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Original Article

Under-5 Mortality in Tanzania: A Demographic Scenario

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Abstract

Background: The government of the United Republic of Tanzania has initiated the Integrated Management of Childhood Illness program to improve the health and wellbeing of children.

Methods: Tanzania's under-five mortality rate is still 1.7 times higher than the world average and, in order to achieve its Millennium Development Goal 4 target, its annual reduction rate is quite low at 2.2. The main aim of the study is to examine under-five mortality combined with the Data from the Tanzania Demographic and Health Survey 2008 data was used. Odds ratios for infant and under-five mortality were estimated using logistic regression; crude and adjusting models were adopted.

Results: Mortality cases (18.3%) have been reported to children born with an interval of <24 months. Mothers with no education reported 14.6%, primary education mothers reported 11.1% and higher education reported only 5.3% (P<0.001). Therefore, maternal education plays is a major role on fertility and infant and under-five mortality behavior.

Conclusion: Maternal education also influences a mother's behavior in her usage of available health services to improve the health of the children. Further in-depth analysis is immensely needed in this situation.

Keywords: Mortality rate, Under-5 mortality, Child mortality, Infant mortality, Birth interval

Introduction

Tanzania is ranked 27 in the world average with high under 5 mortality rate of approximately between 130 and 150 per 1000 live births (1-3). Recent figures show that under-5 mortality rates have been substantially reduced but unsatisfactory to reach Millennium Development Goal 4 (MDG) target (4- 6).

Several related review of literatures indicate that under-5 mortality in Tanzania started to decline from 1960s but during that period the reduction rate was very low (only 3%), high pace of declined started to be realized from 2000 (2, 6). Another survey show that under-5 mortality declined from 143 per 1000 live births during the period between 1996 and 2000 to about 81 per 1000 live births in the period between 2006 and 2010. However, under-served regions still have high under-five mortality than their better off peers due to differentials in socioeconomic, demographics and health service factors within the population (7-9). Few study findings show that the northern regions and regions just south of Lake Victoria have substantially reduced under-5 mortality rate while the southern regions like Lindi and Mtwara still struggling to achieve an acceptable level of under-5 mortality (1, 9). Zanzibar Island with under-5 mortality rate of 79 per 1000 live births marks the only zone with lowest rate compared to the rest of

the Tanzania mainland, where the maximum under-five mortality rate is observed in Eastern zone with 145 per 1000 live births (10).

In Tanzania, infant mortality rate and under 5 mortality rates were calculated separately. After independence in 1961 to around 1990s there were mainly maternal fertility behaviors, where factors like less birth interval, teenage pregnancy and previous child death were found significance in determining under-five mortality (11). Socioeconomic and health services variables within the subgroups of population were found insignificance in determining under-5 mortality (1, 11).

Furthermore, Tanzania households with highest wealth quintile have lowest under-5 mortality of 101 per 1000 live births while households with lowest wealth quintile have highest under-5 mortality of 129 per 1000 live births (12). Similarly, a strong association of high under-5 mortality rate with low socioeconomic status of the sampled population in rural Tanzania (13, 14). Other studies argue that more death is observed in the infant age with neonatal and post neonatal contributing to more than half of less than five mortality rates, for example of 81 under-5 mortality per 1000 live births observed in 2010 by TDHS, 51 is contributed by infant and the remaining 30 is from childhood mortality rate (15, 16). Geographical variation in under-5 mortality has also shown a striking feature, under-5 children have high probability of dying if they are born in rural areas compared to their counterpart in urban areas (4). Similar results show a high under-five mortality rate of 112 per 1000 live births in rural areas compared to 110 per 1000 live births in urban areas (17). Regardless of this, in rural areas there is low infant mortality rates compared to urban and this is attributed by high prevalence of HIV and AIDS and malaria incidence in most of urban areas in the country (17).

