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EFFECTS OF MALNUTRITION AMONG CHILDREN IN SUB-SAHARAN AFRICA AND SOUTHERN ASIA

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Effects of malnutrition among children in Sub-Saharan Africa and Southern Asia

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Abstract

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The purpose of this thesis is to verify and describe the effects of malnutrition among children in Sub Saharan Africa and Southern Asia. The research question was; what are the effects of malnutrition among children in Sub-Saharan Africa and Southern Asia?

The aim of this study was to find out and describe why developing countries are associated with malnutrition complications and the impact is having in the health and lives of children. Although rare in developed countries, malnutrition in children remains a menace in many developing countries. Malnutrition occurs most commonly in Southern Asia and Sub-Saharan Africa. The effective management of severe acute malnutrition (SAM) is a huge challenge in low resource healthcare locations.

The method of data collection was systematic literature review which means conducting a literature search, selecting data relevant to the purpose question, description of the data selected and analyzing the data. This review was based on books from Laurea University of Applied Science's library, Helsinki university library and previously conducted studies done through current articles, journals and web search. In addition, electronic search was also conducted through Laurea's electronic database NELL.

From the findings it was reported that malnutrition among children in Sub-Saharan Africa and Southern Asia contribute to health problems such as malaria, enteric infectious diseases involving hundreds of millions of children in the world. Malnutrition among children leads to impairment in child development and academic achievement, and also affects the economy of the state. Lack of parental education about nutrition also plays a very important role in child's nutritional health.

The food industry, policy makers, and health care professionals will have an important role in changing practices and strengthening education and research to prevent malnutrition for current and future generations. More effective prevention and treatment of malnutrition is needed urgently in order to save lives.

Keywords: Malnutrition, children, effects of malnutrition

Table of contents

1	INTRODUCTION	5
2	DEFINITION OF CONCEPT.....	7
2.1	Malnutrition	7
2.1.1	Undernutrition	9
2.1.2	Overnutrition.....	11
2.2	Children.....	11
2.2.1	Physiological Development	12
2.2.2	Cognitive Development.....	13
3	PURPOSE OF STUDY	14
4	SYSTEMATIC LITERATURE REVIEW	15
4.1	Literature Search.....	15
4.2	Data Screening.....	16
4.3	Data Extraction.....	20
4.4	Data Analysis.....	22
5	FINDINGS OF THE STUDY	24
5.1	Educationaleffects	24
5.2	Health effects.....	25
5.3	Economic effects	27
6	DISCUSSION	29
6.1	Trustworthiness.....	33
6.2	Ethical Considerations.....	33
6.3	Limitations	34
6.4	Recommendations.....	34
	References	36
	Figures	40
	Tables	41
	Appendices	42

1 INTRODUCTION

Malnutrition is estimated to contribute to more than one third of all child deaths, although it is rarely listed as the direct cause. Childhood malnutrition is a serious challenge in Sub-Saharan Africa and a major underlying cause of death. It is a result of dynamic and complex interaction between political, social, economic, environmental and other factors. Malnutrition is a major contributor to mortality and is increasingly recognized as a cause of potentially lifelong functional disability. Malnutrition is well recognized as a widespread health problem with consequences that are acute and even, more often long-term problems. Malnutrition remains a problem of public health concern in most developing countries (Kennedy, Pedro, Seghieri, Nantel & Brouwer 2007). Containing less or no animal products, and slight amounts of fresh fruits and vegetables, diets are deficient in micronutrients and of poor quality.

In a global context, approximately 45% of the 6.6 million deaths of children under-five year of age in 2012 are caused by undernutrition (UNICEF, 2012). Geographically, the majority of the undernutrition burden exists in Sub-Saharan Africa and South-Central Asia (Bhutta and Salam 2012). Malnutrition has three commonly used comprehensive types named stunting, wasting and underweight: measured by height for age, weight for height and weight for age indexes respectively. Adequate nutrition continues to play an important role during the school age years in assuring that children reach their full potential for growth, development and health. Nutrition problems can still occur during this age, such as iron-deficiency anemia, under nutrition such as Kwashiorkor, marasmus, overnutrition and dental caries. The prevalence of obesity is increasing but the beginning of eating disorders can also be detected in some school age and preadolescent children.

