

**Original Article****DEMOGRAPHIC AND SOCIOECONOMIC DETERMINANTS OF INFANT AND CHILD MORTALITY IN WAD-MEDANI CHILDREN TEACHING HOSPITAL – GEZIRA STATE, SUDAN (2005-2008)**

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**ABSTRACT:**

Infants and child under-five years' morbidity and mortality trends, due to several causes, reflect a country level of socioeconomic development and quality of life. The aim of this study is to identify the factors related to infant and child mortality in Wad-Medani Children Teaching Hospital in central Sudan. It investigated the relationship between the demographic and socioeconomic factors and infant and child mortality. Hospital deaths registration records in Wad-Medani Children Teaching Hospital, during the years (2005 – 2008) were used, 100 cases were chosen randomly. The study also utilized data collected by filling a structured questionnaire addressed to 200 women in their reproductive age (15 -49 years) attending the out-patient clinic. Frequency distributions and statistical significant tests based on chi-square for independence were conducted using SPSS program.

The infant and under-five mortality rate was estimated at 73 and 60 per 1000 live births respectively. The most significant variables that determine the infant and child mortality were preceding birth interval, child immunization and education of mothers. The infant and under-five mortality rate are still persistently high and demographic and socio-economic factors have a great influence on the health status of children in central Sudan. The government should give more attention to improve the immunization services and concentrate on health education campaigns for mothers to reduce the prevalence of under five mortality.

**Key words:**

*Infant mortality, demographic factors, under five mortality, socioeconomic, central Sudan,*

**الخلاصة**

معدلات وفيات الأطفال و الرضع من أهم المؤشرات لقياس المستوى الصحي في المجتمع، كما أنها تشكل معايير مهمة لفعالية و برامج و سياسات الصحة في المجتمع المعني التي تهدف لخفض معدل وفيات الرضع و الأطفال دون سن الخامسة. تهدف هذه الدراسة للتعرف على العوامل الاجتماعية والاقتصادية المؤثرة على

وفيات الأطفال و الرضع دون سن الخامسة بمستشفى ود مدني التعليمي لطب الأطفال وسط السودان، لتحديد تأثير العوامل الاجتماعية والاقتصادية والديمغرافية والبيولوجية على الحالة الصحية للأطفال دون سن الخامسة.

تمت عملية جمع البيانات بطريقتين الأولى كانت باستخدام بيانات المستشفى الخاصة بوفيات الأطفال و الرضع خلال الفترة (2005-2008) حيث تم اختيار 100 حالة اختياراً عشوائياً. أما الطريقة الأخرى فكانت باستخدام طريقة الاستبانة لعدد 200 امرأة في سن الإنجاب (15 - 49) حضرن مع أطفالهن للعيادة الخارجية بالمستشفى، حيث تم اختيارهن بطريقة عشوائية. تم تحليل البيانات إحصائياً باستخدام التوزيعات التكرارية و اختبار ( كاي- تربيع) بواسطة البرنامج الإحصائي (SPSS).

أوضحت نتائج الدراسة أن معدل وفيات الرضع والأطفال دون سن الخامسة حوالي 70 لكل ألف طفل حي و 60 لكل ألف طفل حي علي التوالي. كما أوضحت أن هنالك علاقة إحصائية ذات معنوية عالية بين وفيات الأطفال و الرضع و مستوى التحصين و الترتيب الولادي و وزن الطفل عند الولادة و تعليم الأمهات. توصي هذه الدراسة باهتمام الدولة بحملات تطعيم الأطفال وتوسيع حملات تنقيف الأمهات لتخفيض معدلات وفيات الأطفال دون سن الخامسة.

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## Introduction

Infant and children under-five years mortality trends, reflect a country level of socioeconomic development and quality of life. These trends are used to monitor and evaluate the health programmes and policies. They indicate how well the needs of a society are being met. One of the important Millennium Development Goals (MDGs) adopted in the year 2000 by 189 countries is to reduce the under-five-mortality rate by two thirds between 1990 and 2015.<sup>1</sup>

Infant and child mortality is mostly affected by the health and sanitary conditions. The causes were biologically stems from the interacting effects of multiple causes that included malnutrition and infectious diseases. The main causes of infant and child mortality in less developed nations like Sudan are dehydration and chronic diarrhea, acute respiratory infections (ARI), infectious diseases, some of which are preventable by vaccine, and malnutrition.<sup>2</sup> Malnutrition is associated with more than half of all child deaths worldwide. Three-quarters of the children who die

from causes related to malnutrition were only mildly or moderately malnourished, showing no outward sign of their vulnerability.<sup>3</sup>

Mosely and Chen in 1984 identified five proximate determinant variables,<sup>4</sup> grouped into five factors, environmental contamination, nutrient availability, injury, personal illness control factors and maternal factors. Through these determinants social economic factors operate to influence the infant and child morbidity and consequently mortality. All measures of community development, measures of family social and economic status such as average years of female education, family income, beside medical facilities and public sanitation, were studied as indicators of specific health intervention.

