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Morbidity and Mortality for Children Under Five Years Old caused By Malnutrition in Khartoum State (2000-2005)

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DEDICATION

To my family

ACKNOWLEDGEMENT

I would like to express my heart-felt gratitude to my Supervisor Dr.Khalaf Allah Ahmed Mohammed who has given me his opinions, assistance and also the guidance of my future life While he also advised me continuously and encouraged me throughout the study, my thanks to him are unlimited.

Contents

Abstract

The study investigates under five children morbidity and mortality caused by malnutrition in Khartoum state and the relation between risk factors (full term, pre term, diseases {diarrhea, pneumonia and malaria}, environmental factors, maternal education and socio-economic status. The data used is secondary data collected from ministry of health covering the years 2000 up to 2005. Results were presented in tables and figures by using factor analysis technique. The data were entered and analyzed by using SPSS program.

The research comes to the conclusion that:

- Under five children malnutrition is the major cause of morbidity and mortality among this age group with high levels.
- The high levels of morbidity and mortality is less in the infant group (0-1) and the reason beyond that is no doubt breast feeding.
- Frequent pneumonia infection during winter seasons.
- Diarrhea infection during fall is frequently detected.
- The year 2001 gains the highest levels in morbidity and mortality resulted from malnutrition.
- The year 2005 has the less morbidity and mortality cases for the following reasons:
    - Maternal education showed improvement during the last years in the state.
    - Economic and socio-economic status is growing rapidly.
    - The medicaments became available in almost all the hospitals and clinical centers in Khartoum state.
    - The government of the state started to establish projects and programs to serve Khartoum state environmental and public health situations such as "Khartoum Free of Malaria initiative".

The conclusion and recommendations were made in an attempt to give statistics and solutions to help eradicate malnutrition. The research recommends more efforts to be offered by both the governmental bodies and NGOs. Further, establishing new NGOs that concentrate in developing public health. Besides, introduce health education and encourage studies in this field will help eradicate these diseases. Also, the government should do its best to make the medicaments to all malnutrition diseases available in all hospitals and clinics.

الخلاصة

الدراسه تبحث الاصابات و الوفيات للاطفال تحت سن الخامسه نتيجة امراض سوء التغذيه في ولاية الخرطوم والعلاقه يين سلوك الخطر : (النمو الكامل ,النمو الناقص,الامراض"الاسهالات,امراض الجهاز التنفسي ,الملاريا",عوامل البيئه,تعليم الامهات,العوامل الاجتماعيه والاقتصاديه). نوع البيانات التي استخدمت بيانات ثانويه مصدرها وزارة الصحه الولايئه.هذه الدراسه للفتره من سنة 2000 الى 2005 في ولاية الخرطوم,النتائج موضحه بالجداول والارقام باستخدام اسلوب التحليل العاملي وتم ادخال البيانات عن طريق برنامج SPSS. التوصيات تشير الى طرق تساعد على القضاء على الاسباب التي تؤدي الى الاصابه بامراض سوء التغذيه. خلص البحث الي النتائج التاليه :

- تفشي امراض سوء التغذيه في اوساط هذه الفئه العمريه مسببة الكثير من حالات الوفيات
- قلة تفشي هذه الامراض في اوساط الذين تقل اعمارهم عن العام وذلك بسبب الرضاعه الطبيعيه
- تكرار الاصابه بالالتهابات خلال فصل الشتاء
- انتشار الاسهالات في الخريف
- شهد عام 2001 اكبر نسبه اصابه ووفيات وسط الاطفال نتيجة امراض سوء التغذيه
- وبالمقابل شهد العام 2005 اقل نسبة ووفيات وسط الاطفال نتيجة امراض سوء التغذيه , و يعزى ذلك للاسباب التاليه:

أ- التطور الذي شهدته الولايه في مجال تعليم الامهات خلال السنوات الاخيره

ب- التقدم الاقتصادي وتطور الاقتصاد الاجتماعي

ت- توفر الدواء في الكثير من المستشفيات والعيادات المنتشره في ارجاء ولاية الخرطوم

ث- شروع الولاية في انشاء البرامج والمشاريع التي تساعد في الحفاظ على صحة البئه وذلك مثل " مشروع الخرطوم خاليه من الملاريا"

اشارت التوصيات الى ضرورة بذل المزيد من الجهد من قبل الحكومه والمنظمات التطوعيه والى ضرورة انشاء مشاريع وبرامج تعمل على تصحيح البئه. كما و دعت التوصيات الى ادخال نظام التعليم الصحي و تشجيع الدراسات في هذا المجال لدعم مسيرة دحر هذه الامراض . ونوهت التوصيات الى اهمية توفر الدواء كاداة فعاله للقضاء على هذه الامراض .

Chapter One

Introduction

1.1. Problem Statement:

Malnutrition means a person's body is not getting enough nutrients. The condition may result from an inadequate or unbalanced diet, digestive difficulties, absorption problems, or other medical conditions.

Malnutrition can occur because of the lack of a single vitamin in the diet, or it can be because the person isn't getting enough food. Starvation is a form of malnutrition. Malnutrition can also occur when nutrients are adequately consumed in the diet, but one or more nutrients are not digested or absorbed properly. Malnutrition may be mild enough to show no symptoms or so severe that the damage it has done is irreversible even though the individual may be kept alive. Worldwide, malnutrition continues to be significant problem, especially among children who cannot fend adequately for themselves. Poverty, natural disasters, political problem and wars, in addition to other factors like early weaning, infections, and cultural habits contribute to the development of widespread malnutrition among the general population and specially children.

About 167 million children under five years old worldwide almost one third if developing-country suffering were malnourished. Malnutrition causes a great deal of human suffering, and it is a violation of a child's human rights. It is associated with more than half of all deaths of children worldwide. People who survive a malnourished childhood are less physically and intellectually productive and suffer from more chronic illness and disability. The costs to society are enormous. Eradicating malnutrition remains a tremendous public policy challenge. The future prevalence of child malnutrition clearly depends on the degree of effort exerted to reduce it. Despite all effort made to reduce child malnutrition its prevalence remains high.

1.2 Justifications:

Documentation of under five children morbidity and mortality caused by malnutrition is important, because it helps in knowing the magnitude of the problem and its causes so as to develop measures for fighting it health statistics is very vital for proper planning.

1.3 Objectives:

The objective of this study is to document the prevalence of morbidity and mortality caused by malnutrition among under five children and shows their distribution by geographic location, age, gender and season.

1.4 Hypotheses:

The researcher is suggesting the following:

-Under five children malnutrition is a major cause of morbidity and mortality among this age group...

-Predisposing factors play a big role in the development of malnutrition and mortality among target group.

1.5 Research Methodology:

*** General approach:**

The research commences the study with literature review that allows explaining the concept of malnutrition and its impacts on children under 5 years of age.

Secondary quantitative data is obtained from reliable sources (Ministry of Health Registries and records of health institution at target area).

*** Study design:**

This study is intended to be descriptive as well as analytical cross-sectional focusing on morbidity and mortality among under five children in Khartoum State in the period from 2000 to 2005.

*** Tools for data collection:**

The following tools are to be used during this study:

1-Literature review.

2-Secondary data analysis.

*** Data management and analysis plan:**

Data collected through above-mentioned tools is checked for reliability and consistency.

Software (SPSS) is used to run the raw data obtained from secondary sources.

Chapter Two

Malnutrition

2.1 Introduction:

Many children in some parts of the world simply do not get enough to eat. Following a political or natural disaster, the news media was quickly to make us all more aware of the severe forms of childhood malnutrition which are prevalent during famine.

A WHO expert committee divided the protein-energy deficiency syndromes into marasmus, where failure to grow is associated with emaciation and a faire appetite, kwashiorkor, where malnutrition is associated with oedema and loss of appetite, and unspecified where growth retardation and under nutrition are evident without frank ways emaciation or oedema. These terms describe the various ways by which starvation of whatever can affect the growing child with starvation of whatever degree comes misery and an increased risk of infections. Both add to domestic problems and increase the risk of death or permanent damage.

2.1.1 Marasmus:

Maramus in western societies may be seen infants born severely undernourished, or after severe chronic illnesses, particularly affecting the bowel. In poorer communities, nutritional maramus commonly occurs due to failure of lactation in people who just cannot afford artificial milks. Thus it is more common in low-birth-weight infants, twins and in infants after infection, particularly gastroenteritis.

The infant's survival depends on the mother's ability to maintain lactation, even if the infant unable to suckle for days, if food can be found, the prognosis of these infants is good. During a famine children of all ages may become marasmic and the recovery of older children may take longer. The risk of death due to superadded infection during the recovery phase is also higher.

2.1.2 Kwashiorkor:

Kwashiorkor is colorful word that gives the impression of specific disease entity however it is but one end of aspectrum. Most commonly, it occurs in children 18 – 24 months old at the time of weaning. The marasmic child receives a little of balanced diet, in the child with kwashiorkor the energy intake may be just about adequate but the protein content is in sufficient for growth. As consequence there is muscle wasting but preservation of some subcutaneous fat. The infant is oedematous, listless and irritable. There may bead flaky paint dermatitis of ad pigmented skin and hair is sparse and friable. The liver may be large due to fatty infiltration and the serum albumin concentration may be reduced. The complications include hypothermia, hypoglycemia, drowsiness, severe diarrhea, cardiac failure and all these are compounded by superimposed infections.

