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Levels, Trends and Differentials in Infant Mortality in Kenya: Analysis of 1998, 2003 and 2008/09 Kenya Demographic and Health Survey Data

Omedi Gilbert
Lecturer, Kisii University, Faculty of Education, P. O. Box 158-50310 Vihiga, Kenya
Email address: gilynes@yahoo.com

Abstract
Reduction in the number of babies dying before their first birthday celebration is a global priority, the United Nations having targeted a two-third reduction in infant and child mortality between 1990 and 2015. As a nation, Kenya observed a normal curve in infant mortality rate in the period 1998 through 2008/09: 74 (1998), 77 (2003) and 52 (2008/09). This study used three consecutive Kenya demographic and health survey datasets to examine the trends of infant mortality over time, their levels and differentials based on socioeconomic, geographic and demographic factors. Direct estimation technique was used to obtain levels and trends of infant mortality while crosstabulation analysis was used to compute infant mortality differentials based on the study covariates. It was observed that infant mortality was significantly high in Nyanza region where it was 2.6 times that of Eastern region. Except for Nyanza and Western regions, neonatal mortality rate constitute a greater proportion of infant deaths in all other regions. Births to older mothers and small-sized births had higher infant mortality rates than births to women aged less than 35 years and medium to large-sized births. Maternal illiteracy and currently working women accounted for higher infant mortality rates than mothers who had some literacy skills and who were not working. The significant associations of socioeconomic, geographic and demographic variables with neonatal, post-neonatal and infant mortality suggest the need for sector-specific policies and programmes to address the need for increased child survival.

Introduction

Childhood mortality remains a key indicator not only of child health and nutrition but also of the implementation of child survival interventions and social and economic development of a nation. UNICEF (2011) notes that as global momentum and investment for accelerating child survival grow, monitoring progress at the global and country levels has become even more critical. Since the inception of demographic and health surveys, Kenya has recorded an erratic decline in infant mortality. The country, as per the millennium development goal number 4, is expected to report an infant mortally rate of 20 infant deaths per 1,000 live births this year 2015. The rate, according to 2008/09 KDHS, was 52 deaths per 1,000 live births leaving the country with no hope of achieving the millenium development goal number four.

The 2008/09 Kenya demographic and health survey report shows that neonates and infants are the most at risk of dying, and there has been less progress for them than within the under-five age category as a whole. Forty-two per cent of under-five deaths occur within the first month of life while 70 per cent are in the first year of life. Considerable variations exist in the level of neonatal, post-neonatal and infant mortality based on various factors. This backs-up what was suggested by Madise (2003) and Da Vanzo et al. (1983) that the study of infant mortality should be done with at least two age segments since the causes of mortality change as the child grows.

This paper presents estimates of infant mortality in Kenya since 1998 and goes further to present and discuss the differentials in the rate based on various factors. The 2005 United Nations Human Development Report asserts that no indicator captures the divergence in human development opportunity more powerfully than child mortality. Thus, the study findings will be of great significance to policy makers and implementers, and academic researchers in the country. A well known fact is that reduction of mortality creates an environment conducive for fertility reduction as the need to insure against potential deaths of children or replacing the dead infants is reduced.

Literature Review

Education and literacy play a significant part in explaining childhood mortality. Kiros and Hogan (2001) pointed out that although limited information exists on mechanisms by which parental education might improve child survival, social scientists have speculated that higher levels of education lead to increased income which in turn decreases malnutrition. Educated fathers may boost their children's chances of survival through their greater affluence and knowledge. Kibet (2010) acknowledges that certain diseases depend upon the standard of living: diarrhoeal diseases are greatly influenced by nutrition and personal health. Income is therefore necessary to provide babies with nutritious diet that prevents diarrhoea which claims many child lives in sub-Saharan Africa.

A literate mother, on accessing information relevant to child health, such as the need for exclusive

breastfeeding for the first six months of life and observation of proper hygiene in handling babies, is able to put it into practice to ensure child survival. An illiterate mother can fail to seek prenatal and postnatal care services even though such services are available for free and within easy access. A study by Amouzou & Hill (2004) on child mortality and socio-economic status in sub-Saharan Africa illustrates that illiteracy accounts for two-thirds (67 percent) of the variation in under-five mortality rate; a 10 percent point reduction in women's illiteracy rate reduces under-five mortality by 13 percent.