The Sudan is one of the countries where children are at high risk of death. The last census in 1993 revealed that one child dies in every ten. Perhaps, this ratio is even better than reality because that census did not include all regions of the country. The neonatal, infant and under-five mortality rates in the Sudan, were estimated at 41, 81 and 112 per 1,000 live births respectively. These rates were lowest in Gezira State (NMR: 27; IMR: 52; U5MR:63).<sup>3</sup> The neonatal mortality rate in the Sudan does not change significantly in the decade between the Sudan Fertility Survey (SFS) (1978/1979)<sup>5</sup> and Sudan Demographic Health Survey (SDHS), (44 deaths per 1000 births), but the under five mortality rate decreased by 20% from 143 deaths per 1000 to 112 per 1000. In urban areas the under five mortality is 19% (117 per 1000 births) which is lower than in rural areas (144 per 1000 births).<sup>6</sup>

### Materials and Methods

Gezira State in central Sudan has a total area of 23,373 km and a heterogeneous population of about 3,300,000, of these, 81 % lives in rural areas and the majority around 99 % of them is Muslims. The age distribution indicates a very young population; about 42 % is under age 15 years<sup>3</sup>. Most of the population are tenants at Gezira agricultural scheme, government employees, traders, farmers and unskilled labourers. About 27 % above age 10 years, has no formal education. The proportion of females in the prime reproductive age (20 – 39) is remarkably higher than males, which undoubtedly favours high fertility, in the absence of or poor family planning programs. On the average every household has 6.5 members. All these indicate that the population of Gezira State is still in an early stage of demographic development with high rates of fertility and mortality. The state is highly endemic with

malaria which could post serious health problems to infant and children.

Wad-Medani Children Teaching Hospital (WCTH) was chosen as a site for this study as it is the main referral hospital for child medical and surgical problems outside Khartoum, the capital of Sudan. It provides services for Gezira and other neighbouring states. More than 50,000 children attend the hospital every year.

### **Study Design**

The study employed two study designs; the first was a retrospective design, by which secondary information from the hospital records was used. These data included the child name, age, sex, weight, date of death, causes of death, parental education, occupation and place of residence in the period including the years (2005-2008). The second design was cross-sectional, by which data were collected using structured questionnaire from women who have had children aged (1-5) years attending the hospital outpatient clinic and had at least one dead child. The data concentrate on both socio-economic and biological factors that affect the health of infant and child that resulted in death.

A simple random sampling technique was used to yield 300 women who had at least one child less than five years of age. The records of 200 children under-five were chosen. A structured questionnaire was addressed to 100 women attending the WCTH out-patient clinic, all by simple random technique. Statistical Packages for Social Sciences (SPSS) were used to analyze the data. An ethical approval was obtained from the regional ethical clearance committee.

### **Results and Discussion**

The result of this study showed that, the deaths were more prevalent in both first and second age groups (0-24 months). This comprised 63.6% as accumulative percentage and 36.3% of them were infants less than one year of age Table 1. Worldwide an estimated million infants die before their first birthday each year, 5 million die within the first month of life and an estimated 3.4 million in the first week of life. As with maternal deaths, nearly all neonatal deaths (98%) occur in the developing countries.<sup>7</sup> The mortality rate was higher among males, both in the hospital records and the women' survey, 52.7% to 47.3% respectively. In the five years preceding the Sudan House Health Survey, death rate by gender was reported to be more prevalent among females.<sup>3</sup> The child mortality is falling at less than half the rate required to

meet the first target: if present trends continue there will be 8.5m child deaths in 2015.<sup>8</sup>

Maternal age is a useful demographic indicator. A higher mortality rates were found among mothers of young age groups, who had just started their reproductive period and had only experienced their first birth, 24.3% of the deaths are among children of mothers in age group (15-19). The distribution of infant and child death by age group of mothers showed a linear decline with a cumulative percentage of 47%. According to UNFPA report in 1998, those babies born to teenage mothers were as twice as likely to die in the first year of life.<sup>9</sup> Moreover children of very young mothers are more likely to experience later problems including developmental delay and poor performance at school.<sup>7</sup> WHO reports showed that, children born to mothers over 40-year of age and women with many previous births, are likely to give still births or births that may not survive childhood, or are likely to have congenital abnormalities.<sup>10</sup>