An inadequate supply of food is not primarily a medical problem however the health service can help in the following ways.

By encouraging and supporting the lactating mother, there is no reason why breast feeding should not be. Continued for 18 or 24 months, by advising parents about weaning, by recommending those local foods which will meet the protein needs of the growing child, by the early recognition of children in difficulties so that limited food resources can be optimally deployed, and by the treatment of associated infections and vitamin deficiency states.

2.1.3 Marasmic Kwashiorkor:

Children suffering from this disease show mixed signs and symptoms of both kwashiorkor and marasmus.

Kwashiorkor	Marasmic
- It occurs when dietisvery low in protein and includes calories from carbohydrates.	- The diet is low in protein and includes calories.
- Thin muscles but fat is present.	- Thin muscles and thin fat.
- Oedema occurs.	- Oedema absent
- Moon shaped face due to oedema.	- Old man's face with wrinkles.
- Changes in hair.	- Normal hair
- It affects the children between 1 – 4 years.	- It affects in fantsimder 1 year of age.
- The child does not give starting look.	- Child gives starting look.

Source: WHO, 2006

2.2 Malnutrition World wide:

2.2.1 The Spectrum of Malnutrition:

Hunger and malnutrition remain amongst the most devastating problems world wide particularly facing the worlds under privileged and poor malnutrition world wide includes spectrum of nutrient. Related disorders, deficiencies and condition including the following major public health problems:

- Intra-uterine growth retardation
- Protein energy malnutrition
- Iron deficiency
- Vitamin A deficiency
- Iron deficiency an anemia
- Obesity and other diet- related non – communicable diseases. (WHO . 2005)

Arrange of other specific nutritional deficiency diseases often related to distinct population including:

- Foliate deficiency
- Zinc deficiency
- Calcium deficiency and osteoporosis
- Beriberi, pellagra, scurry
- Selenium deficiencies

Malnutrition thus covers a broad spectrum of ills, including under nutrition, specific nutrient deficiencies and over nutrition, and it kills, maims, retards, cripples, blinds, and impairs human development on truly massive scale world wide. Despite significant improvement in world food supplies, health conditions and availability of educational and social services, because of the fundamental role consequences are of enormous significance, even in term of mortality a lone.

In the developing world in 1995 estimated 104 million deaths among children under 5 years of age. Protein energy malnutrition was associated and causative factor in 5.1 million of these deaths i.e. (49%): (WHO , 2005).

On the other hand, evidence has recently been complied suggesting that of the more than 10 million cases of cancer that occurred in 1996 an estimated 30 – 40 % (3 -4 million ever year) are preventable by feasible, appropriate diets, and by physical activity and maintenance of appropriate body weight.

2.2.2 Malnutrition on Across the Life Span:

Malnutrition affects all age group across entire life span from the moment of conception, throughout fetal life, iodine foliate and intrauterine nutrition have a profound influence on development, growth, mortality, not only in uteri and in early, but on morbidity, physical and mental capacity throughout life, including the development of diet – related NCDS later in life.

Table (2.1): Malnutrition on across the life span

Life stage	Common nutritional disorders	Main consequences
Embryo / foet us	(UNGR, IDD, foliate deficiency	- low birth weight - brain damage - neural tube defect - still births
Neonate	Low birth neigh, IDD	- Growth retardation - Developmental retardation - Brain damage - Early anorexia - Continuing malnutrition
Infant and young child	PEM, IDD, VAD, IDA	- Developmental relation - Increased risk of infection - High risk of death - Blindness - Anemia
Adolescent	PEM, IDD, IDA, foliate deficiency calcium deficiency	- Delayed growth spurt - Stunted height - Delayed / retarded intellectual development - Goiter - Increased risk of infection - Blindness
	- Anemia - Inadequate bone mineralization	
Pregnant and lactating mothers	PEM, IDD, VAD, foliate deficiency calcium deficiency	- Insufficient weight gain in pregnancy- IUGR - Maternal anemia - Maternal mortality - Increased risk of faction - Night blindness/ blindness - Low birth weigh/ high risk death rate for foet us
Adults	PEM, IDA, obesity cancer	- Thinness - Lethargy - Obesity - Heart disease - Diabetes - Hypertension/stroke - Anemia
Elderly	PEM, IDA, obesity cancer, osteoporosis	- Thinness - Obesity - Spine and hip fractures and Accidents - Heart disease - Diabetes

Source: WHO children world report,2006

2-2-3 Reporting on Global Malnutrition:

On the nutrition programme's three main objectives is "to develop and maintain global nutrition data bases for reporting on the world's major forms of malnutrition".

This is indeed a crucial function of WHO INUT required by world health assembly, expected and used by the international community, drown upon by member states, important for priority setting and assessing which W.H.O is in a unique position to maintain.

The following section summarizes the current global and regional dimensions of several major forms of malnutrition:

- Intrauterine growth retardation
- Protein – energy malnutrition
- Iodine deficiency disorders
- Vitamin A deficiency
- Over weight and obesity

Other nutrition deficiencies of emerging public health importance:

- Foliate deficiency
- Zinc deficiency
- Calcium deficiency
- Selenium deficiency
- Diet and cancer

2-2-4 Intrauterine growth retardation and maternal malnutrition:

A formidable precursor of infant and young child malnutrition is fontal malfunction, more formally de find as in developing countries where and estimated 30 million newborns per year (23%) are effected according to Denies, B.J et M, villar J. levels and patterns of intrauterine growth retardation in developing countries European journal of clinical nutrition.

November 1997 in this context, LOGR is defined as weight below the 10th percentile of birth. Weight for - gestational – age reference curve Of the magnitude and geographical distribution of LUGR under taken in 106 developing counties the rate is about 2% developed countries).

When estimated regional age incidences are compared using the more traditional indicator of LUGK in full term babies < 2500g at 37 weeks gestation) based on an analysis of data from 109 countries, nearly 75% of all affected new born are in Asia. Mainly south central Asia followed by Africa and Latin America.

Table (2.2) : Estimated incidence of intrauterine growth retardations proportion and number of new bore affected per year:

Region	%	Total number (thousands)
Middle Africa	14.9	554
Western Africa	11.4	1001
Asia	12.3	10147
Latin America and the Caribbean	6.5	779
Oceania	9.8	18.4
Developing countries	11.0	13699

Source (WHO, 2006)

Maternal malnutrition is the major determinant of UGR in developing countries, as evidenced by low gestational weight gain, low pre – pregnancy body mass index, and short maternal stature. Maternal anemia- gastrointestinal and respiratory infections – malaria and cigarette smoking are also important etiological doctors. High rates of IUGR should be interpreted as an urgent public health warning of risk of malnutrition and morbidity in women of children age and not merely an indicator of high risk of malnutrition-morbidity and mortality for the new born. Nevertheless, IUGR is associated with greater risks for the infant and young child. Including increased malnutrition. Morbidity and mortality – poor cognitive and neurological development and, in adult hood, increased risk of cardiovascular disease- High blood pressure obstructive lung disease, diabetes, hyper cholesterolaemia, and renal disease.

IUGR also reinforces the inter generational cycle of poverty – malnutrition and disease with enormous costs in both human and socio-economic development terms.

2.2.5 Protein – Energy Malnutrition:

Over all global progress in reducing protein malnutrition among infant and young children is exceedingly slow, and completely inadequate for oven approaching the year 2000 goal of 50 % reduction in 1990 prevalence levels. Currently – an estimated 167.9 million children under 5 years of age i.e. 27.41 of the world's in this age group, are still malnourished when measure in terms of right for age, nevertheless this clearly represents significant progress when compare with the 198.6 million children a prevalence of 36.4 % who were malnourished in 1975.

Regional trends and numbers of children suffering from malnutrition reflect the main under lining issues. Because the chop in percentage prevalence has not been as rapid as the rise in population in some areas Africa of example: the actual number of malnourished children has in fact risen.

Natural disasters, war – civil disturbance, and population displacement have all contributed to continuing high rates of malnutrition- however, over tow – thirds (76 %) of the worlds malnourished children still live in Asia (Specially south Asia) while 21 % are found in Africa and only 3 % in Latin America.

Progress:

High global PEM prevalence rates conceal, among statistical averages, remarkable successes being achieved by substantial number of member states and the considerable resources being allocated to combat malnutrition and it's under lying calluses. No indicator of progress in the struggle against PEM is that 25 out of a sample of 60 developing countries now show a measurable improvement in nutritional status, and thus declining rates of NEM, in the under – five population, in clouding bout of 25 contents in Africa, 9 out of 19 in Latin America, 4 out of 5 in the eastern Mediterranean 3 out of 6 in south – east Asia, and 3 out of 5 in the western Pacific.

2.2.6 Iodine Deficiency Disorders:

Iodine deficiency disorders (IDD) constitute the single greatest cause of preventable brain damage in the fetus and infant and related psychomotor development in young children.

The spectrum of pathological conditions resulting from iodine deficiency includes cretinism, deaf mustism, squint, spastic dips tic diplegia, mental retardation, dwarfism, stillbirth, congenital anomalies, and in creased prenatal mortality it is estimated that currently some 911 million people (infants, children and adults) suffer from goiter, more than half of whom 52% are in Asia, 16.1 % in Africa, 10.2 % in Europe.