Improved health centers and coverage of vaccination is one of the programme initiated by the country; in this programme for example drugs and health equipment's are supposed to be available when needed (6). Integrated Management of Childhood Illness (IMCI) is another programme initiated to cover all the districts monitoring child diseases. Such as malaria control programme through promotion of the use of Insecticide Treated Nets (ITN) has proven well in reducing malaria incidence. Furthermore pregnancy women are not left behind; Intermittent Prevention Treatment (IPT) has been established to provide medical attention of malaria to under-five children and their mothers within the first 24 hours of onset symptoms. Other programmes like vitamin A supplementation, Prevention of Mother to Child Transmission (PMCT), promotion of exclusive breastfeeding for the first month of infancy and effective management of childhood diarrhea are well set off in the country (18). Regardless of all the initiatives, it is argued that these programmes are of short lived and they are not reaching the people in need like those in rural areas and impoverished communities. Apart from that the Cholera outbreak and HIV and AIDS and substantial urban/rural, regional and socioeconomics differences are among the challenges hinder further reduction of under-five mortality (4). Therefore, the main aim of the study is to examine under-5 mortality combined with selected time period from 1990 to 2008 and selected background factors affecting child mortality in Tanzania. Further, it is very important to generate discussion on declining childhood mortality and to promote awareness of the issues associated with birth interval and duration of breastfeeding. Specifically, time factor with earlier birth interval, intent to give birth interval, age at first birth and maternal education will be taken into account to analyze the levels and trends of mortality rates in Tanzania.

Materials and Methods

Study settings

The study is based on less than 5 mortality in Tanzania, which is the Government of the United Republic of Tanzania mainland (formally Tanganyika) and Zanzibar Island. The United Republic of Tanzania is located on the Eastern part of African continent with an area size of approximately 947,300 km2. According to the Tanzania National

Bureau of Statistics (NBS), the population almost doubled from 23.1 million to 34.4 million between 1988 and 2008 respectively with an inter-censual growth rate of approximately 2.9%. The country's crude death rate is estimate to be 12.64 deaths per 1000 midyear population. On the side of reproductive issues, crude birth rate is 32.64 births per 1000 mid-year population and the Total Fertility Rate (TFR) is 5.6 births per woman and the percentage of women in the reproductive age being 24.06% to the total population estimated in 2008.

The overall country is consisting of young population with a median age of 18.5 years. The total population aged 15 years and above who can read and write Kiswahili (main language), English or Arabic is believed to be 69.4%.

Data

We used present data from the Tanzania Demographic and Health Survey (TDHS) 2008 a cross sectional nationally representative survey of men and currently married women aged 15-49. The interviewed individuals in the age group between 15 and 49 years were 9343 and 6979 females and males respectively from the total population. The variables for this analysis were selected from 3 different files namely; child birth history, household particulars and women's file. The reference period were considered up to 5 years preceding the survey. The statistical significance level was set at $P < 0.005$. The surveys used in this study targeted both households and individuals (males and female aged between 15 and 49) as units of analysis. However, dwellings such as schools, hostels, hotels and guest houses, hospitals and prisons were excluded from the sample. Each survey sampled approximately a total of 10,312 households. The interviewed individuals in the age group between 15 and 49 years were 9343 and 6979 females and males respectively from the total population.

In the first stage, 475 clusters were selected from the lists of enumeration areas from the primary sampling units. 25 clusters were selected in Dar es Salaam and 18 clusters were selected from each of the remaining regions. In the second stage, complete household listing was done in all selected clusters and then they were systematically selected where 22 households were selected from each cluster except Dar es Salaam where 16 households were selected. In Tanzanian Zanzibar, 18 sample points were selected in each of the five regions that give a total of 90 sample points. In the selection of the households from the sampling points, 18 households were selected from each sampling point in Unguja regions, and 36 were selected from the sampling points in Pemba regions. The under-5 mortality rate has long been used as a key measure of childhood mortality, measuring the probability of dying from all causes before the age of 5 years among children (19).

Statistical Tools

The first step in data analysis involves the description of single variable or *univariate* analysis. In this analysis, *bivariate* analysis is used thereafter to show the relationships between the predictors and children surviving (CS) and children died (CD) using the X^2 and *p-value*. Logistic regression model of under 5 mortality multipliers (K_i) and reference time (t_x) were used. Odds ratios for infant and under-five mortality were estimated using logistic regression; crude and adjusting models were adopted.

