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## **Determinants of Child Malnutrition in Sudan**

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### **ABSTRACT**

*This paper aims at identifying the causes of malnutrition among children who are under five years of age and suggesting some recommendations that can reduce it. The study employed secondary data obtained from the Multiple Cluster Indicators Survey for the year 2014 obtained by the Central Bureau of Statistics in collaboration with the United Nations Children's Emergency Fund (UNICEF). Using the linear regression method, the results suggested three breastfeeding factors and one factor of each of hygiene, additional feeding, sanitation and care and maternal health and nutrition factor respectively to have an important role in reducing malnutrition among under five children. In light of the results obtained from this study it worthwhile to recommend the continuation and appropriateness of breastfeeding, lengthen the median duration of any breastfeeding, safely disposal of the child's stools, diversification of food, post-natal health check for the newborn and antenatal care visit during the first trimester because of its importance in reducing malnutrition among children.*

**KEYWORDS:** *Child, Nutrition, Malnutrition, Sudan.*

### **INTRODUCTION:**

Child growth is internationally recognized as an important indicator of nutritional status and health in populations, as that changes in body dimensions reflect the overall health and welfare of individuals and populations. Anthropometry is used to assess and predict performance, health and survival of individuals and reflect the economic and social well-being of populations. Anthropometry is a widely used, inexpensive and non-invasive measure of the general nutritional status of an individual or a population group.

According to Cogill, Bruce(2001), recent studies have demonstrated the applications of anthropometry to include the prediction of who will benefit from interventions, identifying social and economic inequity and evaluating responses to interventions. Anthropometry can be used for various purposes, depending on the anthropometric indicators selected. For example, low weight-for-height (wasting) is useful for screening children at risk and for measuring short-term changes in nutritional status, low weight-for-age (Stunting) index identifies the condition of being underweight, for a specific age, while underweight, based on weight-for-age, is a composite measure of stunting and wasting and is recommended as the indicator to assess changes in the magnitude of malnutrition over time.

Underweight is used to measure nutritional imbalance resulting in under nutrition, and Underweight children is defined as percentage of children under five years of age falling below minus two standard deviations from the median weight-for-age of the WHO reference

population. Thus, underweight children is the percentage of children who have low weight for age and it can reflect ‘wasting’, ‘stunting’, or both (WHO,2010).Wasting in children is a symptom of acute under nutrition, usually as a consequence of insufficient food intake or a high incidence of infectious diseases, especially diarrhoea. Wasting in turn impairs the functioning of the immune system and can lead to increased severity and duration of and susceptibility to infectious diseases and an increased risk for death. While stunting is a reduced growth rate in human development Children who suffer from growth retardation as a result of poor diets or recurrent infections tend to be at greater risk for illness and death. Stunting is the result of long-term nutritional deprivation or illness, or a combination of both and often results in delayed mental development, poor school performance and reduced intellectual capacity.

As weight is easy to measure, underweight is the indicator for which most data have been collected in the past. Evidence has shown that the mortality risk of children who are even mildly underweight is increased, and severely underweight children are at even greater risk. According to (Sibanda et al, 2014), in Sudan, 2.2 million children less than five years of age are stunted – just over one in every three children. It is no wonder that Sudan is one of the 14 countries where 80 per cent of the world’s stunted children live<sup>14</sup>. A stunted child faces a higher risk of dying from infectious disease (1.9 to 6.5 times more likely to die) and the child is likely to perform less well in school (equivalent to two to three years’ loss of education). Stunting is associated with impaired brain development, meaning lasting, impaired mental functioning. This, in turn, leads to significantly reduced learning. Adults stunted as children earn a lower income in life (on average, 22 per cent less), which further exacerbates deprivation. For a country as a whole, stunting may result in a loss to GDP of 2 to 3 per cent per year.

