Factor contributing to protein energy malnutrition among under than five years in sinnar pediatric teaching hospital -2009 .

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In public and environment health (MPEH) in (public health )
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الآية

بسم الله الرحمن الرحيم

قال تعالى: ( وَقَالَ رَبِّ أَوْزِعْنِي أَنْ أَشْكُرَ نَعْمَتَكَ الَّتِي أَنْعَمْتَ عَلَيْنِ وَعَلِيَّ وَالَّذِيَ وَأَنْ أَعْمَلَ صَالِحاً تَرْضَاهُ وَأَخْلُصُنِي بِرَحْمَتِكَ فِي عِبَادَتِكَ الصَّالِحِينَ ).

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Dedication

To my father, mother, husband, sisters and brothers.
Abbreviations

- **N**  Sample size.
- **FMOH**  Federal ministry of health
- **WHO**  World Health Organization
- **FOA**  Food Organization Agriculture
- **UNICEF**  United Nations Children’s Fund
- **MCH**  Maternal and Children Health
- **IMF**  International Monetary Fund
- **BMI**  Body Mass Index
- **MUAC**  Mid Upper Arm Circumstance
- **ENT**  Ear, Nose, Throat
- **COPD**  Chronic Obstructive Pulmonary Disease
- **NFHS**  National Family Health Survey
- **UN**  United Nations
- **CPA**  Comprehensive Peace Agreement
- **INC**  Interim National Constitution
- **SSIC**  Southern Sudan Interim Constitution
- **GOSS**  Government of Southern Sudan
- **PEM**  Protein Energy Malnutrition
- **HIV**  Human Immune deficiency Virus
- **AIDS**  Acquired Immune Deficiency Syndrome
Abstract

**Background:** Protein-energy malnutrition (PEM) is a fatal body-depletion disorder. It occurs when the body lacks the calories it needs from protein, carbohydrates and fats. It is a leading cause of child death in developing countries. There are three forms of protein energy malnutrition that include Marasmus, Kwashiorkor and Marasmic-kwashiorkor. According to WHO reports, 149.6 million children under 5 years of age (26.7%) of the world's children of this age group were malnourished in terms of weight - for – age. Geographically, over two thirds of them (72%) live in Asia, while 25% in Africa and 2.3% in Latin America.

**Material and Method:** The study adopted the descriptive cross-sectional hospital based methodology. This was conducted in Sinnar Pediatric Teaching Hospital, from 15 March to 15 May 2009. The objective of the research was to study factors contributing to protein energy malnutrition among children under five years the study covered 269 of these children, of whom 39 suffered from (PEM). The research used the methodology of pre- prepared questionnaire, anthropometric measure (weight for age). Data was analyzed using the Statistical Package for Social Science (SPSS), the association between different variables was checked by using Chi- Square test. P. value ≤ 0.05 was considered significant.

**Results:** The total proportion of protein energy malnutrition among children under 5 years was (14.5%). PEM was found in (17.9%) of males and (12.1%) of females, but no significant difference was revealed (P = 0.1). PEM was significantly higher among children in age of 11-23 months (32.1%), (P = 0.001) as well as it was found significantly affected by monthly per capita income (P < 0.05). The study also showed that, PEM was found significantly associated with diarrheal disease, malaria and respiratory infections (P < 0.05).

**Conclusion:** Protein energy malnutrition is high among children of uneducated mothers, children with diarrheal diseases, malaria and respiratory Infections as
well as it was significantly affected by family income. There is a need for health education among family members, and health care authorities required to improve control of diseases associated with protein energy malnutrition.
المستخلص

خلفية: سوء التغذية الناتج عن نقص البروتين والطاقة هو مرض قاتل، ويحدث نتيجة لنقص الجسم للسعرات التي يحتاجها من مواد البروتين، الكاربوهيدرات والدهون ويعتبر من الأسباب الرئيسية لوفيات الأطفال في الدول النامية. هناك ثلاثة أنواع لسوء التغذية الناتج عن نقص البروتين والطاقة وتشمل مرازمس، كواش، وزنازيس كواش. ووفقاً لتقديرات منظمة الصحة العالمية فإن 149.6 مليون طفل أعمارهم دون سن الخامسة (26.7%) من أطفال العالم يعانون من سوء التغذية من خلال مؤشر الوزن/العمر. جغرافياً فإن ثلثيهم (72%) يعيشون في آسيا، (25%) في أفريقيا و (2.3%) في أمريكا اللاتينية.

منهجية البحث: الدراسة وصفية تحليلية أجريت في مستشفى سنار التعليمي للأطفال في الفترة من 15 مارس وحتى 15 مايو 2009، شملت الدراسة (269) طفلاً تحت الخامسة من العمر منهم (39) يعانون من سوء التغذية الناتج عن نقص البروتين والطاقة، أجريت الدراسة باستخدام استبيان مسبقاً ومقياس الأثاثومترك (الوزن/العمر) ثم تحليل البيانات باستخدام برنامج الحزم الإحصائية للعلوم الاجتماعية واستخدام اختبار مربع كأي لمعرفة العلاقة بين المتغيرات المختلفة وتعتبر العلاقة ذات دلالة إحصائية إذا كانت القيمة الإحصائية أقل من 0.05.

النتائج: أظهرت نتائج الدراسة أن معدل انتشار سوء التغذية الناتج عن نقص البروتين والطاقة بين الأطفال دون سن الخامسة كان (14.5%). وجد أن سوء التغذية الناتج عن نقص البروتين والطاقة لدى الذكور و莴دى (17.2%) من الإناث والمثاني، ولم تظهر الدراسة ارتباط ذو دلالة إحصائية مع النوع (القيمة الاحتمالية = 0.1). اثبتت الدراسة أيضاً أن سوء التغذية الناتج عن نقص البروتين والطاقة له ارتباط ذو دلالة إحصائية مع الأطفال في عمر 11-23 شهر (32.1%) (القيمة الاحتمالية = 0.01)، كما له ارتباط ذو دلالة إحصائية مع الدخل الشهري (القيمة الاحتمالية > 0.05). أيضاً أثبتت الدراسة أن سوء التغذية الناتج عن نقص البروتين والطاقة له علاقة بأمراض الأسهالات، الملاريا وال الجهاز التنفسي (القيمة الاحتمالية < 0.05).

الخلاصة: خلصت الدراسة إلى أن الإصابة بسوء التغذية الناتج عن نقص البروتين والطاقة عالية وضائة الأطفال ذو الأمهات غير المتعلمات، الأطفال الذين يعانون من الإسهالات، الملاريا والالتهابات الجهاز التنفسي، كما وجد أن له ارتباط مع دخل الأسرة. هناك حاجة للتثقيف الصحي وسط الأسر، كما أن جهات الرعاية الصحية مطالبة بتحسين مكافحة الأمراض التي لها علاقة بمعرض سوء التغذية الناتج عن نقص البروتين والطاقة.
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Chapter one

Introduction

Objectives

Literature Review
1.1 Introduction

Malnutrition essentially means “bad nourishment”. It concerns not enough as well as too much food, the wrong types of food, and the body's response to a wide range of infections that result in mal-absorption of nutrients or the inability to use nutrients properly to maintain health clinically, malnutrition is characterized by inadequate or excess intake of protein, energy, and micronutrients such as vitamins, and the frequent infections and disorders that result (WHO, 2000).

World Health Organization (WHO) defines malnutrition as "the cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions." The term protein-energy malnutrition (PEM) applies to a group of related disorders that include marasmus, kwashiorkor, and intermediate states of marasmus-kwashiorkor (Noah, 2008).

Malnutrition continues to be a worldwide problem, particularly in lesser developed countries. Worldwide between 1999 and 2005 there were 850 million people undernourished the number of malnourished people has recently (FAO, 2008).

Mortality due to malnutrition accounted for 58% of the total mortality in 2006. In the world approximately 62 millions people, all causes of death combined, die each year. One in twelve people worldwide are malnourished (Jean, 2003). In 2006, more than 36 millions died of hunger or diseases due to deficiencies in micronutrients, the World Health Organization estimates that one-third of the world is well-fed, one-third is under-fed and one-third is starving (Baro, et al, 2006).

1.2 Situation in Sudan

Federal Ministry of Health represented in national nutrition department conducted a national nutrition survey covered 80,000 children less than five years in six Northern regions, the results showed that the overall rate of under nutrition of children below 5 years in different states of the Sudan during 2001 the overall under nutrition found to be (15%) in Sennar,( 9.5%) in Northern, (16.4%) in South Kordofan and (13.2%) in Gedarif (FMOH, 2001).
The national nutrition department of health reports 2000 indicates that, the Sudan as one of the developing countries is suffering from a number of nutritional problems, such as Protein energy malnutrition (PEM), vitamin (A) deficiency and iodine deficiency (FMOH 2002).

