences are significant for the estimation of such sensitive indicators. Increasing the number of decimals in the lookup table could be false precision due to the inherent limitations of using the $q(x)$ to derive other mortality rates from Model Life Tables.

Table 5: Proportion of dead children to live births and the estimate of IMR and U5MR from model Life table.

Proportion of dead children	IMR	U5MR
0.050	46.30	59.40
0.051	46.82	60.21
0.052	47.34	61.02
0.053	47.86	61.83
0.054	48.38	62.64
0.055	48.90	63.45
0.056	49.42	64.26
0.057	49.94	65.07
0.058	50.46	65.88
0.059	50.98	66.69
0.060	51.50	67.50
0.061	52.01	68.30
0.062	52.52	69.10
0.063	53.03	69.90
0.064	53.54	70.70
0.065	54.05	71.50
0.066	54.56	72.30
0.067	55.07	73.10
0.068	55.58	73.90
0.069	56.09	74.70
0.070	56.60	75.50

Thus PBT can be used to monitor the IECM over time in a routine manner from the health facilities or from particular community/communities.

6.4 Interpretation of the CMR estimates

It is recommended that the PBT be used to monitor childhood mortality trends over time and not be used to estimate absolute levels.^{31,32} Thus the interpretation of these results should not be considered absolute levels of CMR for KZN or its health districts.

The IMR and U5MR estimated from data collected during the year 2001 were actually estimates of earlier period. In the original method described by Brass and Macrae³¹ the reference point for their calculations was the birth of the next child. If information were collected antenatally the mean birth interval would be reduced by the time prior to delivery that the woman presents at the antenatal clinic. The values relates to the mortality experience of the children from the preceding births and the time location of this estimate be considered about two thirds of the birth interval before the date of birth of the last-born child.²⁶ The estimate of CMR from 2001 PBT study would thus refer to the CMR for 1999.

The “crude” Infant Mortality Rate calculated from the data collected in 2001 for KZN was 98/1000 live births (95% CI, 91-105) and “crude” U5MR of 142/1000 population of < 5 yrs (95% CI, 128-152) respectively which reflects the actual CMR in 1999. This is significantly higher than the IMR and U5MR reported in the South African Demographic and Health Survey of 1998, which reported an IMR of 52/1000 live births and U5MR was 74/1000 population of under five for KZN. The estimate of IMR for KZN from the Census 1996 data was 89/1000 live births. Other IMR estimate such as 1993 SALDRU Poverty Survey for rural areas in South

Africa (94/1000 live births) and for South Africa as a whole (81/1000 live births).⁷ Thus the difference of our estimate was less marked particularly in view of the fact that IMR has been increasing over time interval between 1993 (SALDRU), 1996 census and 1999 (which is the time reference for this estimate).⁷

Since 6 of the 11 health districts of KZN had low response rates, the provincial estimate and the estimates of these districts (Durban Metro and DC 28, DC 26, DC 27, DC 29 and DC 43) would unlikely be reliable. However, one could consider these estimates useful for the areas where these health facilities are situated.

IMR estimations showed huge ranges in countrywide estimates from 12 different studies. The IMR ranged from 11 to over 80/1000 live births during 1993 to 1998.⁷ The factors, which are likely to contribute to such disparities, could be methodological, representativity of population, lack of probing survey instruments and the practice of proxy reporting by the head of the household. All these factors thus limit the comparability of our CMR estimates.

Two problems that have emerged as serious threats to child health and well-being are rapidly rising HIV infections and the scourge of trauma and violence against children.⁹ The impact of HIV/AIDS epidemic had shown major impact on all cause infant and child mortality.^{16,17}

The IMR and U5MR estimations from the five health districts that had higher response rates (>72%) had large variations. IMR of 84 per 1000 live births (95%

CI, 36-167) was the lowest in DC24 and 111 per 1000 live births (95% CI, 52-161) being the highest in DC 25 for the year 1999 (table 3). The IMR of 84 per 1000 live births for DC 25 is similar to the IMR of DC 23 (86/1000 live births).