**Problem statement:**

Sudan consist of 18 states, the states are divided into localities, the total number of localities is184 according to the recent census of 2008. The geography and ecology contribute to the prevailing health and nutrition. The vast geographic areas, coupled with inadequate road and transport infrastructure, affect coverage and access to health services. WHO global data base on Child Growth and Nutrition shows Sudan as the worst country with anemia among pregnant women among the 10 MDG4 and 5 priority countries in the Region. The nutrition situation in Sudan is characterized by persistently high levels of acute malnutrition and stunting. Both trends have continued since record keeping began in 1987. In absolute terms, the nutrition situation of children is worsening and underscores the urgent need for policy and programme action for the prevention and treatment of child malnutrition. The rising prevalence of malnutrition and population growth explain why the absolute numbers of wasted, stunted and underweight children under five years of age have risen significantly. Today, there are more wasted and stunted children in Sudan than there were 20 years ago (Sibanda et al, 2014). The paper argues that, it is very important to know more about the levels of child malnutrition and identify the most important variables that contributed to increase malnutrition in children as well as to suggest measures that would contribute in reducing the level of child malnutrition.

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**The importance and objectives of the study:**

The importance of this study stems from the fact that malnutrition is the leading cause of illness and death around the world and in Sudan in particular, especially in areas that have been affected by war, such as Blue Nile, Nuba Mountains and Darfur in addition to eastern Sudan, which suffer from malnutrition since the past decades.

Thus, the knowledge of the most important determinants of malnutrition in children gives the government and its partners the ability to develop the most appropriate policies and strategies that can reduce the incidence of malnutrition and thus alleviate its effects such as sickness and death.

The study aims to find out the main causes of child malnutrition in the Sudan state so as to be useful in malnutrition eradication programs. The specific objective is to assess some recommendations about malnutrition reduction in Sudan.

**Causes of malnutrition:**

The causes of malnutrition are directly related to inadequate dietary intake as well as disease, but indirectly to many factors, among others household food security, maternal and child care, health services and the environment. While most nutrition interventions are delivered through the health sector, non-health interventions can also be critical. Actions should target the different causes to reach sustainable change, which requires a multisectoral approach (WHO, 2013).

The most significant contributors to infant and child malnutrition appear to be inappropriate infant and young child feeding practices especially lack of exclusive breastfeeding, poor hygiene, sanitation and caring practices, along with the health and nutrition status of the mother (NAFIN,2010).

**Breastfeeding:**

Breast milk meets up to 70% of an infants' energy, protein, calcium, vitamin A, vitamin C, iron folate and zinc requirements in the first 6 months of life and up to 50% in the first year of life. Breastfeeding therefore contributes significantly to protecting nutritional and immune status and as such reducing health costs for both families and the health system (NAFIN,2010). Accordingly, Namibian babies that are not breastfed have been shown to be five times more likely to die of infectious disease than breastfed infants in the first 2 months of life; and twice as likely to succumb to infectious disease within the first half year of life.

**Hygiene, sanitation and care:**

"Access to safe drinking-water and improved sanitation are fundamental needs and human rights vital for the dignity and health of all people. The health and economic benefits of a safe water supply to households and individuals (especially children) are well documented. Both indicators are used to monitor progress towards the Millennium Development Goals"(WHO/UNICEF).

Frequent childhood infections, principally due to inappropriate infant feeding practices and compounded by low sanitation coverage and sub-optimal hygiene practices such as infrequent or lack of hand washing with soap at critical are important underlying causes of malnutrition. At any given time 5% to 17% of Namibian children under 5 years old have some illness (eg, malaria, pneumonia or diarrhea) that impacts on their nutrition. Diarrhea

and pneumonia are highly prevalent in regions with low sanitation coverage. Less than 70% of Namibia's population has access to improved sanitation facilities. The nutritional status of children growing up in environments with low sanitation and prevalent unhygienic practices is undermined not only because they lose more nutrients than they can consume, but they have to compete with invading pathogens (NAFIN, 2010).

#### **Maternal health and nutrition status:**

The nutritional status of a woman before she becomes pregnant can determine the birth weight and survival of her future children. This is particularly true of women who have experienced protein–energy malnutrition at sometime during their lives

According to (NAFIN, 2010), mother's nutrition and health status and care during pregnancy is a critical factor in infant and childhood malnutrition in Namibia. Accordingly, the NDHS 2006/7 showed that children born to underweight mothers were two to three times more likely to be severely stunted compared to children born to normal or overweight mothers and children born to overweight mothers have a twofold risk of being overweight compared to those born of mothers with normal weight.