More tragically and estimated 16.5 million people world wide are cretins, and it is likely that another 49.5 million suffer less severe, though still measurable, form of brain damage due to iodine deficiency.

Table (2.3) : Iodine deficiency disorders: prevalence and numbers of people affected by goiter and cretinism:

W.H.O region		**Goiter(TGR)**	***Cretins***	
	Prevalence (%)	**Pop. Affected (mill)**	**Pre(%)**	***Popaff***
Africa	23.7	147	1.48	*4.21*
America	6.5	52	0.33	*0.34*
South – East Asia	14.9	220	0.81	*3.56*
Europe	10.7	93	0.26	*0.48*
Easter-Mediterranean	30.3	145	2.59	*7.18*
Western Pacific	15.5	254	0.14	*0.74*
World	*15.6*	*911*	*0.92*	*16.51*

Source (WHO ,2006)

Progress: here has been recent dramatic progress in reducing IDD in many countries. The swift acceleration of national IDD programs has led to tangible progress largely through universal salt iodization which is the most feasible means of preventing and controlling IDD.

In 1990, where as only 46 out off 118 countries where IDD was known to be significant public health problem in 1990 had national salt – iodization programs, 83 countries had such programs by 1995, with most of the remaining 35 countries taking steps to determine the magnitude and public health significance of IDD. Since 1990, 72 countries have conducted initial or follow – up surveys and many have established national monitoring systems. UNICEF reports impressive progress in salt iodization in 48 developing countries which until 3 years ago had little salt iodization activity.

In the last 5 years, several countries including Bolivia, Iron (Islamic republic of Iran) and Thailand, have approached, or even succeeded, the elimination goal. Despite the magnitude of the problem, there is a real possibility that IDD cooled be eliminated as major public health problem by the year 2000 in a large number of countries. Work is underway by who for preparing comprehensives progress report on IDD to be presented to be health assembly in 1999.

2-2-7 Vitamin A Deficiency:

Vitamin A deficiency among children in developing countries remains the leading cause of preventable server visual impairment and blindness and is a significant contributes to severe infections and death. Recent studies highlighted the increased risk in mortality facing pregnant women who are vitamin A deficient and also the association of vitamin A deficiency with elevated risk of mother – to – child transmission of HIV.

According to WHO's micronutrient deficiency in formation system, approximately 2.8 million children under 5 years of age currently exhibit sign of clinical exophthalmia however the great majority of vitamin A deficient children over 90% only show sub clinical symptoms and nevertheless have, on average, a 20 times graters risk of death from sever infections associated with micronutrient deficiency. The prevalence of VAD in pregnant women is unknown but in some countries of south East Asia, night blindness prevalence has been reported to be up to 10 -20 %. Current information suggests that 118 countries have clinical or sub clinical vitamin A deficiency. Africa has the highest prevalence of VAD, while the highest number of clinically and sub clinically affected are in south – East Asia. In many countries, vitamin A supplementation the main component of the strategy to combat VAD – however, an increasing number of countries are implementing food. Fortification programs while measures to improve vitamin A dietary intake by increased production of vegetable and animal product is still limited, there is nevertheless encouraging evidence that sever vitamin A deficiency is decreasing in some parts of Asia and South America. Estimated population of children under 5 years of age affected by vitamin A deficiency in WHO regions.

Table (2.4)

population affected by vitamin A

Regions	Sub clinical		Clinical	
	Num (Million)	Prevalence (%)	Num (Mill)	Prevalence (%)
Africa	49	45.8	1.08	1.0
The Americas	17	21.5	0.06	0.1
South-East Asia	125	70.2	1.3	0.7
Europe	-	-	-	-
EasternMediterranean	23	31.5	0.16	0.3
Western pacific	42	30.0	0.1	0.1
Total	256	40.3	2.7	0.1

Source: MDIS ,2005

2.2.8 Iron deficiency Anaemia:

The main causes of anemia is iron deficiency and anemia have profound negative effects on human health and development, including increased maternal and newborn mortality impaired health and development of infant and children, limited learning capacity, impaired immune function and reduced working and productive capacity. Iron deficiency anemia is thus a major impediment to individual and national development while anemia affects and estimated 2 billion people worldwide in developed and developing countries are also anemic. Most of this being iron deficient anemia

(IDA) although malaria and other nutrient deficiencies are important in some population.

Lack of progress:

The main causes of such a high magnitude of IDA are low dietary intake of iron and poor bioavailability of dietary iron followed by infection and intestinal parasitic infestations. Several other indirect causative factors such as poverty poor infant feeding practices, illiteracy and ineffective food policies that lead to how intake of iron are also associated. Unfortunately there has been little appreciable change in this worldwide high prevalence situation over the last two decades, and there are few active programmes that have succeeded in quickly reducing and preventing anemia in developing countries, lack of political commitment to control anemia, improper planning of control programmes, and absence of community involvement in solving the problem of anemia are important contributing factors.

Table (2.5):Estimated population affected by anemia and iron deficiency in WHO regions

WHO Region	**Anemia**		**Iron deficiency**		**Iron def**	
	Num(Mill)	**Pre %**	**(Mill)**	**%**	**(Mill)**	**%**
Africa	233.7	38.8	175.3	29.1	438.2	72.8
The Americas	141.7	18.1	106.3	13.6	265.7	33.9
South-East Asia	765.2	52.7	573.9	39.5	1434.8	98.8
Europe	79.8	9.2	59.9	6.9	149.6	17.3
Eastern Mediterranean	179.5	38.5	134.6	28.9	336.6	72.9
Western pacific	578.4	38.4	433.8	28.8	1084.5	72.0
Total	1978.3	34.3	1483.7	25.7	3709.3	64.3

Source: WHO,2004

Estimated based on:

- The result of studies that showed that up to a prevalence of 40% iron deficiency anemia, the prevalence is about 2.5 items that of iron deficiency anemia, above 40% iron deficiency is present in virtually the entire population.
- Assuming that 75% of anemic population is also iron deficient.

2.2.9 Over weight and obesity:

Current status. An emerging epidemic

Evidence is now emerging to suggest that the prevalence of over weight and obesity is already a massive global problem, and increasing worldwide at an alarming rate. Both developed and developing countries are affected. Moreover, as the problem appears to be increasing rapidly in children as well as in adults, the true health consequences may only become fully apparent in the distant future, the following key option is evident from the data.

- Obesity prevalence is increasing worldwide at an alarming rate in both developed and developing countries.
- In many developing countries, obesity co-exists with under nutrition (BMK 18.5). Obesity is still relatively un common in Africa and Asian countries, but is more prevalent in urban than in rural population. In economically advanced regions, prevalence rate may be as high as in industrialized countries.
- Women generally have higher rates of obesity than men although men have higher rates of overweight.

- The current lack of consistency and agreement between different studies over the classification of obesity of children and adolescents make it difficult to give and overview of the global prevalence of obesity for younger age groups. Never the less, whatever classification system has been used, studies investigating obesity during child hood and adolescence have generally reported increasing prevalence of obesity.
- Lack of a common measurement standard (e.g. > 85 percentile, > 120% weight for height, > + 2 SD above reference median weight for heights) for defining over weight in children and adolescents, has made it difficult to assess global magnitude of obesity in children. However, nationally representative from 79 developing countries and some industrialized countries suggest that, by who standards (> + 2 SD above relevance median weight for height), around 22 million under five children are over weight.

Table (2.6): Regional and global prevalence and numbers of overweight children under five years of age, by who regions, 1995

	Children (>+2SD above median wt/h)		**Adults (BMI>30KG/m2)**	
WHO regions	**Prevalence(%)**	**Number (mill)**	**%**	**Mill**
Africa	2.7	2.8	2.0	5.1
The Americas	4.6	3.6	17.4	82.7
Southeast Asia	0.6	1.0	0.8	6.3
Europe	NA	NA	12.4	76.1
Eastern Mediterranean	4.4	3.2	3.5	6.3
Westernspacific	3.7	5.2	2.5	26.4
Global	3.6	12.9	6.0	203.4

Source: WHO,2001

Obesity in school children approaches 10% not only in industrialized countries like the USA, Japan and some European countries, but high rates are also evident in rapidly industrializing countries. e.g. Algeria, Argentina, Chile, Egypt, Indonesia, Iran, Kiribati, Morocco, Peru, South Africa, Thailand, and many countries in the Caribbean.

Overweight and obesity during child hood is one of the major risk factors for the development of obesity in adulthood with up to 30% of obese children becoming obese adults.

The prevalence of obesity in adults is 10% to 25% in most countries of Western Europe, 20% to 25% in some countries in the Americas, up to 40% in some countries in the western pacific. Obesity is a significant risk factor for a range of serious no communicable diseases, e.g. cardiovascular diseases hypertension and stroke, diabetes mellitus (type 2: non-insulin- dependent), various form of cancer, and other gastrointestinal and liver diseases, varicose veins, gall-bladder disease accidents, and other serious health problem.

Obesity rates, which are doubling every 5-10 years in many parts of the world, are placing significant additional financial burdens on health systems to deal with the resulting problems. Several industrialized countries have become so concerned with obesity that they are developing national prevention and management strategies. Indeed, global epidemic projections for the next decade are so serious that public health action is urgently required, analysis show that merely concentrating on children and adult who have a high BMI and numbers of people entering the medically defined categories of ill health. It is thus essential to develop new preventive public health strategies which affect the entire society. Without societal changes; a substantial and steadily rising proportion of adult will succumb to the medical complications of obesity, indeed, the medical burden of obesity already threatens to over whelm health services, the spectrum of problem seen in both developing and developed countries is having so negative an impact that obesity should be regarded as one of today's major principal reflected public health problems.