The work status of a mother has a two-way influence on the survival status of an infant. A mother who works outside home is prevented from adequately caring for the infant. The dual burden of employment and household work can reduce the time available for child care services. This results to substantial effect through lack of proper feeding especially breastfeeding in the early stages of life. On the other hand, mothers working outside home can have increased income that results in higher family income and gives the mother a modern outlook, both of which can increase the probability of child survival. Mondal et al. (2009) found the risk of neonatal death to be 37.9 percent lower among working mothers than those who were not working. They attributed the lower risk of infant mortality among working mothers to be due to the fact that they might be well aware about immunisation and care during pregnancy. Counter-intuitively, a mother who works at home is likely to have reduced income making her unable to provide better health services to the infant because of high consultancy fee for the qualified medical personnel, and costly medical tests and medicines. This makes them to prefer home remedies and cheap and near facilities that cannot improve infant health standards.

The association between mortality and childhood place of residence should be an area of interest in studies on childhood mortality. There are births and deaths that take place in rural areas, for example, and are later on reported as city/town births when the demographic and health surveys come at a time when the respective mothers have migrated to urban areas. The repercussion of this is that there occurs underreporting of rural deaths and over-reporting of urban deaths than what the actual figures are. While studying "Socioeconomic Inequalities in Infant and Child Mortality among Urban and Rural Areas in sub-Saharan Africa", Akoto and Tambashe (undated) found urban residence to be associated with a 50 percent higher risk of infant mortality than rural residence in Tanzania in 1998. They attributed this to be a reflection of either the deteriorating living conditions in urban settings as compared to the rural areas, or the rapid improvement in socioeconomic conditions in rural areas as compared to urban areas. Also true is the fact that the effects of economic crisis are felt much more in urban than rural settings, and childhood mortality being much sensitive to fluctuations in the standards of living may explain high urban than rural infant mortality.

The risk of infant death is high among adolescent and older women than it is for middle-aged mothers. Lack of maternal experience in child care and lack of knowledge of health information predisposes children of adolescent mothers to increased risks of morbidity and mortality. Most of the adolescent mothers become pregnant within two years of menarche and when their pelvis and birth canals are still developing, and this heightens their health problems. The risk of a newborn surviving after the mother dies due to maternal complications remains dismal (Omedi, 2014b). Births to old aged mothers, on the other hand, depict high mortality risks since such mothers are likely to have deteriorated health, may be impaired from producing milk, and their capabilities to provide adequate baby care may be deteriorated (Kibet, 2010; Omedi, 2014a). While studying "Factors Influencing Infant Mortality in Kenya and Tanzania", Omedi (2014a) found maternal age to be significantly associated with the risk of death of an infant in Kenya in that mothers aged at least 35 years were 45 percent more likely to lose their births during infant stages compared to those aged 20-34 years.

High childhood mortality is likely to encourage large families as couples strive to have more children to replace them that die (Ainsworth, 1994). A couple may also raise its fertility in response to high childhood mortality in their community. On its side, high fertility raises childhood mortality through the effect of frequent, closely spaced pregnancies that leads to maternal depletion, increase in the rate of transmission of infectious diseases in the child-crowded environments and the strain of large families on the available household resources.

The size of the child at birth, used as a measure of birth weight, is found by asking a mother whether the index child was very small, small, average size, large or very large at birth. Though a very subjective assessment of the birth weight of a child, it has been shown to correlate closely with the actual birth weight. In their study on the socioeconomic determinants of infant mortality in Kenya, Mustafa and Odimegwu (2008) found large and small sized births to be more likely to die at infancy compared to the average sized births in rural Kenya. The study found smaller than average births to be 60 percent more likely to die during infant stages (at $\rho < 0.05$) when compared to average births.

Methodology

Data Source

The study utilised data from three successive Kenya Demographic and Health Surveys: 1998, 2003, and 2008/09 KDHS' undertaken by National Council for Population and Development (NCPD), and Macro International of USA. The surveys were based on individual interviews of women in the reproductive ages, 15-49 years, and

their partners in the sampled households. Given that multiple births are subjected to higher risks of death, the study limited itself to live births that were outcomes of singleton deliveries and who either survived their infancy period or not. The number of singleton births in the five-year periods that preceded the surveys was as follows: 3,431 in 1998; 5,748 in 2003; and 5,895 in 2008/09. Information was collected on birth history, childhood mortality, child and maternal health, reproduction and family planning. Since a woman's complete birth history, including dates of birth and death of each child is available, it is easy to obtain direct estimates of infant mortality.