Methods

Under 5 mortality rate was calculated into two steps. The first step involved the calculation of the number of children died; this was accomplished by subtracting the number of living children from total children ever born. The second step involved the calculation of under-5 mortality this was accomplished by dividing the number of children died by total children ever born expressed per 1000. On the other hand, the probability of dying at early ages was estimated indirectly using data on the average number of CEB_i and average number of CS_i tabulated by mothers in the reproductive age (15-49). This procedure enables the indirect estimation of the IMR (*1q0*), *CMR* (*4q1*) and the life expectancy at birth that related with each *qx* value within each Model Life-Table (MLT) patterns. The Brass (1968) method for converting

proportional dead (Di) of the (CEB_i) reported by women in the age group 15 to 49 years into an estimator of the probability of dying (qx) before attaining certain exact childhood age by using MLT was adopted. More detailed information on this proposed method is well explained in (21, 22, 23, 24, 28).

The basic equation for calculating the probability of dying as proposed by Brass (1968) is

$$q_x = D_i k_i \quad [1]$$

(Where multiplier K_i is meant to adjust for non-mortality factors determining the value of D_i). Having population of the female respondents aged 15 to 50 (FP_i) with their mean age at child bearing (MACB) calculated empirically without using ASFR (age specific fertility rate) using equation developed by Pathak and Ram (1998) as:

$$\mu = 2.25\left(p_2/p_3\right) + 23.95 \quad [2]$$

After that, the first stage involves the calculation of average parity per women in each age group as:

$$P_i = CEB_i/FP_i \quad [3]$$

The second step involves the calculation of the proportional survived per women in the reproductive age. A set of multipliers (k_i and t_i) are calculated using equation 4 and 5 below from the coefficients given by Trussel (1975) and Sullivan (1972) in order to convert $D_i$into q_x and to calculate reference period using the north model Coale & Demeny life table for United Republic of Tanzania available in the MORTPAK version 4.0. This model was selected as standard model because it is well fit in developing countries like Tanzania that family planning is rarely used and women tend to breastfeed for more than a year (United Nations, 1983).

$$k_i = a_i + b_i\left(p_1/p_2\right) + c_i\left(p_2/p_3\right) \quad [4]$$

$$t_i = a_i + b_i\left(p_1/p_2\right) + c_i\left(p_2/p_3\right) \quad [5]$$

Whereas, q_x is calculated as the products of D_i and K_i for each age group of women in the reproductive age then it was converted into infant mortality rate, child mortality rate and life expectancy at birth with reference to certain period of time were calculated.

Results

Based on the multiplier (k_i) and reference time (t_i) an association between some selected socio-economic and demographic characteristics with survivor status of under-5 mortality shows statistically significance in determining the overall under 5 mortality rates in the study area.

Table 1 shows the results of the associations of these characteristics with the survivor chance of the under 5 children.

Table 1: Associations between some selected socioeconomic characteristics with survivor status of under-5 children in Tanzania, 2008

Variables	Child mortality probability (%)		*P-value*	X^2
	No	Yes		
Place of residence				
Urban	11.6	88.4	0.01	7.14
Rural	13.0	87.0		
Regions				
Dar es Salaam	13.4	86.6	0.00	28.55
Other regions	13.4	86.6		
Zanzibar	11.1	88.9		
Maternal education				
No education	14.6	85.4	0.00	87.43
Primary	11.1	88.9		
Secondary	0.0	100.0		
Higher	5.3	94.7		
Paternal education				
Atmost primary	13.6	86.4	0.96	0.08
Secondary	13.4	86.6		
Higher	12.7	87.3		
Wealth index				
Poorest	15.0	85.0	0.00	82.80
Poorer	13.8	86.2		
Middle	13.2	86.8		
Richer	12.3	87.7		
Richest	9.4	90.6		
Currently working				
No	11.9	88.1	0.09	2.90
Yes	12.9	87.1		
All women	**12.7**	**87.3**		

Source: Tanzania Demographic and Health Survey, 2008

Wealth index shows great influence on survivor chance of the under 5 children (*P*<0.001). Richest households only reported 9.4% mortality cases compared to 15% in the poorest households. The working mother reported 13% mortality cases compared to non-working mothers that report 12% (*P* <0.09). Mothers with no education reported 14.6%, primary education mothers reported 11.1% and higher education reported only 5.3% (*P*<0.001). Unlike maternal education, paternal education association with child mortality was not significant (*P*<0.96).