The Sudan House Hold Survey (SHHS) results indicated that nationwide, approximately one-tenth (9.4 per cent) of children under age five in Sudan were severely underweight, 15.2 per cent were severely stunted and 3.5 per cent were severely wasted. The underweight prevalence (severe) was above 15 per cent in five states namely North Darfur (15.4 per cent), Upper Nile (16.6 per cent), Jonglei (16.9 per cent), Northern Bahr El Ghazal (18.7 per cent) and Unity (22.1 per cent). The percentage of severely underweight children ranged between 10 and 15 per cent in seven states, and below ten per cent in the remaining states, the lowest being in Khartoum State at 3.7 per cent. The proportion of children who were severely stunted ranged from 11.7 per cent in Khartoum to 26.8 per cent in Unity State while the wasting prevalence (severe) varied from 0.7 per cent in South Darfur State to 12.2 per cent in Unity State (Unicef, 2007).
1.3 Objectives

**General objective**

To study the factors contributing to protein energy malnutrition among children under 5 years admitted in Sinnar Pediatric Teaching Hospital from 15 March to 15 May 2009.

**Specific objectives**

1- To measure the proportion of protein energy malnutrition.
2- To describe the most affected age group and gender.
3- To assess the socioeconomic and environmental factors magnitude of malnutrition.
1.4 Literature review

Malnutrition is a general term for a medical condition caused by an improper or insufficient diet. It most often refers to under nutrition resulting from inadequate consumption, poor absorption, or excessive loss of nutrients, but the term can also encompass over nutrition, resulting from overeating or excessive intake of specific nutrients. An individual will experience malnutrition if the appropriate amount of, or quality of nutrients comprising a healthy diet are not consumed for an extended period of time. An extended period of malnutrition can result in starvation, disease, and infection (Michael, 2006).

Malnutrition is the lack of sufficient nutrients to maintain healthy bodily functions and is typically associated with extreme poverty in economically developing countries. It is a common cause of reduced intelligence in parts of the world affected by famine (Michael, 2006).

Most commonly, malnourished people either do not have enough calories in their diet, or are eating a diet that lacks protein, vitamins, or trace minerals. Medical problems arising from malnutrition are commonly referred to as deficiency diseases. Scurvy is a well-known and now rare form of malnutrition, in which the victim is deficient in vitamin C. Common forms of malnutrition include protein-energy malnutrition (PEM) and micronutrient malnutrition (Michael, 2006).

1.4.1 Distribution of disease

Chronic food deficits affect about 792 million people in the world (FAO,2008), including 20% of the population in developing countries. Worldwide, malnutrition affects one in three people and each of its major forms dwarfs most other diseases globally (FAO,2008), Malnutrition affects all age groups, but it is especially common among the poor and those with inadequate access to health education and to clean water and good sanitation. More than 70% of children with protein-energy malnutrition live in Asia, 26% live in Africa, and 4% in Latin America and the Caribbean (WHO,2000).
One person dies every second as a result of hunger - 4000 every hour -100, 1 child dies every 5 seconds as a result of hunger - 700 every hour – 16 000 each day - 6 million each year - 60% of all child deaths (2002-2008 estimates) (FAO, 2008).

According to the World Health Organization, hunger is the gravest single threat to the world's public health. According to Jean Ziegler (the United Nations Special Rapporteur on the Right to Food for 2000 to March 2008), mortality due to malnutrition accounted for 58% of the total mortality in 2006. In the world approximately 62 millions people, all causes of death combined, die each year. One in twelve people worldwide are malnourished (Jean, 2003). In 2006, more than 36 millions died of hunger or diseases due to deficiencies in micronutrients, the World Health Organization estimates that one-third of the world is well-fed, one-third is under-fed and one-third is starving (Baro, etal., 2006).

1.4.2 Definitions of malnutrition

Malnutrition is a condition of impaired development or function caused by a long term deficiency, excess, or imbalance in energy and for nutrient intake. The occurrence of specific diseases of malnutrition depends on mostly on the food / population ratio, when food supplies are low and the population is large, undernutrition leads to nutritional deficiency diseases such as goiter and exophthalmia which is the eye problems caused by poor vitamin A intake is common, however, when the food supply is ample or overabundant, poor food choices coupled with an excessive intake can lead to nutrition related chronic diseases, such as certain forms of diabetes, pockets of under nutrition among poor my still be found in food abundant areas, such as the United States (wardlaw, etal., 1993).

World Health Organization (WHO) defines malnutrition as "the cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions." The term protein-energy malnutrition (PEM) applies to a group of related disorders that include marasmus, kwashiorkor, and intermediate states of marasmus-kwashiorkor (Noah, 2008). The term marasmus is derived from the Greek word marasmos, which
means withering or wasting. Marasmus involves inadequate intake of protein and calories and is characterized by emaciation. The term kwashiorkor is taken from the Ga language of Ghana and means "the sickness of the weaning." Williams first used the term in 1933, and it refers to an inadequate protein intake with reasonable caloric (energy) intake. Edema is characteristic of kwashiorkor but is absent in marasmus (Noah, 2008).

**1.4.3 Definition Protein-energy malnutrition (PEM):**

Is a potentially fatal body-depletion disorder. It is the leading cause of death in children in developing countries (Kessler et al., 1999). However, (PEM) refers to inadequate availability or absorption of energy and proteins in the body (Kessler, et al., 1999).

Micronutrient malnutrition refers to inadequate availability of some essential nutrients such as vitamins and trace elements that are required by the body in small quantities. Micronutrient deficiencies lead to a variety of diseases and impair normal functioning of the body (Michael, 2006).

Deficiency in micronutrients such as Vitamin A reduces the capacity of the body to resist diseases, deficiency in iron, iodine and vitamin A is widely prevalent and represent a major public health challenge. An array of afflictions ranging from stunted growth, reduced intelligence and various cognitive abilities, reduced sociability, reduced leadership and assertiveness, reduced activity and energy, reduced muscle growth and strength, and poorer health overall are directly implicated to nutrient deficiencies, also, another, although rare, effect of malnutrition is black spots appearing on the skin (Michael, 2006).

**1.4.4 Causes and consequences of Malnutrition**

Individual nutritional status depends on the interaction between food that is eating, the overall state of health and the physical environment. Malnutrition is both a medical and a social disorder, often rooted in poverty. combined with poverty, malnutrition contributes to a downward spiral that is fuelled by an increased burden of disease, stunted development and reduced ability to work.
Poor water and sanitation are important determinants in this connection, but sometimes improvements do not benefit the entire population, for example where only the wealthy can afford better drinking-water supplies or where irrigation is used to produce export crops. Civil conflicts and wars, by damaging water infrastructure and contaminating supplies, contribute to increased malnutrition (WHO, 2000).

1.4.5 Socio-political Causes of Malnutrition

In the late eighteenth and early nineteenth century, the English economist Thomas Malthus noted how increases in food production were likely to occur along a slow arithmetic progression due to the law of diminishing returns while population growth follows much faster, geometric progressions. His theory argued that this lag in productivity caused food shortages, that it would lead to famines worldwide as humans surpassed the carrying capacity of the land, and that it would create checks on socio-cultural systems in the forms of poverty and misery as humans would earn and live off of just enough to subsist and survive. This Malthusian argument has long since been refuted on several grounds but has none the less served as a backdrop for understanding of the causes of malnutrition (Darkow, 1996).

The actual causes of malnutrition can be varied and complex and are difficult to encapsulate in a single theory. Certainly, as Malthus suggests, lack of agricultural productivity combined with increases in population can cause and are often correlated to malnutrition. Over-cultivation, overgrazing, and deforestation lead to desertification or otherwise impoverished soils that can not support crops or cattle for subsistence agriculture (Darkow, 1996).

But this scenario only accounts for malnutrition in certain, specific instances and does not consider larger social issues such as the influence of political inequality. Further, malnutrition can stem from impacts of natural disasters, from the results of conflict and war, as an impact of the HIV/AIDS pandemic, as a consequence of other health issues such as diarrheal disease or chronic illness.
from lack of education regarding proper nutrition, or from countless other potential factors (Baro, etal., 2006).

Various scales of analysis also have to be considered in order to determine the sociopolitical causes of malnutrition. For example, the population of a community may be at risk if it lacks health-related services, but on a smaller scale certain households or individuals may be at even higher risk due to differences in income levels, access to land, or levels of education (Fotso, etal., 2005).

Also within the household, there may be differences in levels of malnutrition between men and women, and these differences have been shown to vary significantly from one region to another with problem areas showing relative deprivation of women. Children and the elderly tend to be especially susceptible. Approximately 27 percent of children under 5 in developing world are malnourished, and in these developing countries, malnutrition claims about half of the 10 million deaths each year of children under 5 (Nube, et al., 2003).

Often the consequences of malnutrition exacerbate its causes and form a vicious downward spiral. For example, in cases of malnourishment, lack of sufficient nutrients can weaken the immune system and invite infectious disease and by compromising digestive function, many of these diseases can intensify malnutrition. In communities or areas that lack access to safe drinking water, these additional health risks present a critical problem. Lower energy and impaired function of the brain also represent the downward spiral of malnutrition as victims are less able to perform the tasks they need to in order to acquire food, earn an income, or gain an education (Nube, et al., 2003).

1.4.6 Socioeconomic factors of Malnutrition

Malnutrition is largely affected by poverty, ignorance, insufficient education, lack of knowledge, poor environmental sanitation, family size, family income etc (Park, 2007 and UNICEF, 1993).

Family education seems to have a strong effect on reducing the prevalence of underweight (UNICEF, 1993).
In (1991) study about feeding practices and malnutrition carried out among children under five years of age in rural Bangladesh. The result revealed that malnutrition was significantly influenced by income, education of both parents and some infants- feeding practices (Helga ,etal,2007).