Methods of Analysis

The levels and trends of mortality were analysed by applying direct estimation techniques to the birth history data (see Rutstein, 1984). Infant mortality rate was computed as:

IMR= (number of infant deaths/ Total live births) × 1000.

Since some deaths occurring at ages 10 and 11 months are reported as having occurred at age 12 months, the mortality rates were adjusted by multiplying them by the adjustment factors that were found by computing:

{½(deaths reported at age 12 months) + deaths in months 0-11}/deaths in months 0-11

(see Omariba, 2005).

The mortality levels from the three KDHS' were plotted on a comparative line graph to bring out the trends in infant mortality since the year 1998. This was to enable one to see how the mortality has been changing over time, and with millennium development goal number 4 in mind, tell the position of Kenya in the move towards the achievement of the goal. Cross tabulations were done to bring out the differentials in the number of births and infant deaths according to the variables of study. They are these numbers that were used to compute the mortality rates in each respective category.

Results

Levels of Infant Mortality

This section presents estimates of the levels of infant mortality in Kenya from the 2008/09 demographic and health survey data for children born within the five- year period that preceded the survey according to the region of residence. Since mortality levels are one of the indicators of the standard of living of a population, they help to identify segments of the population that could benefit from programs aimed at improving child health and survival.

Table 1: Levels of infant mortality in Kenya

REGION	INFANT MORTALITY	
	Actual	Adjusted[1]
Kenya	50.72	53.01
Nairobi	37.13	40.84
Central	65.57	67.62
Coast	57.21	59.00
Eastern	28.61	29.29
Nyanza	70.16	75.77
Rift Valley	37.86	38.35
Western	49.74	52.36
North Eastern	54.67	55.56

Source: Author's computations based on births and deaths from 2008/09 KDHS

Table 1 presents the rates of infant mortality for the country as a whole and then for the respective regions covered by the demographic and health survey. The mortality rates are expressed as deaths per 1,000 live births. Examining the figures adjusted for age heaping reveals that there was some amount of heaping of deaths at age 12 months, which suggests that infant mortality was understated while child mortality was overstated in the respective regions.

Using the adjustment factors, overall, increased infant mortality rate in all regions. Nyanza is the region that observed the highest underreporting of infant deaths and thus over-reporting of child deaths (actual IMR=70.16; adjusted IMR=75.77). Rift Valley, Eastern and North Eastern provinces observed modest underreporting of infant deaths at the expense of child deaths. On the national level, infant mortality rate increased from 50.72 to 53.01, implying that 1 in every 19 live births do not survive to celebrate their first birthdays. These results are consistent with previous research by Omariba (2005).

[1] The adjustment factors are calculated by assuming that half of the reported deaths at age 12 months actually occurred in the preceding age group, 0-11 months. In this case of infant mortality, half of the deaths reported at age 12 months are added to the number of deaths reported for 0-11 months and this total is divided by the number of deaths at 0-11 months. The reported mortality rates are then multiplied by the adjustment factors to produce the adjusted rates.

Trends in Infant Mortality

Table 2 shows the trends in infant mortality rates in Kenya since the declaration of the millennium development goals by the United Nations. It is quite clear that the country observed a 9 percent increase in the rate from 1998 to 2003, and thereafter a 27 percent decline in the rate between 2003 and 2008/09. Surprisingly, the increase in the rate came as a stall in fertility was observed. Regionally, Nairobi, Coast, Rift Valley and Western Provinces depicted similar trends as the one observed at the national level. Eastern and Nyanza Provinces reported declines in infant mortality rates in the three successive demographic and health surveys. Much as Eastern has the lowest rate (as at 2008/09), Nyanza has recorded the greatest decline in the rate: a 43.5 percent decline. In sola, Central Province has observed an increase in the rate throughout the decade: from 35.97 in 1998 to 45.45 in 2003 to 67.62 in 2008/09. This observation was also noted in Omariba (2005). North Eastern Province, which was excluded in the former KDHS', recorded a decline in infant mortality rate from 95.18 infant deaths per 1,000 live births in 2003 to 55.56 infant deaths per 1,000 live births. It is impossible to tell the mortality behaviour in the region before then since the data sets employed in this study do not provide such information.