**Table 1: Distribution of Infant and Child Death by Age Group**

Age group (by month)	Number of children who died			Percentage
	Hospital	Community	Total	
0 – 12	60	49	109	36.3
12 – 24	44	38	82	27.3
24 – 36	19	28	47	15.7
36 – 48	10	20	30	10.0
48 – 60	17	15	32	10.7
Total	150	150	300	100.0

Children of educated mothers have higher chances of survival than those from uneducated mothers, as it mentioned in the literature review. From the data this information was collected by categorizing mothers into four educational levels: elementary, those with less than four years of education, basic school, those who have completed eight years of school, secondary, those with more than eight years and University, those with more than eleven years in school. As seen from the data, those infants and children who have died are from those mothers with less than four years of education with 41.7% compared to those mothers with more than eleven years of education 1.7% those with basic school attendance have about 29.3% and those with secondary education have 27.3%. (Table 2).

As shown from the same table, the majority of infants and children who had died were from un-educated mothers with 42% compared to only 2.0% for well-educated mothers. This may be due to the fact that educated mothers understand the importance of health care for the child before and after birth.

Moreover educated mother can determine and detect easily if the child is sick and what symptoms are appearing. While uneducated mother will no have time to see these signs and symptoms as mostly may be engaged in where to find food for the day and therefore do not take care of the child

Mother' Educational level	Place of Death		
	Hospital Death N (%)	Community Death N (%)	Total N (%)
Basic school	45 (30.10%)	43 (28.70%)	88 (29.30%)
Elementary	59 (39.30%)	66 (44.00%)	125 (41.70%)
Secondary	44 (29.30%)	38 (25.3%)	82 (27.30%)
University	02 (01.33%)	03 (1.30%)	05 (01.70%)

According to table 3, the mortality rate increased with increasing parity order i.e., in the higher parity women (42.0%). Birth interval as well, influenced the death rate. In 35% of the deaths the birth interval was less than one year, compared to 21.5% in the group of more than two years interval. This indicated that, short interval between birth poses especial high risks.<sup>11</sup> The survey carried out by WHO estimated the infant mortality rate at 200 per 1000 live births, when birth-spacing is less than one year and it drops to 80 per 1000 live births when birth-spacing is three to four

Characteristics	Dead Children N (%)
<b>Birth Order</b>	
1	13 (08.7)
2-3	26 (17.3)
4-5	48 (32.0)
6+	63 (42.0)
<b>Birth Interval</b>	
< 1 yr	51 (34.0)
1-2 yrs	68 (45.3)
> 2 yrs	31 (20.7)
<b>Total</b>	<b>150 (100)</b>

Today, more than 80 percent of the children worldwide are protected against vaccine preventable diseases. In this study only 30% of studied sample had completed their vaccine schedule. This can be explained by the fact that most of hospital attendants are from poor, far outreach rural communities (see table 4).

**Table 4. Percent Distribution of Children Table. 4 Death by Place of Delivery and Child Immunizations Status.**

<i>Characteristics</i>	<i>Dead Children N (%)</i>
<b>Place of Delivery</b>	
Home	189 (62.9)
Hospital	111 (37.1)
<b>Child Immunization</b>	
Full	90 (30.0)
Partial	142 (45.3)
None	68 (22.7)
<b>Total</b>	<b>300 (100)</b>

Place of residence is also regarded as an important factors associated with infant and child mortality. Out of the total of 300 selected cases, the data shows 68.30% of the children who died were come from rural areas, while only 31.7% of them were come from urban areas (see table 5). The same table shows that, the majority of families 65% belonged to the middle income group, whereas low and high income groups constituted 29% and 6.30% respectively.