In addition, adequate nutrition prevents the onset of health-related problems, encouraging a healthy eating pattern can help prevent immediate health concerns as well as promote a healthy lifestyle, which in turn may reduce the risk of the child developing a chronic condition such as obesity, type 2 diabetes and cardiovascular disease later in life (Story, Holts & Sofka 2000). Adequate nutrition, especially eating breakfast has been associated with improved academic performance in school and reduced tardiness and absence (Meyer, Sampson, Weitzman, Rogers & Kayne 1989). Consequently, this meets the energy and nutrient needs of the children, addressing common nutrition problems, and preventing nutrition-related disorders.

The growth and development of school-age and preadolescent children and their relationships to nutritional status is significant right from the beginning. Children continue to grow physically at a steady rate during this period; nevertheless the development from cognitive, emotional and social standpoint is tremendous. This period in a child's life is preparation for the physical and emotional demands of the adolescent growth spurt, with aid of family members, teachers and others in their lives who model healthy eating and physical activity behaviors.

This thesis focuses on the effects of malnutrition and the impact it has on the lives of children in the developing countries, particularly in Sub-Saharan Africa and Southern Asia by reviewing existing scientific-based literatures on the topic of malnutrition. The purpose of this study was to find out and describe why developing countries are associated with malnutrition problems. The study is conducted through a systematic literature review because it synthesizes and analyzes previous literature findings in an impartial way.

2 DEFINITION OF CONCEPT

2.1 Malnutrition

Malnutrition refers to both undernutrition, which predominantly includes acute malnutrition (i.e. wasting), chronic malnutrition (i.e. stunting) and micronutrient malnutrition, as well as overnutrition or overweight(UNICEF2011). Malnutrition is a condition of nutrition in which an absence or excess (or imbalance) of energy, protein and other nutrients causes adverse effects on tissue / body form (body shape, size and composition) and function and clinical outcome (UNICEF 2011).The nutrients involved includes: protein, carbohydrates, calories, vitamins or minerals. Malnutrition is a situation that gradually develops when the body does not get the right amount of vitamins, minerals, and other nutrients needed in maintaining healthy tissues and organ function. Lack of these vital nutrients makes the body susceptible to infections and diseases. Malnutrition increases the risk of infection and infectious disease, and moderate malnutrition weakens every part of the immune system. For instance, it is a major risk factor in the onset of active tuberculosis.

Protein and energy malnutrition and deficiencies of specific micronutrients (including iron, zinc, and vitamins) increase susceptibility to infection. In communities or regions 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 in order to acquire food, earn an income, or gain an education, extra food.

The World Health Organization (WHO) (1995) 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. This dynamic imbalance of nutrients affects children differently than adults and can have profound implications for the developing child.Children with malnutrition lack the nutrients necessary for their bodies to grow and stay healthy. Someone can be malnourished for a long or short period of time, and the condition may be mild or severe. Malnutrition can without doubt affect someone’s physical and mental health. People who are suffering from malnutrition are more likely to get sick; in very severe cases, they may even die from its effects. Kids who are chronically malnourished don’t grow as tall as they should (a condition referred to as stunted growth) and are underweight as well.Malnutrition is classified as either acute (fewer than 3 months in duration) or chronic (duration of 3 months or more). Chronic malnutrition may manifest with growth deficits, especially diminished height velocity (stunting), which is a hallmark of this condition that may be observed earlier than 3 months in the course of malnutrition.A common misconception is that malnutrition, particularly in babies or healthy adults and children, is uncommon in developed countries - the issue that gathers far more attention is obesity relating to overeating. In fact, people in developed countries have a relatively high risk for deficiencies in several nutrients, according to the International Association of Infant Food Manufacturers. These nutrients differ by country; for example, whereas thiamine deficiencies may occur in Southern

Asia, pyridoxine deficiencies are more common in Finland and zinc deficiencies happen more frequently in the U.S. Other nutrients with a higher likelihood for deficiency than others in the U.S. include vitamin K in babies, as breast milk contains little vitamin K and D; vitamin D due to limited sun exposure; and iron, which frequently causes iron deficiency anaemia (Parks 2015).