In Malaysia (1998) a study was conducted, to assessed socioeconomic determinants of nutritional status of children. The result showed a significant correlation between nutritional status and household size and with monthly per capita income (p value <0.05). the finding indicated the influence of socioeconomic factors on the nutritional status of children (Marjan,1998).

Sudan is a low income country, which ranked 139 out of 177 countries based on Human Development Index (0.505) for the year 20051; and according to Human Poverty Index (HPI), Sudan ranks 53rd among 88 developing countries (Unicef, etal, 2007). The incidence of poverty is high and there is considerable variation in poverty levels between and within states (Unicef, etal, 2007).

Economic activity is largely agricultural, which provides livelihood to 70 per cent of the population, contributing to 37 per cent of GDP and 15 per cent of 2 total export earnings. Civil war, political instability and natural disasters have characterized the life in Sudan and hampered economic progress. Since 1999, Sudan began to work with foreign partners to exploit its lucrative oil fields. This has improved the growth in national income to an average of 7 percent perannum and ultimately has resulted in steady growth of the economy. Oil production has become an important source of government revenues contributing about 50 per cent of 2005 budget, in large families a often there is less food for each person, small children may be neglected (Unicef, etal, 2007).

1.4.7. Environmental factors of Malnutrition

With 95% of all malnourished peoples living in the relatively stable climate region of the sub-tropics and tropics, climate change is of great importance to food security in these regions, temperature increases in these regions are "very likely." Even small changes in temperatures can lead to increased frequency of extreme weather conditions (Battista, David,2008).
1.4.8 Specific factors of Malnutrition

Age:- The high risk to develop malnutrition is the age range between 6-48 month due to inadequate food given to them, and infection is common (WHO,1986).

Across sectional anthropometric study designed to assess the nutritional status of children under five years of age attending maternal and children health (MCH) clinic is Dar EL- Salam capital of Tankaia, (1994). Showed that (6%-31%) were stunted, (6%-14%)Were under and (2.4%) wasted. Highest percentage of stunting was observed between (11-25) months. We conclude that malnutrition is still a sizable problem in age less that three years(Malee,etal,1997).

A study conduct in Brazil (2000) about malnutrition, the purpose of this study was to characterizes the malnutrition among malnourished children and pregnant women at nutritional risk, the prevalence of malnutrition was to identified as (30%),(33%)and (8.6%) according to the height/age (15%), weight/age (16.4%) and among the 24-35 month old children according to weight/height (5%)(Soares,2001).

Sex:- Boys are valued more than girl in money cultures for social and economic reason (Park,2007).except in cases of acute malnutrition, girls were more likely to be malnutrition than boys(Helga,2007).

1.4.9 Cultural factors of Malnutrition

Lack of food is not the only cause of malnutrition. Too often, there is starvation in the midst of plenty. People choose poor diets when good ones are available because of cultural influences which vary widely from country to country. These may be stated as follows:-

(a) Food habits, customs, beliefs, traditions and attitudes

Food habits among the oldest and most deeply entrenched aspects of any culture. They have deep psychological roots and are associated with love affection, warmth, selfimage and social prestige The family plays an important role in shaping the food habits which are passed from one generation to another, for example rich is staple cereal in the Eastern and Southern states of India and wheat is staple cereal in the Northern states(Park,2007).
During the second world war, when wheat was made available in place of rice in South India, people refused to buy wheat because it was their staple cereal (Park, 2007).

(b) **Religions:** Religions has powerful influence on the food habits of the people. Hindus don’t eat beef, and Musliums do not eat park some Oodox Hindus don't eat meet, fish, eggs and some vegetables like onion. These are called food taboos (Park, 2007).

(c) **Food fads:** These are like and dislike of person regarding selection (Park, 2007).

(d) **cooking practices:** Disposing rice water and the end of cooking, boiling of food for long period or peeling vegetables, these are cooking practices affecting foods nutritive values (Park, 2007).

(e) **child rearing practices:** as adoption of bottles- feeding and commercially produced refine food (Park, 2007).

(f) **Miscellaneous:** Men in certain countries eat first and women wait and eat last, and poorly. This practice affect their health status adversely (Park, 2007)

1.4.9.1 **Others factors**

Another significant factor is ineffective weaning secondary to ignorance, poor hygiene, economic factors, and cultural factors (Noah, 2008). The prognosis is worse when PEM occurs with HIV infection. Gastrointestinal infections can and often do precipitate clinical PEM because of associated diarrhea, anorexia, vomiting, increased metabolic needs, and decreased intestinal absorption. Parasitic infections play a major role in many parts of the world (Noah, 2008).

1.4.10 **Epidemiology measures**

In 2000, the WHO estimated that malnourished children numbered 181.9 million (32%) in developing countries. In addition, an estimated 149.6 million children younger than 5 years are malnourished when measured in terms of weight for age. In south central Asia and eastern Africa, about half the children have growth retardation due to PEM. This figure is 5 times the prevalence in the western world (Noah, 2008).
1.4.10.1 Mortality/Morbidity

Approximately 50% of the 10 million deaths each year in developing countries occur because of malnutrition in children younger than 5 years (Noah, 2008).

In kwashiorkor, mortality tends to decrease as the age of onset increases (Noah, 2008).

Race

Dermatologic findings appear more significant and occur more frequently among darker-skinned peoples. This finding is likely explained by the greater prevalence and the increased severity of PEM in Third World countries and not to a difference in racial susceptibility (Noah, 2008).

Age

Marasmus most commonly occurs in children younger than 5 years. This period is characterized by increased energy requirements and increased susceptibility to viral and bacterial infections (Noah, 2008).

In some studies, the PEM prevalence among elderly persons is estimated to be as high as 4% for those living in the community, 50% for those hospitalized in acute care units or geriatric rehabilitation units, and 30-40% for those in long-term care facilities. PEM has also been found to be a primary factor of poor prognosis in elderly persons (Noah, 2008).

Host

Protein-energy malnutrition (PEM) is a problem in many developing countries, most commonly affecting children between the ages of 6 months and 5 years (Marcelo, 2006).

The condition may result from lack of food or from infections that cause loss of appetite while increasing the body’s nutrient requirements and losses. Children between 12 and 36 months old are especially at risk since they are the most vulnerable to infections such as gastroenteritis and measles (Marcelo, 2006).

Chronic PEM has many short-term and long-term physical and mental effects, including growth retardation, lowered resistance to infection, and increased
mortality rates in young children. Death rates are high among children with untreated PEM, and the risk of dying increases with the severity of the condition. Even after treatment begins it is not uncommon for deaths to result from electrolyte imbalance, hypothermia, or complicating infections (Marcelo, 2006).

1.4.11 Diagnosis

Overall appearance, behavior, body-fat distribution, and organ function can alert a family physician, internist, or nutrition specialist to the presence of malnutrition. Patients may be asked to record what they eat during a specific period (Robert, et al., 2002).

X rays can determine bone density and reveal gastrointestinal disturbances, and heart and lung damage.

Blood and urine tests are used to measure the patient's levels of vitamins, minerals, and waste products. Nutritional status can also be determined by:

- Comparing a patient's weight to standardized charts
- Calculating body mass index (BMI) according to a formula that divides height into weight
- Measuring skinfold thickness or the circumference of the upper arm (Robert, et al., 2002).

1.4.12 Protein-energy malnutrition

Description

PEM is also referred to as protein-calorie malnutrition. It develops in children and adults whose consumption of protein and energy (measured by calories) is insufficient to satisfy the body's nutritional needs. While pure protein deficiency can occur when a person's diet provides enough energy but lacks the protein minimum, in most cases the deficiency will be dual. PEM may also occur in persons who are unable to absorb vital nutrients or convert them to energy essential for healthy tissue formation and organ function (Michael, 2006).
1.4.12.1 Classification of Protein-energy malnutrition

**Welcome classification of malnutrition**

<table>
<thead>
<tr>
<th>Case</th>
<th>Body weight as % of standard</th>
<th>Edema</th>
<th>Deficit in weight for age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>60 – 80%</td>
<td>-</td>
<td>Mild</td>
</tr>
<tr>
<td>Nutrition dwarf</td>
<td>&lt; 60%</td>
<td>-</td>
<td>Mild</td>
</tr>
<tr>
<td>Marasmus</td>
<td>&lt; 60%</td>
<td>-</td>
<td>Marked</td>
</tr>
<tr>
<td>Kwashiorkor</td>
<td>60 – 80%</td>
<td>+</td>
<td>Mild</td>
</tr>
<tr>
<td>Marasmus-kwashiorkor</td>
<td>&lt; 60%</td>
<td>+</td>
<td>Marked</td>
</tr>
</tbody>
</table>

(source: [www.who.org](http://www.who.org), 2008)

Weight-for-age = (weight of the patient /weight of normal child of the same age)*100

It can be noted that PEM can either be mild form of PEM, this includes the underweight child where the only manifestation is moderate growth failure. Most of PEM cases fall in this category, or severe forms of PEM, these include different forms, namely Marasmus, Kwashiorkor and Marasmic-Kwashiorkor. These forms represent only a small percentage of the total number of cases of PEM (WHO, 2008).

A high predictive value for the risk of death, and therefore had important implications for clinical practice. It was further abused, however, when its use was extended to

The most widely used method of classification of PEM is that suggested by Gomez (1956). It is based on deficit in weight / age, to measure the severity of underweight (WHO, 2008).