**Table 5. Differential of Children Death According to Some Selected Characteristics**

<b>Variable</b>	<b>N (%)</b>
<b>Residence</b>	
Rural	205 (68.30%)
Urban	31 (31.70%)
<b>Place of delivery</b>	
Home	189 (62.90%)
Hospital	111 (37.10%)
<b>Mother' occupation</b>	
Housewife	260 (86.20%)
Unskilled labourers	16 (05.305)
Employee	24 (08.005)
<b>Family income (average expenditure)</b>	
Low	194 (64.70%)
Medium	87 (29.00%)
High	19 (06.30%)

Vitamin A programmes are now under way in 50 countries and can reduce child mortality by 23-34 percent in vitamin A deficient populations.<sup>15</sup> Some efforts to reduce vitamin A deficiency and efforts to enhance vitamin A supplementation. Food-based approaches, including fortification and nutrition education have been established in developing world.<sup>9</sup> SHHS showed that vitamin A supplementation for under-five was 76.4% and for postpartum mothers was 18.5%.<sup>4</sup>

**Table 6. Sudan Household Health Survey (SHHS) and Millennium Development Goals Nutritional indicators. Sudan 2006.**

<b>Nutritional status</b>	<b>prevalence%</b>
<b>Underweight</b>	
<i>Moderate to severe</i>	31.0
<i>Severe</i>	09.4
<b>Stunting</b>	
<i>Moderate to severe</i>	32.5
<i>Severe</i>	15.2
<b>Wasting</b>	
<i>Moderate to severe</i>	14.8
<i>Severe</i>	03.5
<b>Overweight</b>	03.6

Malnutrition is largely silent and invisible emergency, it results in more than half of the nearly 12 million deaths each year, among under 5 years children.<sup>10</sup> WHO has recognized the impact of a wide spread nature of food borne diseases on children under five years. 1.5 billion episodes of diarrhea in children under five years and more than 3 million result in deaths.<sup>16</sup> The 1992 FAO/WHO international conference on nutrition recognized that, hundreds of millions of fewer than five years children worldwide, suffer from communicable and non-communicable diseases caused by contaminated food, food borne infections and is estimated to affect over 100 million people, most of them are children under five years.<sup>16</sup>

The Millennium Development Goal (MDG) target is to reduce by half, the proportion of people who suffer from hunger between 1990 and 2015 as shown in Table 5. The world fit for Children goal is to reduce the prevalence of malnutrition among children under five years of age by at least one third (between 2000 and 2010), specially in children under two years of age. A reduction in



the prevalence of malnutrition will assist in the goal to reduce child mortality<sup>2</sup>.

(Chi -square)  $\chi^2$  test of independence was used to test the association between the independent variables that were assumed to affect the mortality of infants and children under five significantly. Table 6 illustrates the effect of these variables on child mortality. These variables were birth weight, birth interval, child order, child immunization, mothers' education and family income.

Table 7 on the other hand showed that, birth weight, birth interval and family income were all significant at 5%, while the other independent variables child order, child immunization and mothers' education were significant at 1%, indicating that, all variables were strongly significant and associated with infants and under-five mortality.

<b>Table 7. Determinants of infant and under 5 Mortality</b>	
<b>Variable</b>	<b>N (%)</b>
<b>Child weight</b>	
Underweight	92 (30.60%)
Normal	185 (61.70%)
Unknown	23 (07.70%)
<b>Immunization</b>	
Full	90 (30.00%)
Partial	142 (32.00%)
None	126 (42.00%)
<b>Order of birth</b>	
1	26 (08.70%)
2-3	52 (17.30%)
4-5	96 (32.00%)
≥ 6	126 (42.00%)
<b>Birth interval</b>	
< 1 yr	51 (34.00%)
1-2 yrs	68 (45.30%)
> 2 yrs	31 (20.70%)

Actual or projected data on infant mortality indicate progress between 1990 and 1999 in all world's regions, but 10 percent reduction in infants mortality in developing world during the period (1990–1999), appears too slow to meet the target set in the International Development Goals for 2015.<sup>1</sup> So under-five mortality rates in the developing world have been declined too slowly to attain the target of "2/3 reduction" by 2015: rates should have come down by roughly 30 percent in the 1995. Between 1990 and 2005, child mortality decreased in Sub-Saharan Africa

from 185 per 1000 live births to 166 per 1000 live births. In 1998, more than 50 countries including Sudan still had childhood mortality rates of over 100 per 1000 live births.<sup>8</sup>

The analysis of infant and child mortality in WCTH revealed that infant mortality rate was 73 per 1000 live births. This figure is quite consistent with the findings of the 1999 Safe Motherhood Survey (SMS), in which the national level of infant mortality was estimated at 68 deaths per 1000 live births. Also the study estimated under-five mortality as 60 deaths per 1000 live births. The Multiple Indicators Cluster Survey (MICS) which was conducted in the Gezira State in 2002, showed 59 out of 1000 children died before reaching their fifth birthday.<sup>17</sup>

On the examining the determinants of infant and child mortality, the study showed a strong association between child mortality and these determinants. The probability of dying before age five for children born less than two years after a previous birth is more than double that for children born four or more years after a previous birth.<sup>11</sup> Many studies showed that the income is the most relevant to health policy formulation. Current income provides a direct measure of the quality of food, housing, leisure-time amenities and health care an individual is able to acquire, as well as reflecting the relative position in society.