The socioeconomic factors responsible for high CMR and the epidemic cholera are similar. Epidemic cholera is known as a sensitive indicator of severe under-development.⁴⁵ These factors prevail in KZN as evidenced by the highest prevalence of HIV infection among pregnant women (36.5%) and therefore might have contributed to the observed higher rates of CMR.⁴⁶

Based on the census and Demographic and Health Surveys of South Africa, the estimates of Infant Mortality was seen plateaued in the early 1990's and then began to rise rapidly in 1995, whereas mortality at age 1 to 4 years only began to increase rapidly in 1997.²⁹

There is no perfect correlation between cholera attack rate, HIV prevalence and CMR in all KZN health districts. The cholera attack rate (table 4) for DC 23 (77/100,000 population) and DC 24 (31/100,000 population) are comparatively low and also lower CMR (IMR of 86 and 84/1000 live births respectively). The prevalence of HIV among Antenatal clinic attendees during 2001 was highest (40.0%) in DC 25 and the rate was lower for DC23 and DC24 (29.9% & 29.3% respectively) compared to other districts.⁴⁷ These are two neighboring districts and have similar infrastructures, socio-economic and health status. CMR estimates are likely to be similar. On the other hand, the highest estimate of IMR of 111/1000 live births and U5MR of 162/1000 population for DC25 were observed could be due to

poor infra-structure, socio-economic, health status and other health determinants of the residents as it is situated at the deep rural part of the province. Furthermore the higher rates of CMR were observed from the districts DC 21 (IMR of 95/1000 live births and U5MR of 136/1000 population), DC26 and DC 27 (IMR of 100 per 1000 live births and U5MR of 145 per 1000 population) and DC28 (IMR of 128 per 1000 live births and U5MR of 164 per 1000 population respectively). These districts are rural and the main part of previously self-governing KwaZulu homeland, well known for underdevelopment. Thus the higher estimates of CMR rates were not unexpected.

DC22 (Pietermaritzburg) had also estimated unexpectedly higher rate of CMR (IMR of 107 per 1000 live births & U5MR of 142 per 1000 population respectively) compared to other rural health districts such as DC23, DC25 (districts away from the major business and administrative centers such as Durban and Pietermaritzburg). This could be explained as DC23 and DC25 were running special child survival project since 1996. Therefore the impact of such programme had shown some positive impact although further evaluation could be necessary to substantiate such comment. Further issues could also be considered that the representativeness of the public health sector users as explained earlier. Although the response rate of Durban health district was poor, higher numbers of pregnant mothers were interviewed from less number of health facilities and estimated CMR (IMR of 74 and U5MR of 103 per 1000 life births respectively) were lower.

Durban being an urban district, the socioeconomic factors, availability of health facilities, better infrastructures and other factors those influence on CMR, the lower rates are likely for the specific area of the district. Since the poor response rate of health facilities, this cannot be generalized for the district as a whole.

These variations of IMR and U5MR between different health districts would require further investigations in terms of other socio-economic, demographic and health services provisions, cultural, religious and behavioral factors responsible for CMR.

A study conducted at Hlabisa District during 1997 and 1998 (which was part of present DC27) using the same PBT. The IMR was estimated as 53/1000 live births (95% CI, 42-71) and U5MR of 70/1000 population (95% CI, 53-98) for the period of 1995 and 1996.¹⁴ In our study we estimated IMR of 100 (95% CI, 51-147) and U5MR of 145 (95% CI, 72-222) per 000 live births respectively for the whole district (DC27). The response rate of facilities from the district was only 53%. Our estimates of CMR are almost double the figure of the earlier estimate.¹⁴ Thus this estimate could not be considered reliable for DC 27.

It was also noted that there were no comparable data from other districts of KZN. Thus these results (districts with higher response rates) could be used as baseline information for future monitoring of the trends of IMR & U5MR for KZN.

The National and Provincial programme such as Prevention from Mother to Child Transmission (PMTCT) was implemented in KZN since 2002 to reduce the effect

of maternal HIV infection on children. The quantification of HIV pandemic on Childhood mortality in KZN health district should be a priority research to evaluate the (PMTCT) programme through monitoring CMR in KZN or Nationally at large.

7. CONCLUSION

The use of Preceding Birth Technique for estimation of childhood mortality rate in the health districts of KZN was found to have strengths as the method of data collection, analysis and interpretation of the results were found comparatively easy and simple.