1.4.12.2 Waterlow classification

In order to overcome these caveats, Waterlow proposed combining weight-for-height, as an indicator of an acute episode of malnutrition, with height-for-age, as an indicator of chronic nutritional deficits that would be reflected in growth stunting (Waterlow, 1972).
In the other methods of assessing the deficit in height and weight is Waterlow classification to measure the severity of wasting and stunting (WHO, 2008).

**Waterlow classification of malnutrition**

<table>
<thead>
<tr>
<th>Nutrition status</th>
<th>Ht/age % (stunting)</th>
<th>Wt/Ht % (wasting)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>95</td>
<td>90 – 110</td>
</tr>
<tr>
<td>Mild</td>
<td>90 – 94</td>
<td>80 – 89</td>
</tr>
<tr>
<td>Moderate</td>
<td>85 – 89</td>
<td>70 – 79</td>
</tr>
<tr>
<td>Severe</td>
<td>&lt; 85</td>
<td>&lt; 70</td>
</tr>
</tbody>
</table>

(source: [www.who.org](http://www.who.org), 2008)

**1.4.12.3 Mid-Upper Arm Circumstance (MUAC)**

Another useful method for screening malnutrition is to measure the mid-upper arm circumstance (MUAC), (WHO, 2008).

**MUAC classification of malnutrition**

<table>
<thead>
<tr>
<th>MUAC (cm)</th>
<th>Nutritional status</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 13.5</td>
<td>Normal</td>
</tr>
<tr>
<td>12.5 – 13.5</td>
<td>Moderate</td>
</tr>
<tr>
<td>&lt; 12.5</td>
<td>Severe</td>
</tr>
</tbody>
</table>

(source: [www.who.org](http://www.who.org), 2008)

**1.4.12.4 World Health Organization (WHO) classification**

Although these classifications have been used for several years, they have two important disadvantages that often are overlooked. To illustrate the first disadvantage, it is important to highlight the concept of Z-scores as a means of describing an individual child's anthropometric indicators in a normal distribution. The normal distribution of a reference population has been published by the World Health Organization (WHO) and is most often accepted worldwide as the standard for comparison. Eighty percent of the median weight-for-age might be above or below -2 Z-scores, depending on the child's age. The second disadvantage is that, to approximate a fixed point in the normal distribution, say, -2 Z-score, different percents of median have to be used depending on the anthropometric index used—
for example, 90 percent for low height-for-age, or 80 percent of low weight-for-height. In consequence, the World Health Organization Expert Committee on Physical Status has recommended the use of Z-scores to express weight-for-age, weight-for-height, or height-for-age relative to values reported in a reference population (Chávez, et al., 1995).

1.4.13 **Nutritional marasmus:**

It results from prolonged starvation. It may also result from chronic or recurring infections with marginal food intake. The main sign is a severe wasting and the child appears very thin and has no fat. The affected child (or adult) is very thin ("skin and bones"), most of the fat and muscle mass having been expended to provide energy. There is severe wasting of the shoulders, arms, buttocks and thighs, with no visible rib outlines.

Associated signs of the condition:

- A thin “old man “face.
- “ Baggy pants “ (the loose skin of the buttocks hanging down).
- Affected children may appear to be alert in spite of their condition.
- There is no oedema (swelling that pits on pressure) of the lower extremities.

Protein Energy Malnutrition

- Ribs are very prominent (WHO,2000)

1.4.13.1 **Causes and Etiology**

Several factors can lead to marasmus. Their relative importance varies between children and between parts of the world. For example, undernutrition associated with war, inappropriate weaning by a young mother, and precipitating infections can influence incidence of marasmus.

1- Nutrition: In many low-income countries, food variety is limited and results in mineral and vitamin insufficiencies. In cases of anorexia, which are generally associated with infection, the total energy intake becomes insufficient. Therefore, any nutrient deficiency can lead to marasmus because appropriate growth can only be ensured by a balanced diet. Therefore, marasmus can be described as multiple-deficiency malnutrition.
2- Infections: Associated infections often trigger, aggravate, or combine with marasmus. However, evidence exists that this association may have been overestimated. For example, in rural Senegal, the growth of children with or without infections, such as pertussis and measles, was similar. In contrast, the importance of diarrhea in triggering malnutrition through anorexia and weight loss has been well established. Infectious diseases more frequently associated with energy-protein malnutrition are gastroenteritis, respiratory infections, measles, and pertussis. HIV also plays an increasingly significant role in some countries.

3- Socioeconomic factors: Frequently, malnutrition appears during weaning, especially if weaning is suboptimal, as can occur with a low-variety diet, or if weaning foods are introduced only in children older than 8-10 months. The WHO recommends exclusive breastfeeding until age 6 months; then, the introduction of a variety of additional foods is recommended. The socioeconomic environment is often critical in the choice of the weaning food used. For example, in northern Senegal, available foods are often limited to grains, vegetables, and a small amount of fish. Milk and meat are rare. In this region, malnutrition and diarrhea are frequent. In contrast, in the nearby Sahelien pastures where milk and meat are the main foods, diarrhea is less frequent, and malnutrition is rare.

4- Other socioeconomic factors: Other factors, such as the famines associated with climatic disasters or more often with political events and war (as has been the case in east Africa), can play a critical role. The sociofamilial environment can also be important, and children of young or inexperienced mothers, twins, or female infants can be at a higher risk in some parts of the world (Beaufrere, etal, 1998).

1.4.13.2 Sign

Several clinical signs must be assessed in order to detect complications, with special attention to infectious complications (see checklist below). The physical examination must be very thorough because even small abnormalities can be clinically significant. Clinical signs of serious complication can be very subtle in children with marasmus. A body temperature of 37.5°C can correspond to a fever
of 39-40°C in a child without marasmus, and a small cough can be the only sign of a serious pneumonia. After history and physical examination, diagnosing the type and severity of the malnutrition, as well as diagnosing associated infections and complications affecting organs or systems, such as the gastrointestinal, neurological, or cardiovascular system, are critical. This set of diagnoses results in optimal planning of the complementary evaluation and therapeutic strategy (Yadav, 1985).

1.4.13.3 Symptoms

The body breaks down its own tissue to use for energy, children with this condition lose all their body fat and muscle strength, and acquire a skeletal appearance most noticeable in the hands and in the temporal muscle in front of and above each ear. Children with marasmus are small for their age. Since their immune systems are weakened, they suffer from frequent infections. Other symptoms include loss of appetite, diarrhea, skin that is dry and baggy, sparse hair that is dull brown or reddish yellow, mental retardation, behavioral retardation, low body temperature (hypothermia), and slow pulse and breathing rates (Kessler, et al., 1999).

The absence of edema (fluid retention) distinguishes marasmus-like secondary PEM, a gradual wasting process that begins with weight loss and progresses to mild, moderate, or severe malnutrition (cachexia). It is usually associated with cancer, chronic obstructive pulmonary disease (COPD), or another chronic disease that progresses very slowly (Kessler, et al., 1999).

Difficulty chewing, swallowing, and digesting food, pain, nausea, and lack of appetite are among the most common reasons that many hospital patients do not consume enough nutrients. Nutrient loss can be accelerated by bleeding, diarrhea, abnormally high blood sugar levels (glycosuria), kidney disease, malabsorption disorders, and other factors. Fever, infection, surgery, and benign or malignant tumors increase the amount of nutrients that hospitalized patients need. Trauma burns, and some medications also increase caloric requirements (Kessler, et al., 1999).
1.4.14 Kwashiorkor

Is a type of malnutrition with controversial causes, but it is commonly believed to be caused by insufficient protein consumption. It usually affects children aged 1–4 years, although it also occurs in older children and adults. When a child is nursing, it receives certain amino acids vital to growth from its mother's milk. When the child is weaned, if the diet that replaces the milk is high in starches and carbohydrates, and deficient in protein (as is common in parts of the world where the bulk of the diet consists of starchy vegetables, or where famine has struck), the child may develop kwashiorkor (Jamaica, et al., 1946).

The name is derived from one of the languages of coastal Ghana, translated literally "first-second", and means "rejected one", reflecting the development of the condition in the older child who has been weaned from the breast, often as the result of the birth of a sibling (Jamaica, et al., 1946).

1.4.14.1 Causes and Etiology

1- Dietary inadequacy:
when there is a rapid transition from the balanced diet supplied by the breast milk to an unbalanced inadequate diet, very low in proteins and consisting mainly of carbohydrates. This occurs usually during weaning and post weaning periods. The poverty, ignorance and lack of basic education and nutritional knowledge are important factors in this mistake (Nassar, 2000).

2- Precipitating factors:

a) Acute infections like acute infantile diarrhea and measles can precipitate the appearance of kwashiorkor cases due to:
- Catabolic effect of the infection.
- Anorexia which usually accompanies infections.
- The bad habit of withholding food during measles and diarrhea up to the degree of starvation.

b) Malaria and severe helminthes infections may play a role in the development of kwashiorkor in some regions of the world (Nassar, 2000).
The aetiology of kwashiorkor is more complex than simple protein deficiency, and provision of high-protein diets has been shown to worsen the metabolic derangement associated with kwashiorkor (Marcelo, 2006).