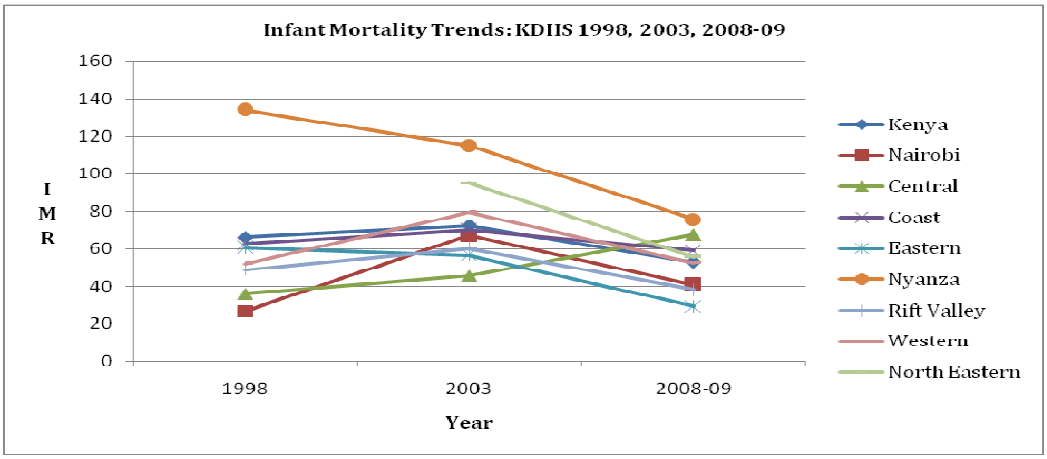
Table 2: Infant mortality trends since 1998 to 2009

REGION	SURVEY		
	1998	2003	2008/09
Kenya	63.54(66.31)	70.29(72.29)	50.72(53.01)
Nairobi	26.55(26.55)	67.16(67.16)	37.13(40.84)
Central	35.97(35.97)	45.45(45.45)	65.57(67.62)
Coast	58.59(62.50)	67.87(70.14)	57.21(59.00)
Eastern	60.61(60.61)	55.88(56.62)	28.61(29.29)
Nyanza	125.82(133.99)	108.92(114.83)	70.16(75.77)
Rift Valley	47.81(48.83)	59.63(60.05)	37.86(38.35)
Western	48.83(52.02)	75.66(79.45)	49.74(52.36)
North Eastern		91.74(95.18)	54.67(55.56)

Parentheses are the adjusted rates

Source: Author's computations based on births and deaths from KDHS 1998; 2003; 2008/09

The information in Table 2 can be well illustrated on a comparative line graph as shown in Figure 1. Though with substantial declines in infant mortality rate, Nyanza remains to be the region with the highest level of infant mortality countrywide while Eastern has the lowest infant mortality rate. For instance, Nyanza's infant mortality rate is 2.6 times that of Eastern province. This is consistent with the findings of KNBS & ICF Macro (2010). Studies have attributed the high infant mortality in Nyanza region to the high prevalence of malaria and other related diseases due to a topography which allows for flooding from tropical rains, numerous irrigation schemes which allow for fertile bleeding grounds for mosquitoes, and nutrition differentials and the related factors, basically the many taboos surrounding food among the Luo which must be observed from the sowing time till the consumption of food (Owen, 1974; Ominde, 1976; Muganzi, 1990).



Differentials in Infant Mortality

Table 3 presents the actual mortality rates in Kenya based on the 2008/09 Kenya demographic and health survey data. The mortality is segmented into neonatal, post-neonatal and infant, literature having indicated that the study of childhood mortality should be done with more than one segment since causes of mortality vary with age (Madise, 2003). The covariates here are: socioeconomic factors (literacy level of the woman, educational level of

the partner, work status of the mother), geographic factors (childhood place of residence, region of residence) and demographic factors (maternal age, size of the birth). Except for a few cases, neonatal mortality is the major contributor in the high infant mortality rates. This is not surprising, 2008/09 KDHS having reported a high neonatal mortality rate (31 deaths per 1,000 live births) than post-neonatal mortality rate, which is standing at 21 deaths per 1,000 live births (KNBS & ICF Macro, 2010).