#### **The statistical methodology and data:**

The proposed study depends upon secondary data obtained from the Multiple Indicators Cluster Survey (MICS) conducted in the year 2014 by the government of Sudan with collaboration with the United Nations Children's Emergency Fund (UNICEF). In addition to the dependent variable (Percentage of children under age 5 who are underweight (CM)), the independent variables used in this study are divided to five main categories:

First, breast feeding factors which includes; percentage of children age 0-23 months who were appropriately breastfed during the previous day (Bpd), percentage of living children aged 0-5 months who were exclusively breastfed (Bfe), percentage of living children aged 0-5 months who were predominantly breastfed (Bfp), percentage of last live-born children in the last two years who were ever breastfed (Pbf), percentage of last live-born children in the last two years who were first breastfed within one hour of birth (Pbf1), percentage of last live-born children in the last two years who were first breastfed within one day of birth (Pbf2), percentage of living children aged 12-15 months who were breastfed continued at first year (Bf1), percentage of living children aged 12-23 months who were breastfed continued at second years (Bf2), median duration of predominant breastfeeding (in month) among children age 0-35 months (Dpb), median duration of any breastfeeding (in month) among children age 0-35 months (Dab), median duration of any exclusive breastfeeding (in month) among children age 0-35 months (Deb).

Second, additional feeding factors which includes; percentage of children age 6-23 months who were currently breastfeeding and receiving solid, semi-solid or soft foods (Bsf), percentage of children age 6-23 months who received minimum dietary diversity during the previous day (Mdd), percentage of children age 6-23 months who received minimum meal frequency during the previous day (Mmf), percentage of children age 6-23 months who received minimum acceptable diet during the previous day (Mad), percentage of children age 0-23 months who were fed with a bottle with a nipple during the previous day (Bbn), percent of households with no salt (Sno), percent of households with salt test result (>0 and <15 PPM) (Si1), and percent of households with salt test result (15+ PPM) (Si2).

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Third, three hygiene factors namely; percentage of children age 0-2 years whose last stools were disposed off safely (Sds), percentage of households with a specific place for hand washing where water and soap or other cleansing agent are present (Wsp) and percentage of households with soap or other cleansing agent anywhere in the dwelling (Scd).

Fourth, sanitation and care factors and includes thirteen variables namely; percentage of children age 0-59 months with diarrhea in the last two weeks for whom advice or treatment was sought from a health facility or provider (Atp), percentage of children age 0-59 months with diarrhea in the last two weeks for whom no advice or treatment sought (Nts), percent distribution of children age 0-59 months with diarrhea in the last two weeks who had treatment with oral rehydration salts (ORS) or any recommended homemade fluid (Tor), percent distribution of children age 0-59 months with diarrhea in the last two weeks who treatment with any zinc (Tablet or Syrup) (Twz), percent distribution of children age 0-59 months with diarrhea in the last two weeks who was given to drink more during diarrhea (Dmd), percent distribution of children age 0-59 months with diarrhea in the last two weeks who was given to eat more during diarrhea (Emd), percentage of children age 0-59 months with symptoms of ARI in the last two weeks who were given antibiotics (Ari), percentage of mothers or caretakers of children under age 5 who recognize at least one of the two danger signs of pneumonia (fast and/or difficult breathing) (Tdp), percentage of household population using improved drinking water sources (Isw), percentage of household members in households using unimproved drinking water sources and using an appropriate water treatment method (Wtm), percentage of women age 15-49 years with a live birth in the last two years whose last live birth received health checks while in facility or at home following birth (Hfh), percentage of women age 15-49 years with a live birth in the last two years whose last live birth received post-natal health check for the newborn (Pcn), percentage of women age 15-49 years with a live birth in the last two years whose last live birth received post-natal health check by doctor/ nurse/ midwife or certified midwife (Pdm)