The results for the association between maternal fertility behavior and survivor of the children are presented in Table 2. The relationship between women in the five-year age groups and the survivor of their children found to be statistically significances (*P*< 0.01).

Low fertility levels in these groups compared to higher groups attribute low mortality cases reported in the lower age groups. Mortality cases (18.3%) have been reported to children born with an interval of <24 months, while the remaining birth intervals reported that low mortality cases, for example 9.5% has been reported to birth interval of between 37- 48 months. Similarly, intent to give birth intervals is also significance, from <24 months have (26.5% death cases) reported high mortality cases. Another significance association (*P*<0.001) is seen between birth parity and survivor status of the children. Women with parity of less than 4 children reported only 8.6% mortality cases compared with 17.5% of more than 9+ parities (Table 2).

On the other side, multiplicity of births shows significance relationship (*P*< 0.01) with survivor status of the children. Above 12% mortality cases are reported to children of single birth whereas 31.5% is reported to children of 2nd of multiples. Lastly, the association between birth order and survival status is also statistically significance (*P*<0.01). High mortality cases are reported to children of first birth order (15%), while other birth order reported low case like 11.2% in birth order above 4+ children.

Table 2: Associations between some selected maternal fertility behavior with survivor status of less than 5 children in Tanzania, 2008

Variables	Child mortality probability (%)		*P-value*	X^2
	No	Yes		
Age group			0.00	154.6
15 - 19	7.2	92.8		
20 - 24	8.4	91.6		
25 - 29	10.3	89.7		
30 - 34	11.4	88.6		
35 - 39	12.7	87.3		
40 - 44	14.9	85.1		
45 - 49	16.3	83.7		
Age at first birth			0.00	71.6
<19	14.2	85.8		
19 - 24	10.7	89.3		
25 - 29	11.0	89.0		
30 - 34	7.8	92.2		
35+	12.5	87.5		
Earlier birth intervals			0.00	287.5
<24 months	18.3	81.7		
24 – 36 months	10.8	89.2		
37 – 48 months	9.5	90.5		
49 and above months	7.6	92.4		
Intent to give birth interval			0.00	715.6
<24months	26.5	73.5		
24 – 36 months	12.1	87.9		
37 – 48 months	9.8	90.2		
49 & above months	10.2	89.8		
Birth parity			0.00	207.0
<4	8.6	91.4		
4 - 8	12.8	87.2		
9+	17.5	82.5		
Multiplicity of birth			0.00	286.6
Single birth	12.1	87.9		
1st of multiple	25.0	75.0		
2nd of multiple	31.5	68.5		
3rd of multiple	75.0	25.0		
Birth order			0.00	45.5
1st order	14.9	85.1		
2 - 3	12.5	87.5		
4+	11.2	88.8		

Source: Tanzania Demographic and Health Survey, 2008

Levels and trends of under-five mortality rate from 1999 - 2015

Table 3 below presents the estimated trend of under 5 mortality rates from 1999 to 2008. The trends show an encouraging progress with under 5 mortality rates being reduced from 162.9 per 1000 live births in 1999 to about 116.8 per 1000 live births in 2008; this is equivalent to the reduction rate of 28.3% for the period of 9 years (or 3.15% per annum).

Table 3: Projection of under-5 mortality rate in Tanzania from 1999 to 2015

Index	Year	U5MR
1	1999	162.90
2	2000	159.49
3	2001	156.08
4	2002	152.68
5	2003	149.27
6	2004	145.86
7	2005	129.60
8	2006	126.31
9	2007	123.01
10	2008	116.79
11@	2010	114.05
12@	2012	98.67
13@	2014	84.63
14@	2015	81.02

Source: Tanzania Demographic and Health Survey, 2008 and @projected value.