2.3 Malnutrition in Sudan

2.2.1 The pattern of server protein calorie malnutrition in Sudanese children attending a large hospital in the Sudan Salah Ali Taha1979: Pages 446-451 states that one hundred fifty patients suffering from server protein- calorie malnutrition, admitted in 1 month to the pediatric words of Wad Medani hospital, Sudan. Were classified according to the welcome classification. Marasmus was the prevailing type. It was common in the 2nd year of life, while kwashiorkor occurred mainly under the age of 12 months. Anthropometric measurements showed that kwashiorkor was an acute disease while marasmus and marasmic kwashiorkor were more chronic. The triceps skin fold was unexpectedly low in kwashiorkor of the simple measurements and ratios used for assessing the nutritional status, the load/ chest ratio applied to children over 1 year was not found to be reliable and the weight for head circumference correlated poorly with deficits in other variables. None of the major clinical features was found to be path gnomonic of any type of server protein- calorie malnutrition. Meagaloblastic anemia was common. Am J.Clin. Nutr 32: 446-451, 1979.

Gomez (1) classification of the types and seventy of protein-calorie malnutrition has stood the test of time. Its main limitation when applied to hospital cases is that it present marasmus and kwashiorkor as two distinct and clearly demarcated disease, and ignores the intermediate forms of severe protein-calorie malnutrition.

The welcome classification (2) embraces the intermediate forms of severe protein-calorie malnutrition international classification for disease number: marasmus (268.0) marasmic- kwashiorkor (269.9) and kwashiorkor (267.0). Furthermore, being based on the simple criteria of the degree of weight deficit and the presence or absence of edema. It avoids the confusion created by clinical description from various centers, it is therefore more suited to the severe case which requires treatment in hospital.

Therefore the welcome system applied to 150 severely malnourished children admitted to the large general hospital at Wad Medani about 120 miles south of Khartoum to establish the pattern of severe malnutrition in the Sudan, to compare the characteristics of its three main types and to compare the results with those of other workers who used the same method of classification.

2.3.1 Patients and Methods:

Patients:

All the severely malnourished patients admitted to the pediatric department of Wad Medani hospital in July 1972 were included in this study. Our criteria of admission were according to the welcome system. But we exclude the category of underweight, who do not usually seek medical advice.

Methods:

A thorough clinical examination was performed together with anthropometric measurements which in from the ministry of health, Sudan.

Address reprint requests to: Dr. S.A. Taha, senior consultant pediatrician % department of pediatrics, faculty of medicine, Riyadh University, the American Journal of clinical nutrition 32. February 1979 PP. 446-451. Printed in U.S.A.

2.3.2 Protein- Calorie Malnutrition in Sudanese Children:

Clouded: weight, length, head circumference, chest circumference. Midarm circumference and triceps skin fold thickness. These were done with the methods and equipment described by Jelliffe.

The following hematological tests were done: hemoglobin estimation using the cyan met hemoglobin method and the packed cell volume by the micro method as described by Dacie and Lewis , the value were classified according to their method and those of the world health organization peripheral blood films were stained with leishamn stain to determine the type of anemia. All the patients had a marrow puncture. Slides were stained by the may. Grunwald-Giemsa stain for morphology and with the Prussian blue technique for assessment of iron . Analysis of blood and done marrow was tested for using the sodium metabisulphite method of Donal and Castle .

The sera of 73 patients were examined for total protein and for albumin by the biuret method described by Wooton (7). The values were classified according to his recommendation.

Results

Types:

Table (1) shows the type of severe malnutrition in this group of patients. Marasmus was the predominating type and accounted for 55% of all cases. Using x^2 test. The difference in the percentage case incidence between marasmus and kwashiorkor, and between marasmus and marasmic- kwashiorkor were highly significant, but that between marasmic- kwashiorkor and kwashiorkor was not.

Age and sex:

The mean age and sex incidence is shown in table (2). Marasmus and marasmic- kwashiorkor patient were older than kwashiorkor.

Table (2.7): Classification and criteria for hospital admission

Nutritional status	Edema	Weight for age percentage (Boston standard) 59th percentile	No. of children	%
Marasmus	-	< 60	83	55
Marasmickwashiorkor	+	< 60	77	31
Kwashiorkor	+	60 – 80	20	13
Total			150	99

Source: Taha, SA.The pattern of severe protein-calorie malnutrition in Sudanese children attending a large hospital in the Sudan 1979.

The following table shows rates of malnutrition in developing countries since 1970 and projections up to 2020.

Region	1970	1995	2020 Status
	(percent)		
Percent underweight south Asia	72.3	49.3	37.4
Sub-Saharan Africa	35.0	31.1	28.8
East Asia	39.5	22.9	12.8
Near East and North Africa	20.7	14.6	5.0
Latin America and the Caribbean	21.0	9.5	1.9
All developing countries	46.5	31.0	18.4
	(millions)		
Number underweight south Asia	92.2	86.0	66.0
Sub-Saharan Africa	18.5	31.4	48.7
East Asia	77.6	38.2	21.4
Near East and North Africa	5.9	6.3	3.2
Latin America and the Caribbean	9.5	5.2	1.1
All developing countries	203.8	167.1	140.3

Source: Lisa C. Smith and Lawrence Haddad 2000.Overcoming Child malnutrition in Developing Countries.

Table (2.8): Age. Sex and anthropometric measurement of the severely malnourished children

	Marasmus	Marasmic-kwashiorkor	Kwashiorkor
No of children	83	47	20
Mean age (mo)	17.2 (8.7)	20.3 (7.11)	12.4 (5.4)[6]
Male: Female ratio	43.40	28:19	11:9
Weight (kg)	5.8 (0.8)	6.1 (0.6)	6.7 (1.0)
Weight (% standard)	54.4 (5.8)	53.0 (0.6)	68.9 (5.6)
Length (cm)	71.9 (5.9)	72.8 (3.9)	73.4 (7.0)
Length (% standard)	90.7 (7.2)	87.9 (7.4)	98.5 (6.4)
Midarm circumference (cm)	9.9 (1.0)	10.1 (0.8)	10.8 (1.5)
Midarm circumference (% standard)	63.2 (8.0)	63.4 (6.6)	68.9 (7.3)
Triceps skin fold (mm)	3.6 (0.8)	4.1 (1.1)	3.8 (0.8)
Triceps skin fold (% standard)	37.0 (8.9)	40.8 (11.1)	39.4 (8.11)
Head circumference (cm)	42.6 (2.6)	42.7 (1.9)	42.7 (2.4)
Head circumference (% standard)	40.0 (2.5)	40.6 (1.9)	41.0 (2.1)
Percentage of children > 12 mo having chest |head ratio>|	91	93	80
Weight height (% standard)	65.0 (8.3)	65.7 (80)	70.3 (8.9)
Weight/head circumference (% standard)	85.1 (16.5)	88.9 (19.2)	97.6 (25.4)

Source:WHO,2003

A percentage of Boston standard 50^{th} percentiles for age b mean (SD).

Patient (17.2 SD 8.7, 20.3 SD 7.1, and 12.4 SD 5.4 months, respectively) Application of the x^2 test confirmed that the percentage age of kwashiorkor cases was significantly lower than the percentage age of marasmic children.

A χ^2 analysis shows that the apparent preponderant of males in this group (55% males and 45% females) was not statistically significant difference in the distribution of the three forms of severe malnutrition between the sexes.

Anthropometric findings are also shown in table 2. to make comparison between the three main types of malnutrition possible, the value were converted into percentages of the Boston standard 50th percentile (8) to eliminate the age variant significance tests are shown in table 3. Except for the triceps skin fold thickness there were significant differences in all anthropometric measurements between marasmus and marasmic- kwashiorkor cases on the one hand and kwashiorkor on the other height was not significantly affected in kwashiorkor patients. Particularly the latter were older and more stunted.

2.3.3Clinical literatures:

In table 4 the main clinical manifestation in the three forms of severe malnutrition are compared there were no significant differences in the incidence of psychomotor and hair changes (x^2 = 1.5) the incidence of dermatosis, however was significantly greater in kwashiorkor and marasmic- kwashiorkor than in marasmus (x^2 = 10.28) (p: 0.01) though it did occur in the later condition the incidence of hepatomegaly was lowtion. The incidence of hepcitomealy was low (6.7%), occurring almost exclusive in the edematous types.