1.4.14.2 Symptoms

Symptoms of kwashiorkor include a swollen abdomen known as a pot belly, as well as alternating bands of pale and dark hair (flag sign) and weight loss. Common skin symptoms include dermatitis and depigmented skin.

The swollen abdomen is generally attributed to two causes: First, the appearance of ascites due to increased capillary permeability from the increased production of cysteinyl leukotrienes (LTC4 and LTE4) as a result of generalized intracellular deficiency of glutathione. Tolga is thought to be attributed to the effect of malnutrition on reducing plasma proteins (discussed below), resulting in a reduced oncotic pressure and therefore increased osmotic flux through the capillary wall. A second cause may be due to a grossly enlarged liver due to fatty liver. This fatty change occurs because of the lack of apolipoproteins which transport lipids (cholesterol) from the liver to tissues throughout the body.

Victims of kwashiorkor fail to produce antibodies following vaccination against diseases, including diphtheria and typhoid (Roger, 2004). Generally, the disease can be treated by adding food energy and protein to the diet; however, it can have a long-term impact on a child's physical and mental development, and in severe cases may lead to death. It also has been known to cause loss of teeth. The main sign is oedema, usually starting in the legs and feet and spreading, in more advanced cases, to the hands and face. Oedema may be detected by the production of a definite pit as a result of moderate pressure for 3 seconds with the thumb over the lower end of the tibia and the dorsum of foot. Because of oedema, children with kwashiorkor may look “fat” so that their parents regard them as well fed (WHO, 2000).

1.4.14.3 signs

- Hair changes loss of pigmentation; curly hair becomes straight easy pluckable.
• Skin lesions and hypo-pigmentation: dark skin may become lighter in some places especially in the skin folds; outer layers of skin may peel off and ulceration may occur; the lesions may reassemble burns.
• Children with Kwashiorkor are usually apathetic, miserable, and irritable. They show no signs of hunger, and it is difficult to persuade them to eat.
The associated signs of Kwashiorkor do not always occur. In some cases, Oedema may be the only visible sign, while in others all the signs may be present (WHO, 2000).

1.4.15 Underweight

The term underweight refers to a human who is considered to be under a healthy weight. The definition is usually made with reference to the body mass index (BMI). A BMI of under 18.5 is usually referred to as underweight (National Institutes of Health, 2009).

1.4.15.1 Causes

The most common cause of a person being underweight is primarily malnutrition caused by the unavailability of adequate food, which can run as high as 50% in parts of sub-Saharan Africa and south Asia. The effects of primary malnutrition may be amplified by disease; even easily treatable diseases such as diarrhea may lead to death (National Institutes of Health, 2009).

In the presence of adequate food resources, being underweight can sometimes be the result of mental or physical disease. There are hundreds of possible causes for excessive weight loss or a person being underweight (Robert, et al, 2002)

1.4.15.2 Some of the more prevalent include:

• Poverty

• Anorexia nervosa
- Bulimia nervosa
- Cancer or Cancer Treatment
- Tuberculosis
- Hyperthyroidism
- Type 1 Diabetes
- Anxiety and depressive disorders
- Drug use, especially stimulants
- Inflammatory bowel disease
- Superior Mesenteric Artery Syndrome
- Malfunctioning digestive organs
- Dental pain
- Over-training (endurance sports)
- HIV/AIDS
- Genetics / Naturally light weight
- Puberty (height increases, body cannot catch up with muscle/fat growth)

1.4.15.3 Symptoms Of Underweight

- Fatigue
- Poor physical stamina
- Low resistance to infection
- Low body weight
- Loss of menstruation
1.4.15. Weight gain

If an individual is severely underweight to the point where problems with his or her health develop, it may be necessary for the person to make a concentrated effort to gain weight. The treatment for an underweight individual is to increase the food energy intake so that more food energy is consumed than is being used as work. It is usually suggested that weight training is also to be undertaken to increase muscle mass. If weight loss results from a disease, resolving the illness and consuming adequate calories can bring many underweight individuals to a healthy body weight (Wilson, 1994).

1.4.16 Malnutrition & Infection

Unrecognized infections are a frequent cause of failure to respond. Those most often overlooked include pneumonia, urinary tract infection, otitis media and tuberculosis. Others include malaria, dengue, viral hepatitis B and HIV infection (WHO, 1995).

1.4.16.1 Persistent diarrhea

This is diarrhoea that occurs every day for at least 14 days. Weight loss is common. If the stool contains visible blood, treat the child with an oral antimicrobial that is effective against most local strains of Shigella. Every child with persistent diarrhoea should be examined for non-intestinal infections, such as pneumonia, sepsis, urinary tract infection and otitis media. Antidiarrhoeal drugs should never be used. Such drugs are not effective. Breast-feeding should be continued as often and for as long as the child wants. Milk intolerance is rare when the recommended, replace the animal milk with yoghurt or a commercial lactose-free formula. Persistent diarrhoea usually resolves when the child begins to gain weight (WHO, 1995).
1.4.16.2 Dysentery

This is diarrhoea with visible blood in the stool. Shigella is the most frequent cause, especially of cases that are severe. Treatment is with an oral antibiotic to which most local strains of Shigella are sensitive. Health facilities in areas where there is a high incidence of bloody diarrhoea should ensure that several antimicrobials known to be effective against most local strains of Shigella spp. are kept in stock. Treatment for amoebiasis should be given when motile trophozoites of *Entamoeba histolytica* containing ingested erythrocytes are found in a fresh stool sample or when bloody diarrhoea continues after successive treatment with two antibiotics that are usually effective for Shigella (WHO, 1994).

1.4.16.3 Pneumonia

Pneumonia is manifested by fast breathing and, sometimes, chest indrawing. Cough, crackly breath sounds and abnormalities on chest X-ray are frequently absent. The cutoff for fast breathing is 50 times per minute or more if the child is aged 2–12 months, or 40 times per minute or more if the child is aged 12 months to 5 years (WHO, 1990).

1.4.16.4 Tuberculosis

Tuberculosis is an important cause of failure to respond. The diagnosis is made by chest X-ray and examination or culture of sputum or tracheal secretions. Occasionally, typical tuberculous lesions can be seen in the fundus of the eye. The Mantoux test is often negative owing to anergy, but may become positive as the child’s nutritional status improves. Antituberculosis drugs should be given only when tuberculosis is diagnosed (WHO, 1997).
1.4.16.5 Helminthiasis

Ascariasis, hookworm infection and trichuriasis. Infection with *Ascaris lumbricoides* (roundworm), *Ancylostoma duodenale* or *Necator americanus* (hookworm), and *Trichuris trichiura* (whipworm) is common in children who play outside. Whipworm infections can cause dysentery, anaemia and, occasionally, prolapse of the rectum. Hookworm infections can cause severe anaemia. Treatment of these infections should be delayed until the rehabilitation phase of treatment for severe malnutrition (WHO, 1999).

1.4.16.6 Malaria

Malaria is diagnosed by microscopic examination of a blood smear for malarial parasites. Malaria often appears during the rehabilitation phase of treatment for malnutrition. Malnourished children with malaria should receive a full course of antimalarial therapy with the dosage based on body weight (WHO, 1999).

1.4.16.7 Measles and other viral infections

All malnourished children should receive measles vaccine when admitted to hospital. This protects other children in hospital from catching the disease, which is associated with a high rate of mortality. A second dose of vaccine should be given before discharge. There is no specific treatment for measles, disseminated herpes or other systemic viral infections. However, most children with these infections develop secondary systemic bacterial infections and septic shock (WHO, 1999).

1.4.17 Prevention and control of malnutrition

General principles for prevention and control of malnutrition:

There is no simple solution to the problems of malnutrition, it should be based on integrate and comprehensive approach as illustrated in the following
recommendation of the 8th FAO/WHO experts committee on nutrition (WHO, 1996).

(1) **Health promotion**

(i) Measures directed to pregnant and lactating women.

(ii) promotion of breast-feeding.

(iii) development of low cost weaning foods and the child should be encouraged to eat more food at frequent intervals.

(iv) measures to improve family diet.

(v) nutrition education, promotion of correct feeding practices.

(vi) Home economics and family environment.

(2) **Specific protection**

(i) the child's diet must contain protein and energy rich food.

(ii) Immunization.

(iii) food-fortification.

(3) **Early diagnosis and treatment**

(i) Periodic surveillance.

(ii) Early diagnosis of any retarded growth.

(iii) Early diagnosis and treatment of infections and diarrhea.

(iv) Development of supplementary feeding programs during epidemics.

(v) development of programs for early re-dehydration of children with diarrhea.

(vi) Reforming of heavily infested children.

(4) **Rehabilitation.**
(i) Nutrition rehabilitation services.

(ii) Follow up care.

(iii) Hospital treatment.

Therefore, ending malnutrition is not only a question of time and economics development, but also is a question of policy and commitment from the community and governments (WHO, 1990)
Chapter two

Material & Method
Material and Methods

Type of the study:-

A cross sectional descriptive, hospital based study was conducted to find out the factors that contributing to malnutrition among children less than 5 years old admitted at Sinnar Pediatric Teaching Hospital during the period from 15 March to 15 May 2009.

Study area:-

Sinnar Teaching Hospital for Paediatric which was established in 2009 to enhance the primary health care for children.

The hospital units consisted of (4) wards with (250) beds, the hospital divided into surgical department, Medical department, obstetric, x-ray units, pharmacy and administration unit.