Maternal fertility behavior

Table 4 below presents the odds ratio of infant mortality by maternal fertility behavior. The age of the mother was found to be statistically significant in influencing IMR. As the age of the mother at birth increases, the chance of dying decreases; for example, the children that belong to mothers in the age group 20 – 24 have 0.59 odds of dying compare to those belonging in the age group of reference category 15 – 19. Adjusted odds ratio for age of mothers in the same age group has been increased to 0.64 odds of dying compared to the reference category.

The odds ratio of the mother's age at first birth shows that, for those who are 20 years and older, the odds are 1.05 times reduced from the child mortality with young mothers aged 15-19 years. These results are similar with adjusted category odds of 1.10. This is a good sign that maternal education plays a major role in reducing child mortality.

Both preceding and succeeding birth intervals are statistically significant with IMR. For example, infants with preceding intervals of 37 – 48, and 49 and greater, are 0.73 and 0.62 times (respectively) less likely to die. Thus it can be argued that the ideal preceding interval is from 37 onwards. On the other hand, as the succeeding birth intervals increase, so do the survival odds of the infants. For example, an infant with the succeeding interval of 24 – 36 months to his/her siblings has 0.39 odds of dying, compared to the one in the interval of <24.

Table 5 below presents more details of odds ratios of under-five mortality rates by the mother's maternal fertility behaviors. The age of mothers overall finding was statistically significant, but there were some variations between young (15-24) and older women (25 and above). Adjusted values of odds are clearly visible in this variation.

But, when looking at the age of the mother at first birth, it was observed that as the age at first birth increases, the chances of the infant dying drops by approximately 3%. Adjusted values show a greater than 10% drop of the under-five mortality.

Mother's primary and higher educational status shows that the odds ratio of the level of under-five mortality has been reduced by 30% when compared with illiterate mothers.

The birth intervals between siblings were also found to have relative significance. Children born with the earlier birth intervals of 49+ months have 0.98 odds of dying (1.37 times more likely to survive) compared to those with the intent to give birth interval of < 24 months. There is not *much* difference within the remaining birth intervals. However, adjusted values of odds ratios in the extended birth intervals from 37 to 49 months show that the under–five mortality could be reduced by double with the reference category. That means the birth interval is one of the key factors in the study area.

Table 4: Adjusted odds ratios with 95 % confidence intervals (CI) for reporting, infant mortality by maternal fertility behavior in Tanzania, 2008

Variables	Crude			Adjusted		
	OR	95 % C I		OR	95 % C I	
Age group (ref: 15 - 19)	1.00			1.00		
20 – 24	0.59	0.17	2.08	0.64	0.20	2.44
25 – 29	0.23	0.07	0.76	0.25	0.12	0.79
30 – 34	0.21	0.06	0.70	0.25	0.10	0.95
35 – 39	0.20	0.06	0.68	0.23	0.09	0.70
40 – 44	0.17	0.05	0.57	0.26	0.10	0.61
45 – 49	0.13	0.04	0.44	0.15	0.07	0.56
Age at 1st birth (ref: 15 - 19)***)***	1.00			1.00		
20 and above	1.05	1.03	1.08	1.10	1.09	1.16
Preceding birth interval (ref: <24)	1.00			1.00		
24 – 36	1.05	0.79	1.40	1.10	0.88	1.65
37 – 48	0.73	0.55	0.97	0.80	1.04	0.88
49+	0.62	0.45	0.86	0.65	0.97	1.01
Succeeding birth interval (ref: <24)	1.00			1.00		
24 – 36	0.39	0.33	0.46	0.46	0.39	0.50
37 – 48	0.27	0.22	0.35	0.33	0.24	0.40
49+	0.32	0.25	0.41	0.35	0.26	0.45
Parity (ref: <3)	1.00			1.00		
4– 8	0.76	0.62	0.92	0.81	0.65	0.95
9+	0.85	0.68	1.05	0.89	0.77	1.15
Multiplicity of birth (ref: single)	1.00			1.00		
1st of multiple	4.25	2.63	6.87	5.15	3.03	7.77
2nd of multiple	3.08	2.10	4.54	4.00	2.49	5.21
3rd of multiple	1.45	0.27	7.95	1.69	0.31	8.00
Birth order (ref: 1st order)	1.00			1.00		
2 and above	1.05	1.02	1.08	1.22	1.10	1.22