2.3.4Hematological and Biochemical findings:

Table 5 shows the hematological and biochemical features. Most of the children were found to be anemia. Marasmic-kwashiorkor patients had significantly lower hemoglobin levels (t = 2.03, p = 0.05)

Table (2:9): Significance tests of age and some of the anthropometric data

Parameter (% d. standard)	Marasmus/marasmic-kwashiorkor	M/K	M-K / K
	t p a	t p	t p
Age	2.04 0.5 5	2.3 0.05	1.4 0.001 5
Wt for age	1.4 Ns[b]	2.3	

Source: Omer, H.Elshazali A. and Elhassan A. Studies on the anaemia of kwashiorkor and marsmus in the Sudan.J.Trop, Pedicat.Evon.Child Health ,1996

Table (2.10): Relative frequency of clinical feature in severe forms of protein- calorie malnutrition (N=150)

Clinical sign (s)	Marasmus		Marasmic-kwashiorkor		Kwashiorkor		Total	
	n = 83		n = 47		n = 20			
	No	%	No	%	No	%	No	%
Skin changes	13	15.7	19	40.4	8	40.0	40	26.7
Hair changes	66	79.5	38	83.0	19	95.0	124	82.7
Psychomotor	75	90.4	44	93.6	19	95.0	138	92.0
Heptomegaly	1	1.2	4	8.5	5	25.0	10	6.7
Vitamin(A) deficiency	3	3.6	1		Nil		4	2.7
Vitamin(B)deficiency	16	19.3	13	27.7	6	30.3	35	23.3
Vitamin C deficiency	Nil		2	4.3	2	10.0	4	2.7
Vitamin D deficiency	Nil		Nil		Nil		Nil	

Source: Wafi, F.Herrera G.Spiegelman D.Elamin A and Mohamed K.A prospective study of malnutrition in relation to child mortality in the Sudan. American J.M,2004

Table (2: 11): Protein calorie malnutrition in Sudanese children

	Marasmus	**Marasmic kwashiorkor**	**Kwashiorkor**
Hemoglobin (9/100ml)	**(N = 83)**	**(N = 47)**	**(N = 20)**
Mean (SD)	9.8 (1.9)	9.3 (2.0)	10.3 (1.7)
Range	5.5 – 14.0	2.0 – 13.7	6.3 – 13.2
Hematrocrit (%)			
Mean (SD)	33.9 (5.3)	32.9 (5.9)	35.3 (4.5)
Range	20.0 – 46.0	10.0 – 46.0	24.0 – 44.0
Classification(no.of children)			
Hemoglobin (9/100 ml)			
No. < 11	57 (68.7%)	38 (80.8%)	9 (45 %)
No. 11-	8(9.6 %)	2 (4.2%)	7 (35%)
No. > 11	18 (21.7 %)	7 (14.9%)	4 (20%)
Hematrocrit (%)			
< 36	47 (56.5%)	30 (63.8%)	10 (50%)
36 -	35 (42.2%)	16 (34.0%)	9 (45%)
> 44	1 (1.2%)	1 (2.1%)	1 (5%)
Table plasma protein (9/100ml)			
N = 73	N = 32	N = 27	N = 14
Mean (SD)	6.7 (0.9)	46 (0.6)	4.8 (0.5)
Range	5.1 – 8.3	3.4 – 5.9	3.8 – 5.9
Serum albumin classification			
(no. of children)			
< 3 9/100 ml	Nile	22	14
3 – 4 9/100 ml	14	5	0
> 4 9/100 ml	18	0	0

Source: Wafi, F.Herrera G.Spiegelman D.Elamin A and Mohamed K.A prospective study of malnutrition in relation to child mortality in the Sudan. American J.M 1997

Signification differences in the hematocrit values peripheral blood films bone marrows were analyzed in 94 cases. One case of sickle – cell anemia was (41%) or iron deficiency and megaloblastic erythropoeisis (30%).

The total plasma proteins and serum albumin levels were normal in marasmic – kwashiorkor. The apparent differences between the latter syndromes were not statistically significant.

These findings show that marasmus is the prevalent pattern of protein – calorie malnutrition in the Sudan in the other countries in the Middle East (9 -13). Nor has these been change admitted to hospital in 1966 to 1967 and classified according to the Gomez (1) system. Showed preponderance of marasmus over the edematous types in the ratio of 4: 3 Taha1979). Abdulla Med.J.6:1.1968 recorded similar finding in Khartoum- Omdurman and Khartoum North.

The mean age incidence for marasmus and marasmus-kwashiorkor in this series is similar to that found by Shakir et- al (12) and Omer et al (16) but for kwashiorkor it was much lower than has been recorded before.

Sex differences in the present study were not statistically significant. This finding is not in accord with those of numerous workers who have found either a male or female preponderance.

The apparent male preponderance in the Middle East hospital studies in not real and is the result of cultural influences that hide the true community incidence, (17), (8).

The anthropometric data confirm that kwashiorkor is a syndrome of acute since there is minimal retardation of growth the fact that there were no significant differences in weight height (which measures wasting) between marasmus and marasmic-kwashiorkor means that one equally.

Prevalence: Types and risk factor for malnutrition in displaced Sudanese children as stated by Nuha Mamoun: faculty of Medicine ,U of K, Sudan in a study published in 2005. The nutritional status of 327 under five children living in Mayoo displacement camp , Khartoum ,Sudan ,was assessed during May-August 2004.Risk factor for protein –energy malnutrition (PEM)were also studied. According to WHO criteria, a total of 186 (56.1%) children had malnutrition, of these 101 (30.1%), 43(13.1%) and 42(12.8%) mildly, moderately and severely malnourished respectively, According to Welcome classification was found to be underweight (38.2%). Marasmus, Kwashiorkor were detected in (6.4%) and (0.9%) respectively. There was no case of marasmic –kwashiorkor in the studied population. Prevalence of vitamin A was 9.2% of which 0.9% had night blindness. Age ,sex ,lack of immunization ,lack of breast –feeding ,history of fever and history of diarrhea were tested and were not found be risk factors for malnutrition in this group of children .

Nuha Mamoun(AJID;2005) came to the result that a total of 327 children from 200 families were enrolled to the study. According to WHO criteria the prevalence of malnutrition was 56.1, 30.9, 13.1and 12.8% were mildly, moderately and severely malnourished, respectively.

Underweight, marasmus and kwashiorkor constituted 38.2, 6.4 and 0.9% of the type malnutrition respectively. There was no case of marasmus –kwashiorkor in the study population.

Prevalence of vitamin A deficiency was found to be 8.3% as indicated by conjunctival and corneal xerosis.While 0.9% had night blindness. There was no significant association of expected risk factor (last month diarrhea, last month fever, artificial bottle feeding, absence of parents' educational level of vaccination) with malnutrition using univariate and multivariate analysis in table 2:

Table (2: 12) Factor associated with malnutrition using univariate or multivariate analysis

The variable	OR	95%ci	P	OR	95%cf	P
Bottle feeding	1.2	0.75-2.08	0.18	1.2	0.72-2.03	0.4
No breast feeding	0.7	0.81-3.3	1.0	0.7	0.1-3.05	0.6
Absence of the mother	1.08	0.43-2.6	0.3	2.03	0.55-7.4	0.2
Absence of the father	0.78	0.38-1.5	0.14	0.76	0.13-4.5	0.77
Absence of both parents	0.73	0.37-1.44	0.41	0.49	0.18-1.32	0.16
History of fever	1.3	0.87-2.1	0.1	1.31	0.82-2.1	0.24
History of diarrhea	1.2	0.8-1.9	0.3	1.1	0.73-1.8	0.58

Source: Mamoun, N.prevalence Types of risk factors for Malnutrition in Displaced Sudanese children .American Journal of Infectious diseases 2005

A prospective study of malnutrition in relation to child mortality in the Sudan

Wafaie w Fawzi "source the American journal of clinical malnutrition"

We examined prospectively the relation between malnutrition and mortality among Sudanese children A cohort of 28753 between the age of 6 month and 6years was examined every 6 m for 18m.Two hundred thirty-two children died during 18 m of follow up (480624 child –months).low weight-for-height was associated with an increased risk of mortality (P<0.0001).Even children with z scores between 1 and 2 were 50% more likely to die in the following 6 m than were children with z scores >-1 (multivariate relative mortality :1.5:95% CI : (1.1 .2.2).There was also an inverse relation between height –for age and mortality (P<0.0001).Among breast fed children ,the relative mortality associated with a Z score for weight-for-height of <-3 compared with >-2 was 7.3 (95% C.I: 3.3 ,15.9) among children not breast fed ,it was 26.0 (95% CI: 12.8,53.0,P for interaction : 0.001).

A strong and significant synergy was also found between infection and wasting or stunting as predictors of child mortality (P for interaction: 0.001 and 0.02, respectively)

In developing countries, children who are below the customary cutoff point of -2 Z for weight –for height may be at higher risk of death. Breast –feeding and reduction of morbidity should be advocated in programs designed to reduce malnutrition and mortality among children.

Fawzi (A.J 1997):comes to the result that two hundred thirty-two deaths occurred during 480624 child-months of observation. A significant positive trend was noted between mortality and the degree of wasting, as defined by weight-for-height (P for trend <0.0001) Children in each of the four lower categories of weight-for-height were at a higher risk of death compared with children in the baseline category ,even after adjustment for socioeconomic status ,morbidity and seasonality. Children with z scores between -1 and -2 were 50% more likely to die in the following six months compared with children with z scores >-1 (multivariate RM =1.5, 95% CI=1.1 ,2.2).

When children in extreme categories (<-4 Z compared with >-1Z) were compared , the RM was 19.7(95%CI=9.2, 42.1)when the results were adjusted for height –for –age Z score, the RM comparing children in extreme categories 31.0(95%CI=14.2, 67.6)the result were not different for children in the upper for-age categories of weight- for-height. Suggesting that height for –age was more important as a confounder. And hence a risk factor for death, at very low levels of weight –for-height compared with children with higher weight –for – height Z scores. Height –for -age, a measure of stunting, was also associated with a higher risk of mortality (p for trend < 0.0001).