Table 3: Neonatal, post-neonatal and infant mortality differentials in Kenya, 2008/09 KDHS

Variable	NMR[1]	PNMR[2]	IMR[3]
Maternal Level of Literacy			
Cannot Read	35.92	23.31	59.23
Can Read	27.51	19.52	47.03
Partner's Level of Education			
No education	29.13	17.26	46.39
Primary	32.20	25.17	57.36
Secondary and higher	29.24	19.67	48.91
Work Status of the Mother			
Not working	25.48	17.91	43.39
Currently working	32.92	23.13	56.05
Childhood Place of Residence			
City	24.34	38.54	62.88
Town	22.28	19.50	41.78
Country-side	32.14	18.93	51.07
Abroad	7.25	28.99	36.23
Region of Residence			
Nairobi	29.70	7.43	37.13
Central	47.13	18.44	65.57
Coast	39.33	17.88	57.21
Eastern	23.16	5.45	28.61
Nyanza	31.81	38.35	70.16
Rift Valley	22.33	15.53	37.86
Western	20.94	28.80	49.74
North Eastern	31.75	22.93	54.67
Maternal Age			
Under-20	29.75	21.74	51.49
20-34	27.73	19.11	46.83
35 and above	42.52	30.18	72.70
Size at Birth			
Small	51.63	30.76	82.39
Medium	25.00	15.64	40.64
Large	23.78	19.55	43.34

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The results indicate that maternal literacy is negatively associated to infant mortality: births to literate mothers have a lower mortality rate when compared to births to illiterate mothers. 2008/09 Kenya demographic and health survey defines literacy as the ability to read
and write in any language and acknowledges that it is an important personal asset allowing individuals increased opportunities in life. The ability of a mother to read exposes her to media and other information that may be relevant in childcare. Such a mother is not only able to read but also to comprehend messages about childcare and nutrition that she comes across which, when put to practice, increases the chances of child survival.

Though a mother may be uneducated, the education level of her husband plays a major role in the contribution towards a household's income. A highly educated partner is likely to be employed and wealthy. Part of his income is channelled towards the welfare of the child in that a woman is able to attend antenatal and postnatal clinics appropriately, is able to meet the costs of his wife delivering not only in a hospital facility but also with a skilled birth attendant. A wealthy man is also able to ensure a high quality diet full of micro-nutrient-rich food for the wife to ensure that high quality and enough milk is generated for the baby to suckle. The

[1] Neonatal mortality rate (NMR) is the probability, expressed per 1,000 live births, of a child dying before the 28th day of life.
[2] Post neonatal mortality rate (PNMR) is the probability, expressed per 1,000 live births, of a child dying between exact age one month and the first birthday. It is computed by finding the difference between IMR and NMR.
[3] Infant mortality rate (IMR) is the probability, expressed per 1,000 live births, of a child dying between birth and the first birthday.

analytical findings indicate that infant mortality rate was high among births to women whose partners had primary school qualifications (57.36) followed by those with secondary and higher education (48.91) and lowest among those with no education at all (46.39). Similar differentials were observed in the neonatal and post-neonatal mortality.

Mothers who were currently working reported a high infant mortality rate than those who were not working (56.05 versus 43.39). This is consistent with findings of other studies (example, Omedi, 2014a; Omedi & Wanjiru, 2014) that found a lower risk of infant death among mothers who are not working when compared to those who are engaged in an employment activity. Such mothers, the studies noted, dedicate a lot of time to the care of their babies and are able to practice exclusive breastfeeding. Working women leave their babies under the care of nannies who sometimes leave the young ones exposed to cold and other environmental risks that ruin their lives. These infants are bottle-fed mostly in unhygienic conditions and are weaned prematurely, both of which heightens their chances of dying before the celebration of their first birthdays.

In the five-year period that preceded the 2008/09 KDHS, infant mortality rate was high among births whose childhood place of residence was a city (62.88) and country-side (51.07) while it was 41.78 for those children whose childhood place of residence was in a town. A study by Kibet (2010) found high infant mortality in Kenya's cities/towns than country-side areas. This might not bring out clear mortality differentials since some of the areas reported as towns might be lagging behind in many things at the disposal of city residents besides having minimal populations. For instance, National Coordinating Agency for Population and Development, NCAPD (2009) reported that 45 percent of the total urban population is in Nairobi yet there are 194 urban centres in Kenya. The high mortality rate in the cities can be attributed to the overcrowded informal settlements, increased pollution from industries and locomotives, and urban poverty. Diarrhoeal diseases and pneumonia in the overcrowded urban slums with compromised sanitation and under/malnourishment accounts for many infant deaths in the cities. Antai and Moradi (2010) found mother residents in highly disadvantaged areas to be younger and of low socioeconomic profile (uneducated and in the poorest wealth quintile) than were other mothers, yet these are some of the known risk factors of infant mortality.