Midwives recorded three routine antenatal questions on a collation sheet as part of the routine history's taken from all first antenatal clinic attendees. The study required no additional staff or special funding yet provided an inexpensive but acceptable technique for measuring childhood mortality useful but otherwise difficult to obtain information in rural areas of KZN.

The study had poor response rates and higher estimates of IMR and U5MR for KZN and its' health districts. The poor response rate thus had influenced (higher or lower) the overall CMR for KZN.

Although there are problems in using Model Life Tables to estimate IMR and U5MR, IECM can be useful to monitor the trend of CMR at local level (community, district or province).

8. RECOMMENDATIONS

Data required estimating IMR and U5MR using PBT could be incorporated into PHC minimum data set to collect routinely at ANC service facilities during a pregnant women's' first ante natal visit to measure and monitor such important indicators over time. This may be used as a surrogate until an efficient vital registration system is implemented.

To measure district level estimation of IMR and U5MR using PBT, it would be better to consider one district at a time in order to achieve better response and to be able to support and follow up the clinics. The only alternative is channel more resources and make it into a huge provincial study.

Further study could be considered to identify the major causes (determinants) of higher childhood mortality rate in KZN and to identify the appropriate strategies to reduce them.

There is an urgent need for strategies to prevent childhood mortality in KZN through health services provision (such as anti-retroviral therapy for HIV positive mothers, Implementation of child survival project etc.) and socio-economic development.

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“Annexure A”

PREVIOUS BIRTH TECHNIQUE – CHILDHOOD MORTALITY SURVEY

Please complete this form for each **NEW ANTENATAL PATIENT** who comes for **1st ANC booking** to your clinic

Once data for the month of May 2001 have been collected, please send them to District Nursing Service Manager.

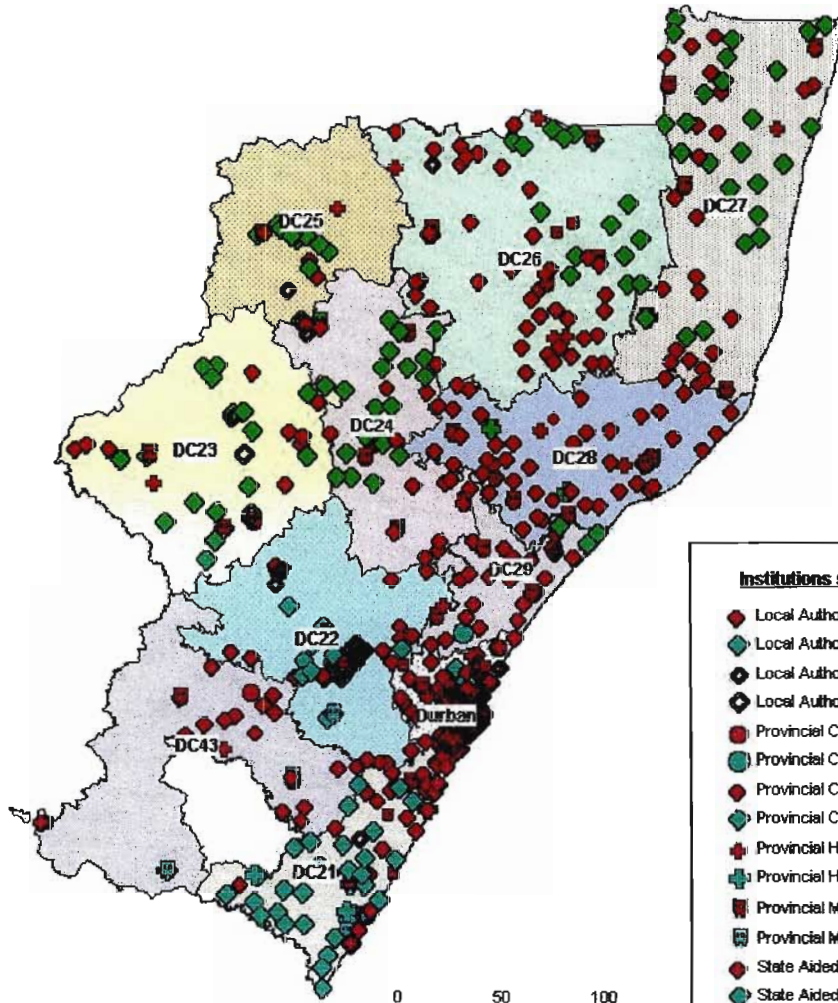
If the previous birth was a multiple pregnancy, then a new line must be completed for each baby. i.e. Twins – 2 lines, Triplets – 3 lines. Previous abortions must also be included.