**Table 8. Association between Under-Five Mortality and some selected Independent Variables.**

Independent variable	X <sup>2</sup> value	Sig.
Birth weight	12.830	0.035*
Birth interval	10.590	0.023*
Family income	9.320	0.033*
Child order	9.210	0.000**
Child immunization	11.345	0.000**
Mothers' education	13.277	0.000**

Note: \*\* Significant at 1% and \* Significant at 5%

Birth weight is a very important determinant of infant mortality. Newborns with a birth weight of less than 2500 gm are classified as low birth weight (LBW) babies (WHO recommendations).<sup>18</sup> Such babies have a greater risk of prenatal and neonatal mortality 2.5 higher than average as well as experience. Recent studies show that, birth weight is a reasonable measure of maternal care and have empirically confirmed its effect on child mortality.<sup>19</sup>

This study showed a significant correlation between maternal education and infant and child mortality. Many studies carried out in countries of varying levels of development have shown a significant connection between the mother's level of education and infant mortality.<sup>20</sup> In 2005 SHHS in the Sudan, it was evident that, the percentage of adequately fed infants (0-11 months) increases with increasing level of mothers education.<sup>3</sup> In a study of DHS data from 17 countries representing range of socioeconomic and health conditions, it was found that, even after controlling for the effect of economic status as measured by house hold possessions and housing conditions, maternal education remains significantly associated with children's chance of survival.<sup>21</sup>

In this respect we can conclude that women who received some education will not only be aware of the need for sanitary precautions and have some knowledge of nutrition, but that they will seek medical attention more actively than women without any schooling. According to SHHS, 2005, the percentage of children classified as moderately or severely underweight decreases with increasing levels of education of the mothers.<sup>3</sup>

The study also found a strong association with child order. Many studies suggested that infant and child mortality increase with the increase of parity after the second birth. The risk of death is considerably higher for a child who has a sibling born within the preceding two years. On the other hand, other studies suggested that infant and child mortality is generally higher for first born children, especially during the first year of life.

Immunization was much more important factor affecting infant and child mortality. The immunization status of the children in this study showed that 30% of the children had been fully vaccinated, 47.3% were partially immunized, whereas, only 22.7% had received no vaccines. This study showed a significant association between immunization and child mortality, and between mother's education and infant and child mortality. Globally, immunizations have saved the lives of millions of children in the last 3 decades following the expanded programme of immunization (EPI) which was launched in 1974. A world Fit for Children goal is to ensure that the rates of full immunization of children under one year of age reach 90 per cent nationally, with at least 80 per cent coverage in every district or equivalent administrative unit.<sup>3</sup>

The most critical factor in immunity mechanism is probably nutrition. So nutrition including beside diet, two important aspects, breast feeding and weaning.<sup>17</sup> Breast feeding for the first

few years of life protects children from infection, provides an ideal source of nutrients, and is economical and safe. The SHHS in 2005, showed that exclusive breast feeding rate of infants aged 0-5 months, is lower in infants of mothers belonging to poorest households as compared to infants of mothers belonging to the richest households.<sup>3</sup> The World fit for Children goal states that children should be exclusively breastfed for 6 months and should continue to be breastfed with safe, appropriate and adequate complementary feeding for up to 2 years of age and beyond.<sup>3</sup>

The study showed a significant association between family income and infant and child mortality. Family income has been identified by many studies as one of the most important socio-economic determinants of infant and child mortality.<sup>18</sup>

### **Recommendations**

The maternal education, antenatal care can be adopted to increase the child survival chances in the Sudan and to meet the target of (MDGs) of reducing infant and child mortality and must be encourage and made accessible to all women particularly in the rural area. Socio-economic measures including; income generating projects directed towards low income groups and development of opportunities for employment should highly be encouraged. Public awareness about the dangers associated with lack of immunization, early child bearing and short birth intervals must be carefully addressed through health education activities using all the available methods of health education. The effective control of infectious diseases requires effective public health infrastructures that will rapidly recognize and respond to these problems and prevent emerging problems.

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