2.4 Additional Factors

Further to the factors mentioned above , there are some few additional factors that contribute to malnutrition causes.

a) Environmental factors:

It’s a matter of good and poor hygiene ; since malnutrition spread in areas like refugees campaigns and poor urban areas in Khartoum , the output is that malnutrition is found where people lack almost all the basic facilities such as medical and health care , the lack of good sanitation and draining systems, educational institutes and healthy water supply networks.

b) Socio-economic status:

Poverty is considered as a major factor of almost all man-made disasters. Thus, people live in poverty and families with low income are usually unable to get high standard levels of health care, education and healthy foods.

c) Cultural factors:

Cultural factors contribute to the spread of malnutrition among Sudanese children living in Khartoum. There are some tribes don’t offer egg to their children because they believe that eating eggs result in deafness which in its turn prevent their children from getting protein that found in eggs. In a country that contains a lot of primitive tribes full of primitive myths, the environment of bad habits that lead to malnutrition is growing and spreading rapidly.

Chapter three

Factor Analysis Technique

3.1 Factor Analysis

Factor analysis is widely used to analyse data, and no doubt, will continue to be widely used in future, the reason for this is that the technique does seem to be useful for gaining insight into structure of multivariate data.[i]

The essential purpose of factor analysis is to describe, if possible the covariance relationship among many variables in terms of a few underlying, but unobservable random quantities called factors (or latent variables). Variables can be grouped according to their correlations, that is, all variables within a particular group are highly correlated among themselves but have relative small correlation with variable in different groups. It is conceivable that each group of variables has a single underlying construct, or factor that is responsible for observed correlation. Factor analysis can be considered as an extension of principal components analysis both can be viewed as an attempt to approximate the covariance matrix (Σ). However the approximation based on factor analysis model is more elaborate.

3.2 Data Requirements:

Factor analysis is conducted on the correlations or covariance's between items. The variables should be quantitative at the interval or ratio level. Categorical data (such as religion or country of origin) are not suitable for factor analysis. Data for which Pearson correlation coefficients can sensibly be calculated should be suitable for factor analysis.

3.3 Assumptions

The data should have a bivariate normal distribution for each pair of variables, and observations should be independent. The factor analysis model specifies that variables are determined by common factors (the factors estimated by the model) and unique factors (which do not overlap between observed variables); the computed estimates are based on the assumption that all unique factors are uncorrelated with each other and with the common factors.[ii]

3.4 The Orthogonal Factor Model

The observed random vector X with P components, has mean μ and covariance matrix Σ, the factors model postulates that X is linearly dependent upon a few unobservable random variable F_1, F_2…Fm called common factors and P additional sources of variation

ε1, ε2… εp called errors in particular the factor analysis model

$$X1 - \mu 1 = l_{11}\ F_1 + l_{12}\ F_2 + \dots + l_{1m}\ F_m + \varepsilon_1 \qquad (3.1)$$

$$X2 - \mu 2 = l_{21}\ F_2 + l_{22}\ F_2 + \dots + l_{2m}\ F_m + \varepsilon_2$$

$$. \ Xp - \mu_p = l_{p1}\ F_p + l_{p2}\ F_2 + \dots + l_{pm}\ F_m + \varepsilon_p$$

Or on matrix form that can be written as follows:-

$$x - \mu = L \quad F + \varepsilon \qquad (3.2)$$

(P*1) (p*m) (m*1) (p*1)

μi = mean of variable i

εi = ith specific error

Fj = jth common factor

Lij = loading factor of the ith variables on jth factor

P = number of variables

m = number of factors

If m = p there is no factor analysis because we can't get the inverse of the matrix L

Because factor analysis used to reduce the data, if the number of factor is equal to the number of variable then there is no need to use Factor analysis.

The coefficient Lij called the loading of the ith variable on the jth factor, so the matrix L is the matrix of factor loadings. The ith specific factor εi associated with the ith response Xi. The p deviation X1 - $\mu 1$, X2 - $\mu 2$,…,. Xp - μp are expressed in term of p+m random variable, F1, F2, …, Fm , $\varepsilon 1$, $\varepsilon 2$… εp which are unobservable. This distinguishes the above model from the multivariate regression model in which the dependant variable can be observed.

With some additional assumptions about random vectors F and ε, the above model implies certain covariance relationships:

The unobservable random vectors F and ε satisfy the following properties: -

F and ε are independent

E(F) = 0 (3.3)

$$Cov(F) = E(FF') = \underset{(m*m)}{I} \quad (3.4)$$

$$E(\varepsilon) = 0 \quad (3.5)$$

$$Cov(\varepsilon) = E(\varepsilon \varepsilon') = \underset{(p*p)}{\Psi} \quad (3.6)$$

Where Ψ is diagonal matrix

$$\begin{bmatrix} \Psi 1 & 0 & \ldots\ldots & 0 \\ 0 & \Psi 2 & \ldots\ldots & 0 \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ 0 & \ldots\ldots & & \Psi p \end{bmatrix}$$

The orthogonal factor model implies a covariance structure for X, from the model (3.2) we have:

$$\underset{(P*1)}{X - \mu} = \underset{(p*m)}{L} \underset{(m*1)}{F} + \underset{(p*1)}{\varepsilon}$$

$$(X - \mu)(X - \mu)' = (LF + \varepsilon)(LF + \varepsilon)'$$

$$= (LF + \varepsilon)((LF)' + \varepsilon')$$

$$= LF(LF)' + \varepsilon(LF)' + LF\varepsilon' + \varepsilon\varepsilon'$$

$$\Sigma = cov(x) = E(X - \mu)(X - \mu)'$$

$$= LE(FF')L' + E(\varepsilon F')L' + LE(F\varepsilon') + E(\varepsilon\varepsilon')$$

Since

E(FF/)= I and F& ε are independent So $E(\varepsilon F)=0$ (3.7)

Therefore

$$\Sigma = L L' + \Psi \qquad (3.8)$$

Or

$$Var(X_i) = l^2_{i1} + l^2_{i2} + \ldots + l^2_{im} + \psi_i \qquad (3.9)$$

$$cov(X_i X_k) = l_{i1} l_{k1} + l_{i2} l_{k2} + \ldots + l_{im} l_{km} \qquad (3.10)$$

Also from the same model(2), we have:

$$\underset{(P*1)}{X - \mu} = \underset{(p*m)}{L} \ \underset{(m*1)}{F} + \underset{(p*1)}{\varepsilon}$$

$$(X - \mu) F' = (LF + \varepsilon) F'$$

$$= LF F' + \varepsilon F'$$

So

$$cov(X,F) = LE(F F') + E(\varepsilon F') = L \qquad (3.11)$$

$$cov(X_i,F_j) = l_{ij} \quad (3.12)$$

3.5 Communality

That portion of variance of the i^{th} variable contributed by the m common factors is called the i^{th} communality. It is important to understanding some basic thing about the variance within an R matrix, the total variance for particular variable will have two components some of it will be shared with other variables or measure (common variance) and some of it will be specific to that measure (unique variance). We tend to use unique to refer to a variable that can be reliably attribute to only one measure, however there is also variance that is specific to one measure but not reliably to one measure so this variance is called error or random variance, the proportion of common variance present in a variable is known as the communality. As such, a variable that has no specific variance (or random variance) would have communality of one; a variable that shares none of its variance with any other variable would have a communality of zero. In factor analysis we are interest in finding common underlying dimensions within the data and so we are primary interested only in the common variance. Therefore, when we run factor analysis its fundamental that we know how much of the variance present in our data is common variance. This presents us with a logical problem, to do the factor analysis we need to know the proportion of common variance present, yet the only way to find the out extent of the common variance is by carrying out a factor analysis, there are two ways to solve this problem:

First Approach: -

We assume that the communality of every variable is equal one by making this assumption we merely transpose our original data in to constituent linear component known as principle component analysis

Second Approach: -

In the second approach is to estimates the amount of common variance by estimating the communality value fore each variable.

There are various methods of estimating communalities but the most wildly use (including SPSS) is to used the Squared Multiple Correlation (SMC) of each variable with all others variables, in this case we use multiple regression using one measure (variable) as outcome (dependant variable) and the other variables as predictors (independent variables), the resulting multiple R^2 would be used as an estimate of the communality of the dependent variable, we should note that R is correlation between the observed value of the dependant variable and predicted values of the independent variables estimated by multiple regression model, mention that large value of the multiple R represent a large correlation between predicted and observed value of the dependant variable. A multiple R of one represents a situation in which the model perfectly predicted the observed data. This second approach is what is done in factor analysis. These estimates allow the factor analysis to be done. Once the underlying factors have been extracted, new communalities can be calculated that represent the multiple correlation between each variable and the factor extracted. Therefore, the communalities measure the proportion of variance explained by the extracted factors.

From the above we can rewrite equation (3.10) as follows

var(Xii) = communalities + specific variance

Or

$h^2_i = l^2_{i1} + l^2_{i2} + \ldots + l^2_{im}$

And

$\sigma_{ii} = h^2_i + \psi i$ where $i = 1,2\ldots p$ (3.14)[iii]

3.6 Methods of estimation

We shall consider two of the most popular methods of parameter estimation. The principal component (and the related principal factor) method and the maximum likelihood method. The solution from either method can be rotated in order to simplify the interpretation of factor.