Source: Tanzania Demographic and Health Survey, 2008

As shown in Table 5**,** birth parity is also statistically significant for the overall child mortality rate. Children belonging to mothers with parity 4 to 8 and 9+ have 1.27 and 1.08 times more risk of dying, respectively, compared to children in parity <3. Adjusted odds with birth parity 4 to 8 have 1.66 times more risk of dying as compared to the reference category.

The multiplicity of birth shows that children of third of multiples have 1.09 times more risk of dying compare to single births; while less difference is observed between first and second of multiples, this calculation is statistically significant.

Finally, birth order found that the children of order 2 to 3 and 4+ have odds of dying of 1.37 and 1.24 times greater when compared to children born first.

Table 5: Adjusted odds ratios with 95 % confidence intervals (CI) for reporting, child mortality by maternal fertility behavior in Tanzania 2008

	Crude			Adjusted		
Variables	**OR**	**95% C.I.**		**OR**	**95 % C.I.**	
Mothers' Age (ref: 15 – 19)	1.00			1.00		
20 – 24	1.63	0.46	5.76	1.77	0.55	6.21
25 – 29	3.87	1.15	13.08	3.94	1.21	13.22
30 – 34	3.63	1.08	12.21	3.77	1.16	13.02
35 – 39	3.33	0.99	11.16	3.50	1.11	11.33
40 – 44	3.32	0.99	11.13	3.42	1.24	11.15
45 – 49	3.93	1.17	13.18	4.01	1.36	14.14
Age at 1st birth *(ref: 15-19)*	1.00			1.00		
20 and above	0.97	0.15	0.90	1.10	1.09	1.20
Maternal education *(ref: Illiterates)*	1.00			1.00		
Primary and above	1.30	0.72	2.33	1.44	0.80	2.42
Earlier birth interval (ref: <24)	1.00			1.00		
24 – 36 months	1.37	1.12	1.67	1.89	1.50	1.97
37 – 48 months	1.43	1.10	1.86	2.00	1.44	2.12
49 & above months	0.98	0.72	1.33	1.11	1.02	1.62
Intent to birth interval (ref: <24)	1.00			1.00		
24 – 36 months	2.20	1.83	2.64	2.41	2.19	3.00
37 – 48 months	2.79	2.18	3.58	3.02	3.73	4.02
49 & above months	2.30	1.78	2.96	2.89	3.11	3.21
Birth parity (ref: <=3)	1.00			1.00		
4 – 8	1.27	1.03	1.56	1.66	1.52	1.71
9+	1.08	.85	1.36	1.15	1.10	1.66
Multiplicity of birth (ref: single birth)	1.00			1.00		
1st of multiple	0.31	0.19	0.52	0.77	0.75	0.80
2nd of multiple	0.48	0.32	0.71	0.55	0.48	1.01
3rd of multiple	1.09	0.20	5.95	1.20	0.64	6.66
Birth order (ref: 1st order)	1.00			1.00		
2nd - 3rd order	1.37	1.15	1.64	1.44	1.77	2.21
4th order and higher	1.24	1.01	1.52	1.31	1.11	1.75

Source: Tanzania Demographic and Health Survey, 2008

Discussion

Low education of the female population could be the predictor of the high total fertility rate of 5.83 observed in the results, which coincide with 5.6 and 5.5 of the National Bureau of Statistics Tanzania (2008) and UNICEF (2010) studies, respectively. Based on the study findings, there is an optimal birth interval. However, prevailing high infant and under-five mortality rates, regardless of

accessibility, might suggest a lack of professional medical personnel and proper medications.

TDHS data having minor differences in the probability of dying cases can be attributed by weighting effects and or difference of methodologies used to estimate overall mortality. We are sure that the results would not differ if similar methodology were to be used to indirectly estimate under-five mortality rates.