Name of Clinic:

Nurse-in-Charge:

Serial No.	Has she ever been pregnant before?		Was it a live Baby Yes=1 No=0	Is the Baby still Alive Yes=1 No=0
	Yes	No		

Map 1: Facilities participated in the study



Institutions showing returns

- ◆ Local Authority Clinic -no return
- ◆ Local Authority Clinic -return
- ◆ Local Authority Sat_Clin -no return
- ◆ Local Authority Sat_Clin -return
- Provincial Cbc -no return
- Provincial Cbc -return
- Provincial Clinic -no return
- Provincial Clinic -return
- ◆ Provincial Hospital -no return
- ◆ Provincial Hospital -return
- ◆ Provincial Mobile -no return
- ◆ Provincial Mobile -return
- State Aided Clinic -no return
- State Aided Clinic -return

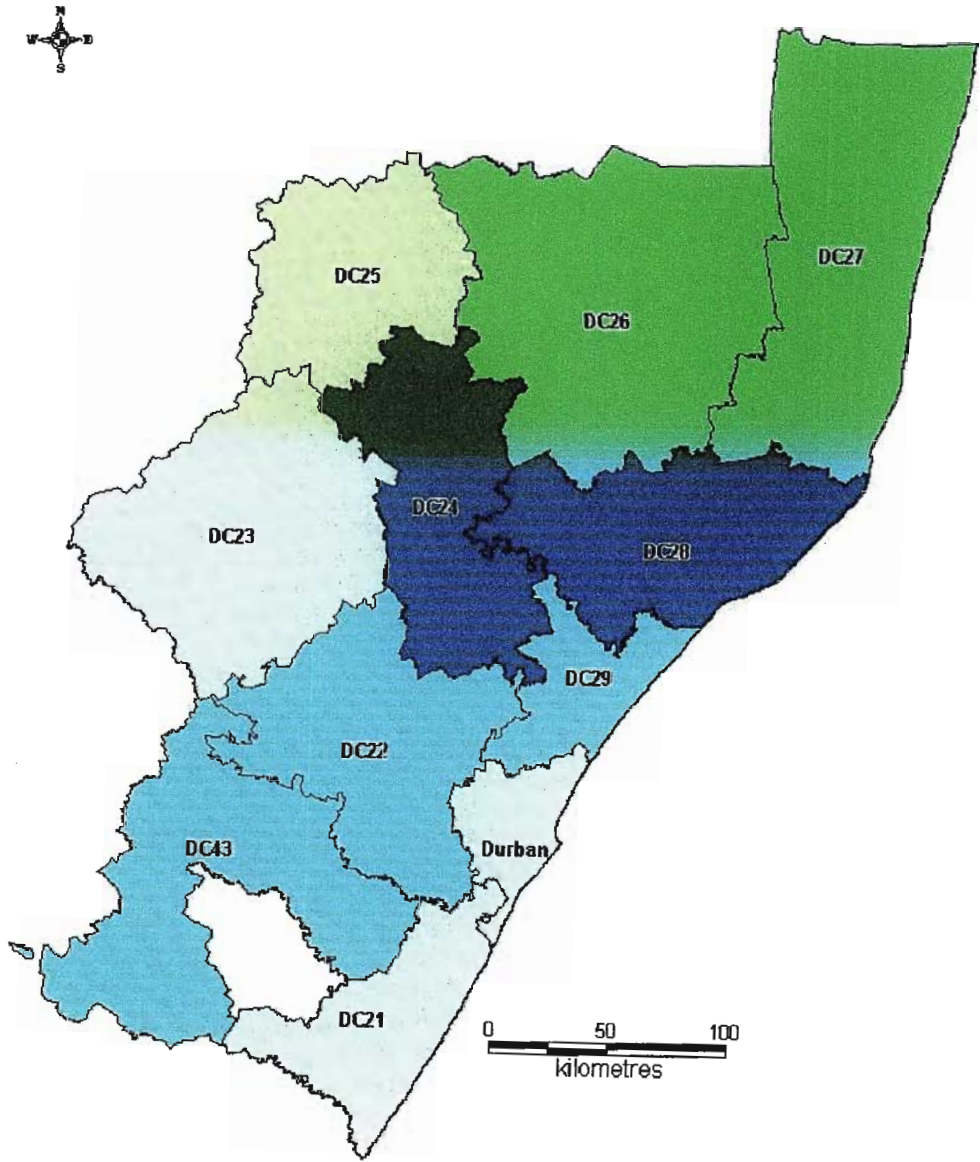
Health District

- DC21
- DC22
- DC23
- DC24
- DC25
- DC26
- DC27
- DC28
- DC29
- DC43
- Durban

Compiled and Produced by
The GIS Unit
KZN Health Department

Date of Production: 16 November 2001

Map 2: IMR for KZN Health Districts



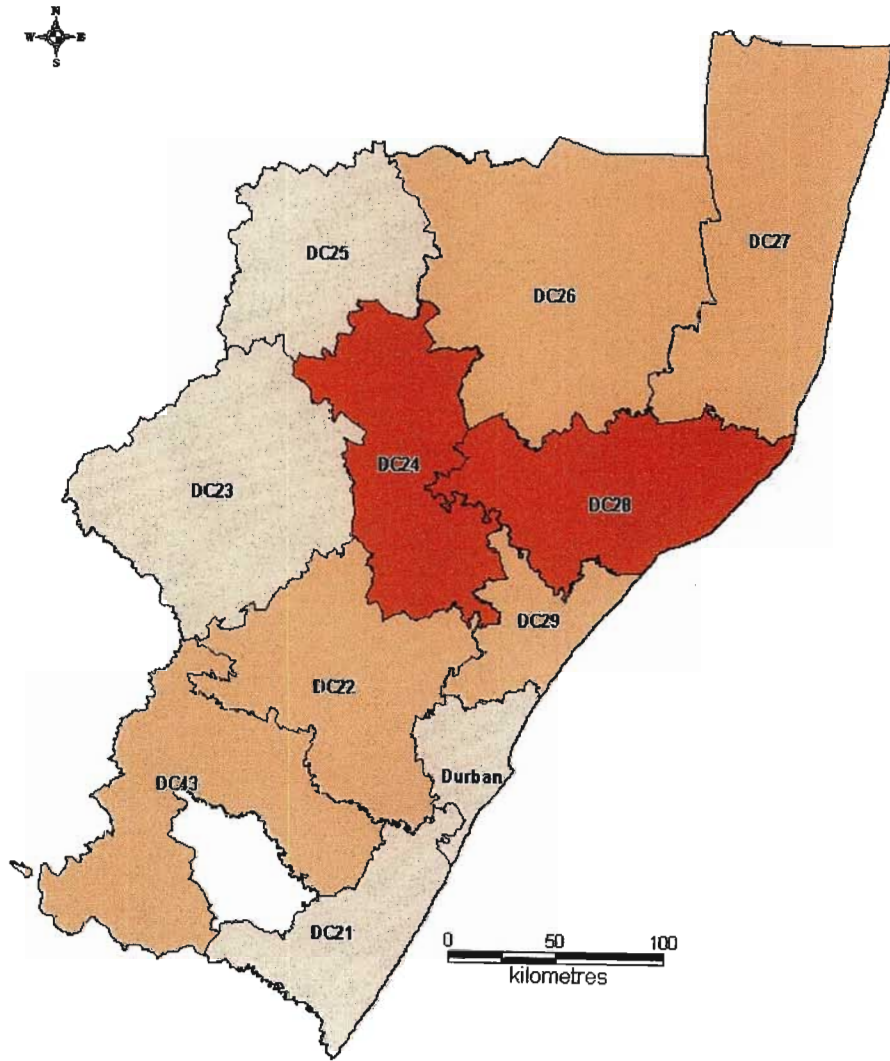
Compiled and Produced by
The GIS Unit
KwaZulu Natal Department of Health

Date of Production: 14 November 2001

Calculation of IMR

- 111 to 112
- 100 to 111
- 74 to 100

Map 3: Under -5 Mortality for KZN Districts



Compiled and Produced by
The GIS Unit
KwaZulu Natal Department of Health

Date of Production: 16 November 2001

Calculation of USMR

- 162 to 164
- 145 to 162
- 103 to 145