The high post-neonatal than neonatal mortality rate among births whose childhood place of residence was city can be explained by the fact that these areas are well served with health facilities and have adequate means of transport at their disposal in case of ailments. This enables the women to attend antenatal clinics and deliver with skilled personnel in health facilities, both of which increase the chances of survival of the neonate. Unfortunately, in this era of competing with life and with a proportion of them being "career women", these mothers end up not exclusively breastfeeding their babies for the recommended six-month period after delivery, some ignorantly failing to attend postnatal clinics hence reducing the chances of child survival. Furthermore, women exhaust their maternity leaves way before the stipulated period of exclusive breastfeeding. The low neonatal mortality is because at this time the mother is on maternity leave with the baby all, if not, most of the time.

The age of the mother at the birth of her baby is known to have a significant influence on the survival status of the child. Older women suffer from such conditions as anaemia, malnutrition and damage to their reproductive systems from earlier births hence increased chances of infant deaths. Teenage mothers are physiologically immature, less likely to provide adequate care for the newborn, have no decision-making authority in their households and, their births being more likely outcomes of unwanted pregnancies, are less likely to receive antenatal and postnatal care services aimed at improving child survival (Alam, 2000; Omedi, 2014a). The analytical findings indicate that high infant mortality rate was observed among women aged at least 35 years while it was low among the mothers aged 20-34 (72.70 versus 46.83 deaths per 1,000 live births).

Some women give birth to many children in anticipation of high mortalities so that, after the death of some, there be at least some surviving to adulthood. Sibling competition for maternal care and the scarce household resources, and premature weaning is observed in such cases leading to the death of the index births. Aaby et al. (1984) observed the number of children in a household to be an important risk factor in that older children are liable to introduce such diseases as measles into the household thereby infecting younger siblings who, for a variety of reasons, are more vulnerable. When parents realize that the risk of death has been kept at bay and that they have many of their children surviving, they tend to stop childbearing by practicing family planning. A higher number of living children is accompanied by an increased demand for family planning (Wangila, 2001) as couples fight towards reducing or stopping child birth. Nyauchi and Omedi (2014) found that rural women with at least five surviving children are 96.6 times (at $\rho < 0.01$) more likely to experience unmet need for limiting births when compared to those with no surviving child. The influence of reduced fertility on child survival is well known. Lower fertility reduces child mortality through reduction of maternal depletion associated with pregnancies and lactation, diminishing sibling competition for the scarce family resources and maternal care, and decreasing areas of transmission of infectious diseases in child-crowded environments.

The size of a baby at birth has a bearing on infant mortality. A low birth weight of less than 2.5 kilogrammes is a significant contributor to neonate deaths besides being strongly associated to maternal health

and wellbeing (UN ACC Sub-Committee on Nutrition, 2000). Studies have indicated the influence of the baby size at birth on the life of a child. Low birth weight and preterm infants are more vulnerable to illness in later childhood (Verhoeff et al., 2004) and often experience impaired cognitive development affecting their long-term opportunities and life chances (Grantham Mac Gregor & Lira, 1998). Table 3 shows that mortality rates among small-sized births are double those of medium-sized births.

Conclusions

The decline recorded in infant mortality over the last decade is marginal leaving the country with no hope of attaining millennium development goal number four given that infant mortality is a major contributor of under-five mortality. There still remains a major challenge on how to address regional variations in infant mortality, some regions being difficult to predict their future mortality levels. Generally, the analytical findings indicated that most infant lives are lost at neonatal stages. Neonatal care should therefore be accorded all the necessary support so as to reduce on the number of children who never live past one month of age. As this happens, policy makers and programme implementers should also look into maternal care since most of the day-break deaths are a result of maternal and obstetric complications, scenarios that claim the lives of mothers too. There is need to put enormous investments in family planning programmes so as to lower fertility further. This is because more births (as told by the number of surviving children) are a result of closely spaced births that translate to high levels of childhood mortalities.

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