Though the findings suggest a fair decline of under-five mortality from the 1999 survey; the projection to 2015 shows that the progress is insufficient to achieve the MDG4 target. Therefore, Tanzania is among the 60 high-priority countries that are off-target to meet the MDG4 goal in 2015. When all the selected variables were entered at once by the odds ratio of logistic regression, maternal education was found to have a significant effect: infants born to mothers of higher education have higher odds of surviving. This is not a new phenomenon as it has been indicated in the literature that education indeed plays an important role in survival odds of children. Maternal age at first birth also indicates a higher mortality for infants born to older mothers.

Those who have young mothers have high chances of infant mortality than older mothers. This might be older mothers have lot of experiences in terms of infant health care compare to young mothers. The child mortality odds ratio was quite high in older mothers due to the lack of knowledge or negligence.

The results for this study suggest that optimal earlier birth intervals should be a minimum of 24 months and greater to reduce the infant mortality rate. Normally, infants of higher order are subject to a high mortality risk if the intent to give birth intervals has been shortened and because of high parity. The study results clearly show that the risk is diminishing if birth intervals and parity are controlled. However, after controlling for all the variables in the model, we still found mortality risks increase with an increase of the birth order. This finding is very clear with the help of the adjusted odds ratio.

We can argue that, as result of future birth interval having significance in the model with both crude and adjusted 95% confidence interval, this can have impact on the infant of higher order. The study discussion based on the selected variables suggested that infants born to single mothers tend to experience high mortality risk because single mothers usually appear to be teenagers. Teenagers are more likely to have low birth weight babies, and this can also be the cause for the high number of Tanzanian infants born to single mothers (the values not mentioned here). In addition to that, both prenatal care and postnatal care are very important at early ages for infant survival. This was also shown clearly where infants born to mothers who obtained prenatal care at the beginning of the first trimester have lower mortality rates than those who don't have this care or have it at a later period (observed from the TDHS report 2008).

Conclusion

Based on the study findings when all the mother's maternal fertility behaviour variables are controlled in child mortality rate, we found that as the maternal age at first birth increases, the survival odds of the children increasing. This result is totally different from the results of the infant mortality rate. For Tanzania to reduce its under-five mortality rates and to achieve the MDG 4 goal, it's required to double its current annual reduction rate of less than 4% to reach that level recommended by the United Nations (7.8%). This can be achieved in several ways, but most important of all is maternal education for women. Maternal education tends to greatly influence a mother's fertility behaviour, which is among the most important predictor of under-five mortality rates. Therefore, maternal education influences a mother's behaviour regarding the usage of available health services in order to improve the health of their children.

We also recommend that key measures be taken which will result in a positive lengthening of birth intervals in order to reduce the number of parity a woman will have and, in turn, the effects of birth order on mortality will subsequently diminish. Birth intervals of at least 24 months are needed to decline under-five mortality. Healthcare facilities

(especially maternal and child healthcare) should be made easily accessible to communities of all categories. On top of that, there should be professional and well-trained medical officers present and vaccinations and proper medicines available. Also important are the promotion of institutional delivery and the achievement of a rate of 100% antenatal and postnatal care so as to reduce neonatal and post-neonatal mortality and, at the same time, to improve the health of the children at their older ages. This study is trying to endorse the encouragement of maternal education and mother's community participation, introduce universal pulse polio vaccinations, and promote an increase in the age at marriage. Therefore, further in-depth analysis is immensely needed in this situation.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc) have been completely observed by the authors.