The staff in the hospital are (3) consultant of pediatrics, (4) Medical Doctors, (12) nurses, (2) nursing technicians, (4) statistician, (5) medical assistants, (1) psychologists and (1) social worker.

Also (6) lab technicians, (2) pharmacist assistant, (3) supervisors and (3) vaccinators, (3) nutritionists, (2) health educators and (12) cleaning labors.

There are nutritional services were devoted for meals prepared regularly only for the cases of malnutrition (marasmus and kwashiorkor) and health education for raising a awareness to mothers who have children with malnourished.

Study population:

Children less than five years admitted to Sinnar Pediatric Teaching Hospital.

Sample Size:

Total coverage, number of all under five years malnourished children admitted in Sinnar Pediatric Teaching Hospital in the period of the study were (269) children.

Data collection:-

(1) Structured Questionnaire. (demographic, socioeconomic and environmental factors).

(2) Standardized weight scale.

(3) Hospital records.
(4) observation.

Data analysis:-

Collected data was analyses by using computer program (SPSS) statistical package social science and finally represent in the tables and $x^2$ tests was used to determined relations between different variables.

Ethical consideration:-

General medical administrator of Sinnar Pediatric Teaching Hospital was excused for a permission to review registrations of tested sample patients.

Mothers of tested patients were politely and honestly excused to help in data collection by filling a predesigned questionnaire an anthropometric measures.
Chapter three

Results
Results

Data was obtained from 269 children under five years in Sinnar paediatric teaching hospital in the period from 15 March to 15 May 2009.

The prevalence of protein energy malnutrition was (14.5%) .

The Distribution of PEM among the children under 5 years in Sinnar paediatric teaching hospital was (6.3%) under weight, (3.0%) Kwashiorkor, (4.5%) marasmus and (0.7%) Marasmic kwash as shown in table (1).

Residence of children in relation to protein energy malnutrition is: (29.4 %) inside the town while (65 .8 %) in the villages and( 4.8 %) their residence was in the periphery as shown in table ( 2 ) the results illustrated high significant association (P- value < 0.05).

Table (3) shows age of mothers children with protein energy malnutrition in Sinnar paediatric teaching hospital ( 33.5 %) were between (15- 20) years,( 49.8 %) were between (21-26) years ,( 13.4 %) were between (27-34) years and ( 3.3%) more than (35) years of age.

The education level of mothers children with protein energy malnutrition were presented in table (4): (46.5 %) of mothers were illiterate,( 5.2 ) of mothers were at khalwa , (20.1 %) had primary school ,( 27.9 %) had secondary school and (.3%) had university the results high significant association (P- value < 0.05).

Family size of the heads of households are (26.4%) in range of (1-3) person, (4-6) were (54.3%) and more than 6 persons represented (19.3%) as shown in table (5) the results significant association (P- value < 0.05).

Number of meals per day ,(2) meals per day represent (43.1% ) ,(3-4) meal per day (39.4) ,(5-6) meal per day (12.3%)and more than six meal (5.2%) as showed in table(6).

Table (7) present that was high significant result between diarrhea diseases with protein energy malnutrition (P- value < 0.05).
Table (8) shows that there was an association between malaria and malnutrition among the study group (P-value < 0.05).

Table (9) shows that there was an association between respiratory infections and malnutrition among the study group (P-value < 0.05).

Table (10) represents gender among the study groups (41.6%) male and (58.4%) females who have protein energy malnutrition so the results there is no association (P-value > 0.05).

Table (11) shows the distribution of malnutrition among different age groups, higher among age group (12-23) month (19.7%), the age group less (36-48) month (12.6%), then the age groups (6-11) month (39.8%), age group (24-35) month (23.1%), and age group (49-60) month (4.8%) so the results high significant association (P-value < 0.05).

Table (12) shows occupation of mothers whose affected children with protein energy malnutrition, mothers house wife (28.6%), workers mother (23.4%), employee (25.3%) and private work (22.7%) the results significant association (P-value < 0.05).

Table (13) represents the most affected children their family income per month between (100-150) SGDS (34.5%), then family income (151-250) SGDS (46.5%) followed by those their family income (251-300) SGDS (13.8%) and more than (300) SGDS (5.2%) the results high significant association (P-value < 0.05).

Table (14) shows that the interval between children spacing from the elder brother (1-11 months) affected by malnutrition (58.7%), those have spacing (12-17 months) comes next (16%), then those have spacing (18-24 months) (13.8%) and (25) and above (11.5%) the results high significant association (P-value < 0.05).

Table (15) shows the immunization status among study groups. were immunized (98.5%) and no immunized (1.5%) statistically significant (P-value < 0.05).
Table (16) represents types of feeding among the study group have had breast feeding (46.8%), those who were taken feeding and food (41.6%), and taken food comes (11.6%) the result no association (P-value > 0.05).

Table (18) shows the way of weaning among study group suddenly weaning (59.1%) gradually weaning (28.6%) and not applicable (12.3%) statistically significant (P-value < 0.05).
Table(1): Types of protein energy malnutrition among children under 5 years in Sinnar paediatric Teaching Hospital 2009.

\[N=269\]

<table>
<thead>
<tr>
<th>Types</th>
<th>No</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>underweight</td>
<td>17</td>
<td>6.3</td>
</tr>
<tr>
<td>Kwashiorkor</td>
<td>8</td>
<td>3.0</td>
</tr>
<tr>
<td>Marasmus</td>
<td>12</td>
<td>4.5</td>
</tr>
<tr>
<td>Marasmic kwash</td>
<td>2</td>
<td>0.7</td>
</tr>
<tr>
<td>Healthy</td>
<td>230</td>
<td>85.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>269</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>


**Table(2):** Residence of children in relation to malnutrition in Sinnar Paediatric Teaching Hospital 2009.

N=269

<table>
<thead>
<tr>
<th>Malnutrition Area</th>
<th>Malnutrition No</th>
<th>Malnutrition %</th>
<th>No Malnutrition No</th>
<th>No Malnutrition %</th>
<th>Total No</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside Sinnar</td>
<td>4</td>
<td>5.1</td>
<td>75</td>
<td>94.9</td>
<td>79</td>
<td>29.4</td>
</tr>
<tr>
<td>Villages</td>
<td>31</td>
<td>17.5</td>
<td>146</td>
<td>82.5</td>
<td>177</td>
<td>65.8</td>
</tr>
<tr>
<td>Periphery</td>
<td>4</td>
<td>30.8</td>
<td>9</td>
<td>69.2</td>
<td>13</td>
<td>4.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>39</strong></td>
<td><strong>14.5</strong></td>
<td><strong>230</strong></td>
<td><strong>85.5</strong></td>
<td><strong>269</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

\[ X^2 = 9.75 \quad \text{P.value} = 0.0076 \quad \text{significant} \]
Table (3): Age distribution of mothers children with malnutrition in Sinnar Paediatric Teaching Hospital 2009.

N=269

<table>
<thead>
<tr>
<th>Age/ Years</th>
<th>Malnutrition</th>
<th>No Malnutrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>15-20 Years</td>
<td>14</td>
<td>76</td>
<td>90</td>
</tr>
<tr>
<td>21-26 Years</td>
<td>11</td>
<td>123</td>
<td>134</td>
</tr>
<tr>
<td>27-34 Years</td>
<td>9</td>
<td>27</td>
<td>36</td>
</tr>
<tr>
<td>More than 35 Years</td>
<td>5</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>230</td>
<td>269</td>
</tr>
</tbody>
</table>

\[x^2 = 19.80\]  

P.value = 0.00018  

significant
**Table (4):** Educational level among mothers of children with malnutrition in Sinnar Pediatric Teaching Hospital 2009.

N = 269

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Children with malnutrition</th>
<th>Healthy children</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>Illiterate</td>
<td>18</td>
<td>14.4</td>
<td>107</td>
</tr>
<tr>
<td>Khalwa</td>
<td>6</td>
<td>42.9</td>
<td>8</td>
</tr>
<tr>
<td>primary</td>
<td>12</td>
<td>22.2</td>
<td>42</td>
</tr>
<tr>
<td>Secondary</td>
<td>3</td>
<td>4</td>
<td>72</td>
</tr>
<tr>
<td>University</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>High University</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>14.5</td>
<td>230</td>
</tr>
</tbody>
</table>

\[ x^2 = 18.52 \quad \text{P.value} = 0.00097 \text{ significant} \]
Table (5): Family size among children with malnutrition in Sinnar Paediatric Teaching Hospital 2009.

N = 269

<table>
<thead>
<tr>
<th>Family size</th>
<th>Frequency of malnutrition children</th>
<th>No Malnutrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>1-3</td>
<td>8</td>
<td>11.3</td>
<td>63</td>
</tr>
<tr>
<td>4-6</td>
<td>15</td>
<td>10.3</td>
<td>131</td>
</tr>
<tr>
<td>More than</td>
<td>16</td>
<td>30.8</td>
<td>36</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>14.5</td>
<td>230</td>
</tr>
</tbody>
</table>

\[ x^2 = 13.805 \quad \text{P.value} = 0.001 \quad \text{significant} \]
Table (6): Number of meals per day among children with malnutrition in Sinnar Paediatric Teaching Hospital 2009.