Finally, maternal health and nutrition variables and namely are; percentage of women age 20-24 who have had a live birth before age 18 (Wbb), percentage of women age 15-49 years with a live birth in the last two years who delivered their last child in health facility (Dhf), percentage of women age 15-49 years with a live birth in the last two years who had their last birth delivered in a health facility and stay there for 12 hours or more (Dhs), percentage of women age 15-49 years with a live birth in the last two years who had no antenatal care visits (Ncv), percentage of women age 15-49 years with a live birth in the last two years who had antenatal care visit during the first trimester (Cvf), percentage of women age 15-49 years with a live birth in the last two years who had antenatal care by medical doctor (Cmd), percentage of women age 15-49 years with a live birth in the last two years who had antenatal care by a skilled provider (Csp), percentage of women age 15-49 years with a live birth in the last two years who had delivery assisted by medical doctor (Dam), percentage of women age 15-49 years with a live birth in the last two years who had delivery assisted by any skilled attendant (Dsa), percentage of women age 15-49 years with a live birth in the last two years who received health checks while in facility or at home following birth (Cfh), percentage of women age 15-49 years with a live birth in the last two years who received post-natal health check for the mother (Pcm), and percentage of women age 15-49 years with a live birth in the last two years who received post-natal health check by doctor/ nurse/ midwife or certified midwife (Pdc).

Backward method of regression is applied to determine the most important factors that can affect the child malnutrition, and the results are as in table (1) below:

Section (A) in table (1) below reports the results of the best fitted equation for the relationship between child malnutrition (CM) and breastfeeding variables, where the figures in parentheses are the t-ratios of the estimated parameters and those inside the square brackets are the significance levels of the parameters. We observe that four out of the seven statistically significant variables are have the expected sign in explaining child malnutrition, namely; Percentage of living children aged 12-15 months who were breastfed continued at first year (Bf1), Median duration of any breastfeeding (in month) among children age 0-35 months (Dab), Median duration of predominant breastfeeding (in month) among children age 0-35 months(Dpb), Percentage of children age 0-23 months who were appropriately breastfed during the previous day(Bpd) with coefficients estimated at (-0.57), (-6.81), (-4.59) and (-0.63) respectively. The value of adjusted R-Squire estimated at (0.72) Shows that the above mentioned breastfeeding variables are responsible of 72 percent of the change in child malnutrition.

**Table (1)**

**Regression of Breastfeeding, Additional Feeding, Hygiene, Sanitation and care and Maternal Health and nutrition on child malnutrition (CM), Northern Sudan, 2014**

Section A		Section B		Section C		Section D		Section E	
Breastfeeding		Additional Feeding		Hygiene		Sanitation and care		Maternal Health and nutrition	
constant	175.39 (3.98) [0.003]	constant	36.78 (11.47) [0.000]	constant	47.62 (12.45) [0.000]	constant	43.95 (19.58) [0.000]	constant	209.31 (3.64) [0.003]
Estimated Coefficient of	Bfp	Estimated Coefficient of	Md	Estimated Coefficient of	Sds	Estimated Coefficient of	Pcn	Estimated Coefficient of	Wbb
	Bf1		Si1						Ncv
	Bf2								Cmd
	Dab								Csp
	0.63 (3.09) [0.011]		-0.29 (-4.78) [0.000]		-0.26 (-3.67) [0.002]		-0.36 (-4.80) [0.000]		-0.60 (-2.49) [0.027]
	-0.57 (-2.36) [0.040]		0.21 (2.56) [0.021]						-1.68 (-2.89) [0.013]
	1.15 (5.33) [0.000]								43.95 (2.55) [0.024]
	-6.81 (-3.33)								43.95 (-2.75)

	[0.008 ]								[0.016 ]
De b	4.217 (4.49) [0.001 ]								Da m 43.95 (-5.65) [0.000 ]
Dp b	-4.592 (-2.44) [0.035 ]								
Bp d	-0.63 (-2.30) [0.044 ]								
R2	0.83	R2	0.679	R2	0.442	R2	0.576	R2	0.811
Adj. R2	0.72	Adj. R2	0.639	Adj. R2	0.409	Adj. R2	0.551	Adj. R2	0.739
f	7.12	f	16.96	f	13.47 9	f	23.06 7	f	11.19
Sig. level	0.003	Sig. level	0.000	Sig. level	0.002	Sig. level	0.000	Sig. level	0.000