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References

1. Ministry of Health and Social Welfare (2008). *Annual Health Statistical Abstract.* Dar es Salaam: Ministry of Health and Social Welfare.
2. Tanzania Demographic and Health Surveys (2008). Available from www. Google .com *http://www.measuredhs.com/Tanzania*
3. UNICEF (2008). *Millennium Development Goals: Reduce child mortality*. Retrieved on November 12th, 2010 from *http://www.unicef.org/mdg/childmortality.html*
4. Janson A (2007). Shed some light on darkness: Will Tanzania reach the millennium development goals? *Acta Paediatrica, 96*(6), 781-786.
5. Morris SS, Black RE, Tomaskovic L (2003). Predicting the distribution of under-five deaths by cause in countries without adequate vital registration systems. *Int J Epidemiol, 32*(6), 1041.
6. Masanja H, de Savigny D, Smithson P, Schellenberg J, John T, Mbuya C (2008). Child survival gains in Tanzania: Analysis of data from demographic and health surveys. *The Lancet, 371*(9620), 1276-1283.
7. Armstrong Schellenberg JRM, Mrisho M, Manzi F, Shirima K, Mbuya C, Mushi, A K (2008). Health and survival of young children in southern Tanzania. *BMC Public Health, 8*, 194-210.
8. Nattey C (2008). Household Socio-economic status as a determinant of under-5 mortality at Rufiji DSS Tanzania. Unpublished Master of Science, University of Witwatersrand.
9. Tottrup C, Tersbol BP, Lindeboom W, Meyrowitsch D (2009). Putting child mortality on a map: Towards an understanding of inequity in health. *Tro Med Int Health, 14*(6), 653-662.
10. Tanzania Demographic and Health Surveys (2005) Available from www. Google .com *http://www.measuredhs.com/Tanzania*
11. Mturi AJ, Curtis SL (1995). The determinants of infant and child mortality in Tanzania. *Health Policy and Planning, 10*(4), 384.
12. Makbel AM (1997). The effect of some socio-economic factors on infant and child mortality in Tanzania: A case study of Tanga Region. Unpublished Master of Arts, University of Dar esa Salaam.
13. Ministry of Health and Social Welfare (MoHSW) (2006). Annual Health Statistical Abstract. Dar es Salaam: Ministry of Health and Social Welfare.
14. Armstrong Schellenberg JRM, Nathan R, Abdulla S, Mukasa O, Marchant TJ, Tanner M (2002). Risk factors for child mortality in rural Tanzania. *Tro Med Int Health, 7*(6), 506-511.
15. Blacker J, Brass W (2005). The estimation of infant mortality from proportions dying among births in the past 24 months. *Southern African Journal of Demography, 10*

(1&2), 25 - 42.
16. Sathiya Susuman A (2010). Correlates of Infant and Child mortality in Ethiopia 2005. *Journal of Community and Health Sciences, 5* (1), 16 – 25.
17. Tanzania National Bureau of Statistics (2006). Census 2002 analytical report. Dar es Salaam: Ministry of Planning, Economic and Empowerment.
18. UNDP (2010). *Millennium Development Goal 4 publication*. Retrieved February 5th, 2011 from *http://www.undp.org*.
19. United Nations (2011). Mortality estimate from major sample surveys: towards the design of a data base for the monitoring of mortality levels and trends, United Nations, Department of Economic and Social Affairs, Population Division, Technical Paper No 2011/2.
20. United Nations (2010). Millennium Development Goals Series of publication report. Retrieved January 3rd, 2011 from *www.un.org/millenniumgoals*.
21. Pathak KB, Ram F (1998). *Techniques of Demograhic Analysis*. Mumbai, India: Himalaya Publish House.
22. United Nations (1983). *Manual X: Indirect techniques for demographic estimation*. New York: Department of International, Economic and Social Affairs.
23. Trussell J (1975). A re-estimation of the multiplying factors for the brass technique for the determining childhood survivorship rates. *Population Studies, 29*(1), 97-107.
24. Sullivan JM (1972). Estimation of infants and childhood surviving probability from children surviving data. *Population Studies, 26(2)*, 81-143.
25. Pallant J (2007). *SPSS* survival manual: A step by step guide to data analysis using SPSS for windows version *15*. Open University Press.
26. Tanzania National Bureau of Statistics (2008). *Regional and Districts Projections*. Dar es Salaam: Ministry of Planning, Economic and Empowerment.
27. UNICEF (2001). Millennium Development Goals: Reduce child mortality. Retrieved on February 27th 2011 from *http://www.unicef.org*.
28. Brass W (1968). Methods of analysis and estimation. In W. Brass et al. (Ed.), *The demography of tropical Africa*. Princeton: Princeton University Press.