N = 269

<table>
<thead>
<tr>
<th>No. of meals per day</th>
<th>Children with malnutrition</th>
<th>Healthy children</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>2 meal</td>
<td>18</td>
<td>15.5</td>
<td>98</td>
</tr>
<tr>
<td>3-4 meal</td>
<td>13</td>
<td>12.3</td>
<td>93</td>
</tr>
<tr>
<td>5-6 meal</td>
<td>6</td>
<td>18.2</td>
<td>27</td>
</tr>
<tr>
<td>More than 6 meal</td>
<td>2</td>
<td>14.3</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>14.5</td>
<td>230</td>
</tr>
</tbody>
</table>

$x^2 = 0.89$  
P.value = 0.8288  
insignificant
**Table (7):** Diarrhoea diseases among children with malnutrition in Sinnar Paediatric Teaching Hospital 2009.

\[ N = 269 \]

<table>
<thead>
<tr>
<th>Malnutrition</th>
<th>Malnutrition</th>
<th>No Malnutrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
<td>19</td>
<td>90.5</td>
<td>2</td>
</tr>
<tr>
<td>No</td>
<td>20</td>
<td>8.1</td>
<td>228</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>39</td>
<td>14.5</td>
<td>230</td>
</tr>
</tbody>
</table>

\[ x^2 = 1.061 \quad \text{P.value} = 0.000 \quad \text{significant} \]
Table (8): Malaria among children in relation to malnutrition in Sinnar Paediatric Teaching Hospital 2009.

N = 269

<table>
<thead>
<tr>
<th>Malnutrition</th>
<th>Malnutrition</th>
<th>No Malnutrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>Yes</td>
<td>6</td>
<td>66.7</td>
<td>3</td>
</tr>
<tr>
<td>No</td>
<td>33</td>
<td>12.7</td>
<td>227</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>14.5</td>
<td>230</td>
</tr>
</tbody>
</table>

\[\chi^2 = 20.443\]  \hspace{1cm}  \text{P.value} = 0.000  \hspace{1cm} \text{significant}
Table (9): Respiratory infections among children in relation to malnutrition in Sinnar Paediatric Teaching Hospital 2009.

N = 269

<table>
<thead>
<tr>
<th>Malnutrition</th>
<th>Respiratory Infections</th>
<th>Malnutrition</th>
<th>No Malnutrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
<td>%</td>
</tr>
<tr>
<td>Yes</td>
<td>4</td>
<td>66.7</td>
<td>2</td>
<td>33.3</td>
</tr>
<tr>
<td>No</td>
<td>35</td>
<td>13.3</td>
<td>228</td>
<td>86.7</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>14.5</td>
<td>230</td>
<td>85.5</td>
</tr>
</tbody>
</table>

$\chi^2 = 13.473$  
P.value $= 0.000$

signific
Table (10): Gender distribution among children in relation to malnutrition in Sinnar Pediatric Teaching Hospital 2009.

N = 269

<table>
<thead>
<tr>
<th>Malnutrition</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>20</td>
<td>19</td>
<td>39</td>
</tr>
<tr>
<td>%</td>
<td>17.9</td>
<td>12.1</td>
<td>14.5</td>
</tr>
<tr>
<td>No Malnutrition</td>
<td>92</td>
<td>138</td>
<td>230</td>
</tr>
<tr>
<td>%</td>
<td>82.1</td>
<td>87.9</td>
<td>85.5</td>
</tr>
<tr>
<td>Total</td>
<td>112</td>
<td>157</td>
<td>269</td>
</tr>
<tr>
<td>%</td>
<td>41.6</td>
<td>58.4</td>
<td>100</td>
</tr>
</tbody>
</table>

$\chi^2 = 1.7$  

P.value = 0.1  

insignificant
Table (11): Age group distribution among children in relation to malnutrition in Sinnar Pediatric Teaching Hospital 2009.

N = 269

<table>
<thead>
<tr>
<th>Malnutrition</th>
<th>Age</th>
<th>Malnutrition</th>
<th>No Malnutrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
<td>%</td>
</tr>
<tr>
<td>less than 11 month</td>
<td>12</td>
<td>11.2</td>
<td>95</td>
<td>88.8</td>
</tr>
<tr>
<td>11-23 month</td>
<td>17</td>
<td>32.1</td>
<td>36</td>
<td>67.9</td>
</tr>
<tr>
<td>23-35 month</td>
<td>8</td>
<td>12.9</td>
<td>54</td>
<td>87.1</td>
</tr>
<tr>
<td>35-48 month</td>
<td>1</td>
<td>2.9</td>
<td>33</td>
<td>97.1</td>
</tr>
<tr>
<td>48-60 month</td>
<td>1</td>
<td>7.7</td>
<td>12</td>
<td>92.3</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>14.5</td>
<td>230</td>
<td>85.5</td>
</tr>
</tbody>
</table>

\[ x^2 = 18.42 \]  \quad \text{P.value} = 0.0010 \quad \text{significant}
Table (12): Occupation of mother's children in relation to malnutrition in Sinnar Pediatric Teaching Hospital 2009.

N = 269

<table>
<thead>
<tr>
<th>Occupation Level</th>
<th>Malnutrition</th>
<th>No Malnutrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>Worker</td>
<td>14</td>
<td>22.22</td>
<td>49</td>
</tr>
<tr>
<td>Employee</td>
<td>9</td>
<td>13.24</td>
<td>59</td>
</tr>
<tr>
<td>Housewife</td>
<td>13</td>
<td>16.88</td>
<td>64</td>
</tr>
<tr>
<td>Private work</td>
<td>3</td>
<td>4.92</td>
<td>58</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>14.50</td>
<td>230</td>
</tr>
</tbody>
</table>

\[x^2 = 7.99\] \hspace{2cm} P.value = 0.046

significant
Table (13): family income per month among children in relation to malnutrition in Sinnar Pediatric Teaching Hospital 2009.

N = 269

<table>
<thead>
<tr>
<th>Malnutrition</th>
<th>Malnutrition</th>
<th>No Malnutrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>100-150 SGDS</td>
<td>15</td>
<td>16.1</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>7.2</td>
<td>116</td>
</tr>
<tr>
<td>151-250 SGDS</td>
<td>10</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>35.7</td>
<td>9</td>
</tr>
<tr>
<td>&gt; 300 SGDS</td>
<td>5</td>
<td>35.7</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>14.5</td>
<td>230</td>
</tr>
</tbody>
</table>

\[ x^2 = 15.34 \]  \[ P \text{ value} = 0.0076 \text{ significant} \]
**Table (14):** The interval between child and elder brother among children in relation to malnutrition in Sinnar Paediatric Teaching Hospital 2009.

\[ N = 269 \]

<table>
<thead>
<tr>
<th>Malnutrition</th>
<th>Malnutrition</th>
<th>No Malnutrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interval between child</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Less than one year</td>
<td>13</td>
<td>8.2</td>
<td>145</td>
</tr>
<tr>
<td>12-17 month</td>
<td>8</td>
<td>18.6</td>
<td>35</td>
</tr>
<tr>
<td>18-24 month</td>
<td>7</td>
<td>18.9</td>
<td>30</td>
</tr>
<tr>
<td>25 and above</td>
<td>11</td>
<td>35.5</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>39</strong></td>
<td><strong>14.5</strong></td>
<td><strong>230</strong></td>
</tr>
</tbody>
</table>

\[ x^2 = 17.19 \]

\[ P.\text{value} = 0.00064 \]

significant

N = 269

<table>
<thead>
<tr>
<th>Malnutrition</th>
<th>Malnutrition</th>
<th>No Malnutrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>Immunize child</td>
<td>37</td>
<td>14</td>
<td>228</td>
</tr>
<tr>
<td>Not immunize</td>
<td>2</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>14.5</td>
<td>230</td>
</tr>
</tbody>
</table>

\[ x^2 = 4.11 \]

P.value = 0.042

significant
**Table (16):** Types of feeding among children in relation to malnutrition in Sinnar Paediatric Teaching Hospital 2009.

N = 269

<table>
<thead>
<tr>
<th>Feeding type</th>
<th>Malnutrition</th>
<th>No Malnutrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>Breastfeeding</td>
<td>17</td>
<td>13.5</td>
<td>109</td>
</tr>
<tr>
<td>Food</td>
<td>14</td>
<td>12.5</td>
<td>98</td>
</tr>
<tr>
<td>Both</td>
<td>8</td>
<td>25.8</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>14.5</td>
<td>230</td>
</tr>
</tbody>
</table>

\[ x^2 = 3.66 \]

P.value = 0.160

insignificant
**Table (17):** Age of supplementary feeding among children in relation to malnutrition in Sinnar Paediatric Teaching Hospital 2009.  
**N = 269**

<table>
<thead>
<tr>
<th>Malnutrition</th>
<th>Malnutrition</th>
<th>No Malnutrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>supplemental feeding</td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>Less than 4 months</td>
<td>2</td>
<td>66.7</td>
<td>1</td>
</tr>
<tr>
<td>After 4 months</td>
<td>15</td>
<td>28.8</td>
<td>37</td>
</tr>
<tr>
<td>6-8 months</td>
<td>15</td>
<td>10</td>
<td>135</td>
</tr>
<tr>
<td>9 – 12 months</td>
<td>7</td>
<td>10.9</td>
<td>57</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>39</strong></td>
<td><strong>14.5</strong></td>
<td><strong>230</strong></td>
</tr>
</tbody>
</table>

\[ x^2 = 18.325 \quad \text{P.value} = 0.000 \quad \text{significant} \]
Table (18): The way of weaning children in relation to malnutrition in Sinnar Paediatric Teaching Hospital 2009.