Source: Own calculations based on Data from tables (A.1)and (A.2)

In section (B) in table (1) the best fitted equation for the relationship between child malnutrition and additional feeding variables is shown, and only the percentage of children age 6-23 months who received minimum dietary diversity during the previous day (Mdd) is turn to have the right sign with a coefficients estimated at (-0.29), whereas percentage of children age 0-2 years whose last stools were disposed of safely (Sds) is comes to be the single factor that affects child malnutrition among the three hygiene factors with a coefficients estimated at (-0.26) as revealed in section (C). Section (D) also shows a single factor among sanitation and care factors that have direct effect on child malnutrition namely; percentage of women age 15-49 years with a live birth in the last two years whose last live birth received post-natal health check for the newborn (Pcn) with a coefficients estimated at (-0.36). While section (E) in table (1) below reports the results of the best fitted equation for the relationship between child malnutrition (CM) and Maternal health and nutrition variables, from where the single variable is percentage of women age 15-49 years with a live birth in the last two years who had antenatal care visit during the first trimester (Cvf) that have the correct sign with coefficient estimated at (-1.68) and adjusted R-Squire (0.74).

## 5. CONCLUSION AND RECOMMENDATIONS:

The study aimed at identifying the causes of malnutrition among children who are under five years of age using the linear regression method and suggesting some recommendations that can reduce child malnutrition.

The study employed secondary data obtained from the Multiple Indicators Cluster Survey for the year 2014 obtained by the Central Bureau of Statistics in collaboration with the United Nations Children's Emergency Fund (UNICEF). The results suggested that among breastfeeding variables, continuation of breastfeeding at first year, the median duration of any breastfeeding and appropriate breastfeeding are comes to be the main variables that can affect child malnutrition, while safely disposal of the child's stools, receiving minimum dietary diversity and post-natal health check for the newborn are comes to be the more important variables affecting child malnutrition among hygiene, additional feeding and sanitation and care variables respectively. Maternal health and nutrition factor is contributed by the antenatal care visit during the first trimester to be the important factor that can affect malnutrition among under five children.

In light of the results obtained from this study it worthwhile to recommend the continuation and appropriateness of breastfeeding, lengthen the median duration of any breastfeeding, safely disposal of the child's stools, diversification of food, post-natal health check for the newborn and antenatal care visit during the first trimester because of its importance in reducing malnutrition among children.

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**Appendices  
Table(A.1)**

State	CM	Bfp	Bf1	Bf2	Dab	Deb	Dpb	Bpd
Northern	21.9	79.5	93.7	48.6	21.2	0.7	4.6	72.4
River Nile	32.2	81.0	95.7	74.6	23.4	1.4	6.1	71.0
Red Sea	33.6	68.4	97.7	69.0	23.5	3.1	4.8	66.4
Kassala	42.0	79.5	74.9	39.8	21.1	4.1	7.1	45.8
Gadarif	37.7	86.7	85.2	37.7	20.1	4.4	6.2	66.0
Khartoum	23.2	81.0	98.7	49.1	21.5	2.9	5.3	67.6
Gezira	32.4	83.0	87.7	52.1	21.5	2.5	5.4	65.8
White Nile	29.8	84.3	94.2	58.7	N.A	N.A	N.A	69.0
Sinnar	36.4	83.3	91.0	42.1	20.0	2.1	5.4	58.0
Blue Nile	35.3	90.4	92.1	40.5	20.1	3.1	6.7	65.1
North Kordofan	32.4	87.4	92.7	36.6	20.0	4.3	6.0	65.5
South Kordofan	34.8	71.2	87.2	61.9	21.7	2.6	5.8	61.4
West Kordofan	38.7	64.2	83.9	65.6	22.4	.7	5.3	54.6
North Darfor	44.9	90.3	87.0	43.7	20.5	4.8	6.2	68.1
West Darfor	29.4	66.7	82.7	40.8	20.9	4.5	7.0	51.2
South Darfor	29.4	84.7	83.4	41.9	20.7	2.5	6.7	57.9
Central Darfor	41.0	65.4	84.9	63.8	21.5	1.9	6.8	50.9
East Darfor	40.2	75.8	89.0	54.0	21.6	3.5	5.5	63.5
Total (Sudan)	33.0	80.8	89.4	48.8	21.2	3.1	5.8	63.1

Source: The Sudan Multiple Indicator Cluster Survey (MICS),2014.