3.7 The principal components (and principal factor) method

The principal components factor analysis of the sample covariance matrix S is specified in term of its eigenvalue-eigenvector pairs $(\lambda_1,\hat{e}_1), (\lambda_2,\hat{e}_2), (\lambda_3,\hat{e}_3)\ldots (\lambda_p,\hat{e}_p)$

where $\lambda_1 \geq \lambda_2 \geq \ldots \geq \lambda_p$. let the number of common factors be m which is less the number of variable (p) the matrix of estimated factors loading (l_{ij}) is given by

$$L = \{(\sqrt{\lambda_1})\,\hat{e}_1 \quad (\sqrt{\lambda_2})\,\hat{e}_2 \quad \ldots \quad (\sqrt{\lambda_m})\,\hat{e}_m\}$$

The estimated specific variances are provided by the diagonal elements of the matrix

$S - L L'$

So

$$\Psi = \begin{bmatrix} \psi_1 & 0 & \cdots & 0 \\ 0 & \psi_2 & \cdots & 0 \\ \vdots & \vdots & & \vdots \\ 0 & \cdots & & \psi_p \end{bmatrix}$$

with $\psi_i = S_{ii} - \Sigma\, lij$ $i=1,2\ldots m$

Communality are estimated as

$h^2_i = l^2_{i1} + l^2_{i2} + \ldots + l^2_{im}$

Noted that the principal component factor analysis of the sample correlation matrix is obtained by stating with R in place of S.

We should note that the principal component factor analysis is appropriate for first pass through the data and it is not required that R or S be non-singular.[iv]

3.8 The maximum likelihood Method

If the common factor F and specific ε can be assumed to be normally distributed, then the maximum likelihood estimates of the factor loadings and specific variance may be obtained.

Where Q is loading of the ith variables on jth factor

$$\begin{aligned}\ell(\mathcal{X};\mu,\Sigma) &= -\frac{n}{2}\log \mid 2\pi\Sigma \mid -\frac{1}{2}\sum_{i=1}^{n}(x_i-\mu)\Sigma^{-1}(x_i-\mu)^\top \\ &= -\frac{n}{2}\log \mid 2\pi\Sigma \mid -\frac{n}{2}\operatorname{tr}(\Sigma^{-1}\mathcal{S}) - \frac{n}{2}(\overline{x}-\mu)\Sigma^{-1}(\overline{x}-\mu)^\top .\end{aligned}$$

This can be rewritten as

$$\ell(\mathcal{X};\widehat{\mu},\Sigma) = -\frac{n}{2}\left\{\log \mid 2\pi\Sigma \mid + \operatorname{tr}(\Sigma^{-1}\mathcal{S})\right\}.$$

Replacing μ by $\widehat{\mu} = \overline{x}$ and substituting $\Sigma = \mathcal{Q}\mathcal{Q}^\top + \Psi$ this becomes

$$\ell(\mathcal{X};\widehat{\mu},\mathcal{Q},\Psi) = -\frac{n}{2}\left[\log\{\mid 2\pi(\mathcal{Q}\mathcal{Q}^\top + \Psi) \mid\} + \operatorname{tr}\{(\mathcal{Q}\mathcal{Q}^\top + \Psi)^{-1}\mathcal{S}\}\right].$$

3.9 Kaiser- Meyer-Olkin (KMO) Measure of sampling Adequacy

The (KMO) statistic can be calculated for individual and multiple variables and represent the ratio of square correlation between variables and the square partial correlation between variables, the (KMO) varies between 0 and 1, a value of 0 indicate that the sum partial correlation is large relative to the sum of correlation indicating that the factor analysis is likely to be inappropriate. A value close to 1 indicates the patterns of correlation are relatively compact and so factor analysis should yield distinct and reliable factors. Kaiser (1974) recommends accepting value greater than .5 as acceptable value, value below this value should to either to collect more data or rethink which variables to include.

3.10 Anti-image correlation Matrix

The diagonal of the anti-image correlation represents the (KMO) for individual variables, as well as checking the over all (KMO) statistic it is important to examine the diagonal elements of the ant-image correlation matrix, the value of should be above .5 for all variables, variables with value below .5 should exclude from the analysis. The off-diagonal elements of the anti-image correlation represent the partial correlation between variable.

3.11 Bartlett's Test of Sphericity

Bartlett's test the null hypothesis that the original correlation matrix is an identity matrix. Factor analysis needs some relationships among variables and if the R-Matrix was an identity matrix then all correlation coefficients would be zero therefore to do factor analysis this test should be significant value less than .05. A significant test tell us that the R-matrix is not an identity matrix therefore there are some relationships among the variables.

3.12 Kaiser Criterion

In factor analysis not all factors are retained in an analysis, Kaiser recommended retaining all factors with eigenvalues greater than one, this criterion is based on the idea that the eigenvalue represent the amount of variation explained by a factor and that an eigenvalue of one represent substantial amount of variation, this criterion is accurate when the average communalities is grater than .6 and the sample not less than 250.

3.13 Factor rotation

Generally in factor analysis most variables have high loadings in the most important factor, and small loading in all other factors. This characteristic makes interpretation very difficult, and so a technique called factor rotation is used to discriminate between factors.

There are two types of rotation that can be done, the first is orthogonal rotation it means that the factor analysis rotated factors while keeping them independent, before rotation, all factors are independent and the orthogonal rotation ensures that the factors remain uncorrelated. The other form of rotation is oblique rotation, the differences with oblique rotation is that factors are allowed to correlate. One approach used in factor analysis is to run the analysis using both types of rotation. Pedhazur and Schemlkin (1991) suggest that if the oblique rotation demonstrates a negligible correlation between the extracted factors then it is reasonable to use the orthogonally rotated solution, if the oblique rotation reveals a correlated factor structure, then the orthogonally rotated solution should be discarded. In any case, the oblique rotation should be used only if there are good reasons to suppose that the underlying factor could be related in theoretical term.[v]

Chapter Four
Data Analysis

4.1 Secondary Quantitative Data:

The secondary data includes the data of morbidity as well as mortality of the infant and children under five years due to malnutrition in Khartoum state.

The collected data is issued by the ministry of health for the years 2000, 2001,2002,2003,2004 and 2005.The data presents morbidity and mortality according to infant, children who were under five years and gender (male and female) classifications for each month during the year. In addition to this, it also presents the morbidity and mortality of the under five year's children cases according to the categorizations of the diseases cause malnutrition (pneumonia, malaria and diarrhea).

Table (4-1): Under five children morbidity and mortality regarding various diseases that cause malnutrition in 2000

Disease	Morbidity	Mortality
Diarrhea	1203	67
Pneumonia	4114	158
Malaria	3244	159
Malnutrition caused by other diseases and different factors	1426	138
Total	9987	522

Source: Ministry of Health-Sudan 2006

Table (4.1) shows that pneumonia gains the highest morbidity among other diseases and that malaria obtained the highest mortality.

Table (4-2): Under five children morbidity and mortality regarding various diseases that cause malnutrition in 2001

Disease	Morbidity	Mortality
Diarrhea	2256	75
Pneumonia	6524	169
Malaria	4291	128
Malnutrition caused by other diseases and different factors	3488	306
Total	16556	678

Source: Ministry of Health-Sudan 2006

Table (4.2) shows that pneumonia gains the highest morbidity among other diseases and that malnutrition caused by other diseases or other factors obtained the highest mortality.

Table (4-3): Under five children morbidity and mortality regarding various diseases that cause malnutrition in 2002

Disease	Morbidity	Mortality
Diarrhea	3312	73
Pneumonia	602	13
Malaria	4774	94
Malnutrition caused by other diseases and different factors	3312	253
Total	12000	433

Source: Ministry of Health-Sudan 2006

Table (4.3) shows that malaria gains the highest morbidity among other diseases and that malnutrition caused by other diseases or other factors obtained the highest mortality.

Table (4-4): Under five children morbidity and mortality regarding various diseases that cause malnutrition in 2003

Disease	Morbidity	Mortality
Diarrhea	2003	49
Pneumonia	583	11
Malaria	2906	55
Malnutrition caused by other diseases and different factors	5103	181
Total	10595	297

Source: Ministry of Health-Sudan 2006

Table (4.4) shows that malnutrition caused by other diseases or other factors obtained the highest mortality and morbidity.

Table (4-5): Under five children morbidity and mortality regarding various diseases that cause malnutrition in 2004

Disease	Morbidity	Mortality
Diarrhea	1992	71
Pneumonia	184	20
Malaria	1666	46
Malnutrition caused by other diseases and different factors	4775	274
Total	8617	411

Source: Ministry of Health-Sudan 2006

Table (4.5) shows that malnutrition caused by other diseases or other factors obtained the highest mortality and morbidity.

Table (4-6): Under five children morbidity and mortality regarding various diseases that cause malnutrition in 2005

Disease	Morbidity	Mortality
Diarrhea	1375	43
Pneumonia	663	19
Malaria	1071	19
Malnutrition caused by other diseases and different factors	3668	228
Total	6779	309

Source: Ministry of Health-Sudan 2006

Table (4.6) shows that malnutrition caused by other diseases or other factors obtained the highest mortality and morbidity.

4.2 Factor analysis

This section utilized two of the most popular methods of the parameters estimation, the principal components and the maximum likelihood methods. The solution from either method can be rotated in order to simplify the interpretation of factors and the results obtained from both methods were compared.