N = 269

<table>
<thead>
<tr>
<th>Malnutrition</th>
<th>Malnutrition</th>
<th>No Malnutrition</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>Suddenly</td>
<td>16</td>
<td>10.1</td>
<td>143</td>
</tr>
<tr>
<td>Gradually</td>
<td>14</td>
<td>18.2</td>
<td>63</td>
</tr>
<tr>
<td>Not applicable</td>
<td>9</td>
<td>27.3</td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>14.5</td>
<td>230</td>
</tr>
</tbody>
</table>

\[ x^2 = 7.71 \]

P.value = 0.021

significant
Discussion

From the data analysis of this study done in Sinnar paediatric teaching hospital with the purpose to study the factors contributing to the malnutrition among children under 5 years old admitted during the period of the study from 15 March to 15 May 2009 with a total of (269 child), it was found that:

The percentage of the protein energy malnutrition is 14.5% It was lower if compared to study done by UNICEF and federal ministry of health (December, 2007) in Sudan was above 15 per cent in four states namely Upper Nile (16.6 per cent), Jonglei (16.9 per cent), Northern Bahr El Ghazal (18.7 per cent) and Unity (22.1 per cent). The percentage of severely underweight children ranged between 10 and 15 per cent in seven states, and the percentage was higher if compared with Khartoum State (3.7 per cent), (0.7 per cent) in South Darfur State to (12.2 per cent) in Unity State.

There was high significant association between the protein energy malnutrition and education level of mothers. It is well clear from result of study respondent that malnutrition with lower educational level of study population is higher among khalwa (42.9%) this result agree with the statement mentioned by (Fotso, etal,2005) and (Baro, etal,2006).

The study represented that Infectious diseases more frequently associated with protein energy malnutrition are gastroenteritis, respiratory infections, measles, and pertussis, also plays an increasingly significant role in some countries, this result agree with the statement mentioned by (Beaufrere, etal,1998).

The study showed that there was no relation between malnutrition among children less than five years and gender, this result agree with (Unicef, 2000).

There was high significant association between protein energy malnutrition and age group distribution among the study group in Sinnar hospital, children the age between (12-23)month old at risk to malnutrition diseases; this agrees with (WHO,2000).

A study showed the role of socioeconomic factors that contributes to developing disease among a study group, The result represented a significant
correlation between protein energy malnutrition and with monthly per capita income (p value <0.05) the result a greed with (Marjan,etal, 1998).

This study showed that the interval between child and elder brother has significant relation to malnutrition was the finding indicated the influence on the nutritional status of children among a study group agree with the a study conduct in Brazil (2000) about malnutrition, the purpose of the study was to characterizes the malnutrition among malnourished children and pregnant women at nutritional risk this mentioned by (Soares,2001).

Type of feeding among the study group statistically insignificant to malnutrition in Sinnar paediatric hospital it showed that (p value >0.05).This result disagree with the statement motioned (Noah, 2008).
Conclusion

-The result of the study indicated that the proportion of children with protein energy malnutrition was 14.5%.

-There was high significant association between malnourished children with education level of mothers. (p.value=0.001).

-There was no relation between malnourished children and gender. (p.value=0.187).

-There was high significant association between malnourished children and age group distribution among the study group, the age of children between (12-23) month old was (32.1%). (p.value=0.0010).

-The result represent that there was a high significant between diarrhea diseases with malnourished children. (p.value=0.000).

-The result showed a significant correlation between malnourished children with monthly per capita income. (p.value=0.0076).
Recommendation

According to the study findings and discussion possible health measures were recommended as follow:

1- Encourage further researchers on all aspects of nutritional status.

2- To increase awareness of the magnitude of all forms of malnutrition as a critical first step to mobilizing the human and financial resources required to overcome the problem.

3- Improving the economical status of the families by the provision of job opportunities and initiation.

4- Nutritional program should be developed and supported by governmental and nongovernmental organization.
References


5- Unicef, FMOH (2007), Sudan Household Survey, Khartoum.


7- Jean Ziegler(2003), (the United Nations Special Rapporteur on the Right to Food for 2000 to March 2008), UN.


9- Noah, S Scheinfeld, MD, JD, F Anusuya Mokashi, MS, AAD (2008), University of Alberta Contributor Information and Disclosures, Columbia University.


14- Fotso, Jean-Christophe and Barthelemy Kuate-Defo (2005), Measuring Socio-economic Status in Health Research in Developing Countries: Should We Be Focusing on Households, Communities, or Both?" Social Indicators Research, 72:189-237, Washington.


22- Malee -MI; Msengi-AE-; Lyamuya EF; Mwinula-JH; Mbena-Ec; Samaranyloe-LP; Scheutz-F, (1997). Nutritional status of under fives attending maternal and child health clinics in Dar el- Salaam. Department of microbiology, Muhimbili University college of health sciences, 368-71, Dar el Salaam, Tanzania.
23- Soares- NT; parente- WG-;(2001) Malnutrition and results of rehabilitation in the City of Fortaleza Ceara Barazil, Portuguese Revisa-de-Nutrico;14:2,103-110;42rel, Barazil.
31- Jamaica Gleaner,Cicely Williams(1946), The Natural Guide to Good Health, United States.
33- Marcelo Mazza Nascimento(2006), Department of Clinical Science, Karolinska Institutet, Karolinska University Hospital, Stockholm, Sweden.
36- Robert E. Lee Drive, Wilmington(2002), American College of Nutrition, NC 20412-0927. (919) 452-1222, United States.


42- Abdelaziz Elamin(2005), Assessment of Nutritional Status Sultan Qaboos University, Oman.


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Questionnaire for study Factors contributed with protein energy (PEM) malnutrition among children under 5 years in Sinnar Pediatric Teaching Hospital - 2009.

Mother data:-

1- Age?

2- Martial Status?
☐ Married ☐ Widow ☐ Divorced ☐ Other

3- Work Status?
☐ Employee ☐ Worker ☐ Full private work ☐ House wife

4- If she works how much is the salary?
☐ 150 – 200 ☐ 200 – 300 ☐ others

5- Family size: ☐ 1-3 person ☐ 4-6 person ☐ more than 6 person

6- Mother educational level?
☐ Illiterate ☐ Khalwa ☐ Primary ☐ Higher secondary
☐ University

7- The site of house they live in?
☐ Inside of the town ☐ Periphery ☐ Village ☐ Others

8 - Have latrine in your house?
☐ Yes ☐ No

9- How disposal your waste?
☐ out side your house ☐ inside ☐ others

10- The sources of water?
☐ public water net(tap) ☐ wheels ☐ Hand pumps ☐ Others
Father data:

11- Work of father: -
☐ Employee ☐ Worker ☐ Full private work ☐ Other

12- Monthly income:-
☐ 100 – 150 ☐ 150 – 250 ☐ 250 – 300 ☐ Other

13- Educational level?
☐ Illiterate ☐ Khalwa ☐ Primary ☐ Higher secondary
☐ University ☐ Others

14- Patient gender: -
☐ Male ☐ Female

15- Age of patient: -
☐ 6 – 12 months ☐ 12 – 24 months ☐ 24 – 36 months
☐ 36 – 48 months ☐ 48 – 60 months ☐ Others

16- Is the baby immunized?
☐ Yes ☐ No

17- Is the immunization doses are completed?
☐ Yes ☐ No

18- The interval between patient and elder brother?
☐ 1 – 12 months ☐ 12 – 18 months ☐ 18 – 24 months ☐ Other

19- The interval between patient and younger brother?
☐ 1 – 12 months ☐ 12 – 18 months ☐ 18 – 24 months ☐ Other

20- How the patient is fed?
☐ Breast feeding ☐ Food ☐ Both

21- When you start supplementary feeding?
☐ After 4 months ☐ 6 – 8 months ☐ 8 – 12 months

22- How many meals he has?
☐ 2 ☐ 3 ☐ 4 ☐ Others

23- Is the patient weaned?
☐ Yes ☐ No

24- When the patient weaned?
☐ 1 – 6 months after birth    ☐ 6 – 12 month’s    ☐ 12 – 24 months
☐ Others

25- Cause of weaning?
☐ The baby is sick    ☐ Mother sickness    ☐ Mother pregnancy
☐ The baby grown older    ☐ He refuse breast    ☐ Others

26- Kind of weaning that the baby has it?
☐ Suddenly    ☐ Gradually

27- Has your baby acquired any infection before he gets PEM?
☐ Malaria    ☐ Diarrhea diseases    ☐ Respiratory Infections    ☐ Others

28- How many times he gets the infection?
☐ Once    ☐ Twice    ☐ 3 times

29- In clinic is your baby weighed?
☐ Yes    ☐ No

30 - In clinics is your baby length is measured?
☐ Yes    ☐ No

31- Have you received advice from health workers about types of supplementary feeding?
☐ Yes    ☐ No

32- The medical diagnosis from records:
☐ Under weight    ☐ Kwashiker    ☐ Marasmus    ☐ Maramic kwash
☐ Others