CM: Percentage of children under age 5 who are underweight.

Bfp: Percentage of living children aged 0-5 months who were predominantly breastfed.

Bf1: Percentage of living children aged 12-15 months who were breastfed (continued breastfeeding at 1 year).

Bf2: Percentage of living children aged 12-23 months who were breastfed (continued breastfeeding at 2 years).

Dab: Median duration of any breastfeeding (in month) among children age 0-35 months.

Deb: Median duration of any exclusive breastfeeding (in month) among children age 0-35 months.

Dpb: Median duration of predominant breastfeeding (in month) among children age 0-35 months.

Bpd: Percentage of children age 0-23 months who were appropriately breastfed during the previous day.

**Table (A.2)**

State	Mdd	Si1	Sds	Pcn	Wbb	Ncv	Cmd	Csp	Dam
Northern	65.4	22.3	79.8	48.2	6.3	5.6	94.7	94.7	49.1
River Nile	44.5	31.5	68.9	45.7	10.7	4.8	88.8	95.2	37.7
Red Sea	36.7	14.1	54.4	32.4	10.2	26.7	64.2	72.4	25.9
Kassala	11.6	34.6	28.6	27.2	24.4	16.5	60.4	83.0	14.3
Gadarif	32.3	42.3	37.8	20.8	25.4	18.9	58.5	80.5	13.8
Khartoum	44.0	19.4	80.0	57.4	10.5	2.4	84.2	97.1	48.0
Gezira	27.7	27.6	57.4	28.5	15.1	16.7	74.9	83.3	25.5
White Nile	36.0	17.1	41.5	32.7	21.7	21.1	71.1	78.8	25.1
Sinnar	29.8	54.6	56.8	24.5	24.1	24.7	59.3	75.3	16.5
Blue Nile	41.7	24.0	69.7	15.8	27.8	28.0	46.9	71.8	7.4
North Kordofan	17.8	17.7	41.8	31.3	23.5	14.4	66.3	85.6	18.9
South Kordofan	23.5	20.2	43.6	16.2	36.8	13.6	38.8	85.1	4.5
West Kordofan	26.1	41.2	63.7	12.4	24.8	34.0	37.2	65.3	6.6
North Darfor	8.8	25.2	31.8	15.8	30.4	28.8	35.5	68.7	6.4
West Darfor	28.4	17.3	59.2	27.1	33.8	22.0	15.6	75.2	6.7
South Darfor	16.5	23.2	40.7	19.0	33.5	35.7	25.3	61.8	9.8
Central Darfor	13.8	28.8	34.0	12.2	38.4	23.6	16.1	67.9	3.0
East Darfor	16.3	32.6	51.4	17.6	29.6	16.3	24.3	82.9	2.8
Total (Sudan)	28.0	26.8	53.0	27.7	21.5	19.9	55.4	79.1	19.2

Source: The Sudan Multiple Indicator Cluster Survey (MICS),2014.

Mdd: Percentage of children age 6-23 months who received minimum dietary diversity during the previous day.

Si1: Percent of households with salt test result (>0 and <15 PPM).

Sds: percentage of children age 0-2 years whose last stools were disposed of safely. the last time the child passed stools.

Pcn: Percentage of women age 15-49 years with a live birth in the last two years whose last live birth received post-natal health check for the newborn.

Wbb: Percentage of women age 20-24 who have had a live birth before age 18.

Ncv: Percentage of women age 15-49 years with a live birth in the last two years who had no antenatal care visits.

Cmd: Percentage of women age 15-49 years with a live birth in the last two years who had antenatal care by medical doctor.

Csp: Percentage of women age 15-49 years with a live birth in the last two years who had antenatal care by a skilled provider.

Dam: Percentage of women age 15-49 years with a live birth in the last two years who had delivery assisted by medical doctor.