Table (4.7) shows Kaiser-Meyar-Olkin (KMO) measure of sampling adequacy, Bartlett's test of sphericity. The (KMO) value is .497 reveal that factor analysis is appropriate and reliable for this data.

The Bartlett's tests measure the original correlation matrix if it is an identity matrix or not.

Table (4.7):

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.497
Bartlett's Test of Sphericity	Approx. Chi-Square	3782.610
	Df	10
	Sig.	.000

Table (4.8) list the eigenvalues associated with each linear component before extraction, after extraction and after rotation, extracted from the principal component method. In the same table the eigenvalues associated with each factor represent the variance explained by that particular linear component. The first three factors explain relatively large amounts of total variance. Factors with eigenvalues greater than one is only extracted in the columns labeled extraction sums of squared loading, there are three factors with eigenvalues greater than one, and in the final part of the table labeled rotation sums of square loading the eigenvalues of factor after rotation are displayed. Before rotation factor one and two accounted for more variance than the remaining factors , 31.713 and 19.735 compared to 16.667 however after rotation it account for 31.650 and 19.331 compared to 17.133 respectively**.**

Table (4.8): Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.903	31.713	31.713	1.903	31.713	31.713	1.899	31.650	31.650
2	1.184	19.735	51.448	1.184	19.735	51.448	1.160	19.331	50.982
3	1.000	16.667	68.115	1.000	16.667	68.115	1.028	17.133	68.115
4	1.000	16.667	84.781						
5	.808	13.475	98.256						
6	.105	1.744	100.000						

Extraction Method: Principal Component Analysis.

Table (4.9) and Table (4.10) shows the communality before and after extraction, the communality indicate that the amount of variance in each variable that is accounted for, Table (4.9) extracted according to Principal component method, since before extraction there are as many factors as there are variables, so all variance is explained by the factors and communalities are one, but after extraction there are only three factors which can not explain all of the variance present in the data but they can explain some of it because there are some information lost. Small values indicate variables that do not fit well with the factor solution and should possibly be drooped from the analysis.

Table (4.9): Table of communality by using principle component analysis extraction method

Communalities

	Initial	Extraction
DEASE	1.000	.260
AGE	1.000	.945
CASE	1.000	.947
MONTH	1.000	.907
YEAR	1.000	.437
QUANTITY	1.000	.591

Extraction Method: Principal Component Analysis.

Table (4.10): Table of communality by using maximum likelihood analysis extraction method

Communalities(a)

	Initial	Extraction
AGE	.801	.838
CASE	.802	.957
MONTH	.008	.007
YEAR	.016	.016
QUANTITY	.034	.999

Extraction Method: Maximum Likelihood. A One or more communalitiy estimates greater than 1 were encountered during iterations. The resulting solution should be interpreted with caution.

Table (4.11) and table (4.12) represent the correlation matrix between the three factors. This matrix contain the correlation coefficients between factors as predicted from the rotated component matrix and the rotated factor matrix, according to principal component and Maximum Likelihood as Extraction Method, if the orthogonal rotation (Varimax) were completely appropriate then we expect a symmetric matrix, since both matrixes are very unsymmetrical then we must convert to oblique rotation (Oblimin).

Table (4.11):

Component Transformation Matrix

Component	1	2	3
1	.997	-.068	.026
2	-.072	-.920	.386
3	.003	.387	.922

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

Table (4-12):

Factor Transformation Matrix

Factor	1	2
1	.058	.998
2	.998	-.058

Extraction Method: Maximum Likelihood. Rotation Method: Varimax with Kaiser Normalization.

4.2.1- Principal component results:

Table (4.13) shows the components matrix from which the rotated structure matrix in table (4.14) was obtained according to principal components as a method of extraction and direct oblimin as a method of rotation.

Table (4.14) show that the categories that load highly in factor 1 includes, "Month and quantity", which explains 31.650% from the total variance as shown in table (4.8).

On the other hand the categories that loaded highly on the second factor includes, "Age and Case" which explains 19.331% from the total variance.

Table (4.13): Component matrix which rotated from structure matrix

Component Matrix(a)

	Component		
	1	2	3
DEASE	-.017	-.464	.210
AGE	.969	-.078	-6.921E-17
CASE	.972	-.050	-2.324E-16
MONTH	.013	.351	.885
YEAR	-.019	-.513	.416
QUANTITY	.135	.757	7.514E-16

Extraction Method: Principal Component Analysis.
a 3 components extracted.

Table (4.14): Structure matrix obtained according to principle components analysis   Structure Matrix

	Factor	
	1	2
AGE	-.006	.915
CASE	.031	.978
MONTH	.086	-.001
YEAR	-.125	.001
QUANTITY	.998	.063

Extraction Method: Maximum Likelihood. Rotation Method: Oblimin with Kaiser Normalization.

4.2.2-Maximum likelihood result:

Table (4.15) shows the factor matrix from which the rotated structure matrix in table (4.16) was obtained according to maximum likelihood as a method of extraction and direct oblimin as a method of rotation.

Two categories that have a high load in the first factor they are “quantity and month”.

Two categories load high in the second factor they are “Case and Age”.

Table (4.15): Factor matrix which rotated from structure matrix

Factor Matrix(a)

	Factor	
	1	2
AGE	.042	.914
CASE	.082	.975
MONTH	.085	-.007
YEAR	-.125	.010
QUANTITY	.999	-.002

Extraction Method: Maximum Likelihood.
a 2 factors extracted. 11 iterations required.

Table (4.16): Structure matrix obtained according to maximum likelihood analysis

Pattern Matrix (a)

	Factor	
	1	2
AGE	-.017	.915
CASE	.019	.978
MONTH	.086	-.002
YEAR	-.125	.003
QUANTITY	.998	.050

Extraction Method: Maximum Likelihood. Rotation Method: Oblimin with Kaiser Normalization.
a Rotation converged in 2 iterations.

Table (4.17) and table (4.18) represent the correlation matrix between the factors. This matrix contain the correlation coefficients among components as predicted from the structure matrix in table (4.13) and table(4.14) , From table (4.17) component 1 and component 2 have great relation with other components, while component 3, component 4, component 5, and component 6 have no relation. From table (4.18) all components interrelated to some degree.

If the components are independent then component correlation matrix should be identity matrix (all factors should have correlation coefficient of zero), and the results which obtained from the oblique rotation should be identical with that one obtained from the orthogonal rotation, since this is not the case therefore independent can not be existed . The orthogonal results should not be trusted and the oblique rotation solution is more meaningful.

Table (4.17):

Correlation Matrix

		DEASE	AGE	CASE	MONTH	YEAR	QUANTITY
Correlation	DEASE	1.000	.000	.000	.000	.000	-.113
	AGE	.000	1.000	.894	.000	.000	.040
	CASE	.000	.894	1.000	.000	.000	.080
	MONTH	.000	.000	.000	1.000	.000	.085
	YEAR	.000	.000	.000	.000	1.000	-.125
	QUANTITY	-.113	.040	.080	.085	-.125	1.000
Sig. (1-tailed)	DEASE		.500	.500	.500	.500	.000
	AGE	.500		.000	.500	.500	.027
	CASE	.500	.000		.500	.500	.000
	MONTH	.500	.500	.500		.500	.000
	YEAR	.500	.500	.500	.500		.000
	QUANTITY	.000	.027	.000	.000	.000	

Table (4.18):

Factor Correlation Matrix

Factor	1	2
1	1.000	.013
2	.013	1.000

Extraction Method: Maximum Likelihood. Rotation Method: Oblimin with Kaiser Normalization.

Chapter Five
Conclusion and Recommendations

5.1 Conclusion:

This study presents under five children morbidity and mortality caused by malnutrition in Khartoum state from the year 2000 up to 2005 and shows their distribution by gender, season and age and come to the conclusion that:

1) Under five children malnutrition is the major cause of morbidity and mortality among this age group with high levels.
2) It shows that the high levels of morbidity and mortality is,to a large extent ,less in the infant group (0-1) and the reason beyond that is no doubt breast feeding.
3) It notes the:

   A-frequent pneumonia infection during winter seasons.

   B-diarrhea infection during fall is frequently detected.
4) The year 2001 gains the highest levels in morbidity and mortality resulted from malnutrition.
5) The year 2005 has the less morbidity and mortality cases due to the facts that:
   - a- Maternal education showed improvement during the last years in the state.
   - b- Economic and socio-economic status is growing rapidly.

c- Health situations are, to some degree, much better in this year than the previous years and the medicaments became available in almost all the hospitals and clinical centers in Khartoum state.
d- The government of the state started to establish projects and programs to serve Khartoum state environmental and public health situations such as "Khartoum Free of Malaria initiative".

5.2 Recommendations:

To eradicate the diseases that cause malnutrition and decrease the number of morbidity and mortality resulted from malnutrition, the researcher recommends the following:-

1) The government should make the medicaments used in treating these diseases available in all hospitals and clinics.

2) More efforts from governmental bodies which are responsible of introducing and controlling consumer protection and standardization and measurement issues.

3) Found organizations and increase the number of programs that contribute to the development of the public health.

4) Offer financial and social support to the poor families in order to have their children get healthy feed.

5) Introduce health education among families and mothers.

6) Encourage studies in this field.

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