Insufficient or lack of access to highly nutritious foods, particularly in the present rise of food prices is a common cause of malnutrition. We leave in a world where we have to leave according to our means of livelihood. This then have an effect on the means of our expenditure for food as we have other responsibilities to attend to. This eventually affects the purchasing power of the individual, ultimately resulting in buying quantity rather than quality, leading to poor feeding practices and inadequate nutritious food leading to malnutrition.

Food access is defined as being when individuals have adequate incomes or other resources to obtain appropriate foods needed to maintain consumption of adequate nutrition level. This accessibility to healthy foods is often a significant constraint in Sub-Saharan Africa. As an example, access to a supermarket or large grocery store is a problem for numerous rural households in developing countries, and often smaller spaza shops in the rural areas sell a smaller selection of foods at a higher price which are often unaffordable to the majority of the population. What this implies is that, when a person is not getting enough food or not getting the right sort of food, malnutrition is closer than expected. On the other hand, if people get enough to eat, they will gradually become malnourished if the food they eat does not provide the proper amount of micronutrients including vitamins and minerals to meet daily nutritional requirement.

Malnutrition at an early age leads to reduced physical and mental development during childhood. Stunting, for example, affects more than 147 million preschoolers in developing countries, according to United Nation Standing Committee (SCN's) World Nutrition Situation 5th report (2014). Iodine deficiency, the same report shows, is the world's greatest single cause of mental retardation and brain damage. This as a result, is the onset or beginning of many diseases that could possibly lead to death and shows how closely malnutrition relates to diseases. Disease and malnutrition are closely linked together. Sometimes disease is the result of malnutrition, sometimes it is a contributing cause. In fact, malnutrition is the largest single contributor to disease in the world, according to the UN's Standing Committee on Nutrition (SCN). Malnutrition is a major concern to public health and a continual disease throughout the developing world. This is an underlying factor in over 50 percent of the 10-11 million children under five years of age who die each year of preventable causes. Worldwide, there are about 60 million children with moderate acute and 13 million with severe acute malnutrition. About 9 % of sub-Saharan African and 15% of Southern Asian children have moderate acute malnutrition and about 2% of children in developing countries have serious acute malnutrition. In India alone, 2.8% of children under 5 years of age (over 5 million children) are severely affected and in many poor countries like Malawi, severe acute malnutrition is the commonest reason

for pediatric clinical admission. Acute malnutrition for instance lies in a position between clinical medicine and public health.

In most developing countries, there are other essential causes like poverty, social exclusion, and poor public health and in most cases, this can be prevented by economic development and public health measures designed to increase dietary quality and quantity, with no need for clinical input. It is anticipated that the prevalence of malnutrition will continue to evolve with improved understanding of the diverse processes that lead to and complicate the treatment of this condition. This is a disorder that is very common and takes away millions of lives in the developing world each and every year. Although the underlying causes of malnutrition extend well beyond the lack of access to certain types of food, (i.e. animal-based foods) the quality of the food source needs to be emphasized.

2.1.1 Undernutrition

In developing countries, prevalence of malnutrition in the form of undernutrition is still high with an estimation of about 850 million affected people between the years 2010 and 2012 (FAO2012). Undernutrition is a disorder that develops in a child or an individual as a result of endlessly failing to get enough of the nutrients the body needs to stay healthy and functioning. Most commonly found in underdeveloped countries, Undernutrition can cause permanent damage to the body and result in stunted growth and a compromised immune system, along with problems throughout the rest of the body's systems. It is also one of the conditions that falls or can be categorized under malnutrition.

Alongside with not getting enough food, an individual who is under-nourished does not get enough of the vitamins and nutrients required to keep the body functioning. Undernutrition has been shown to go hand in hand with poverty and consequently occurs in developed and underdeveloped countries to different degrees. The condition begins to develop in infancy, in children feeding mainly on breast milk. Lack of essential vitamins such as D and K, a diet solely consisting of breast milk can severely influence a child's bone strength and skeletal structure.

Undernutrition has visible effects, such as a low weight and an unhealthy appearance. It also has unseen effects on the physiological function of the body including muscles, the heart, and lungs can begin to deteriorate. This can develop into fatigue, difficulty in breathing, and when the body stops being able to produce enough healthy blood cells, it can result in the development of anaemia. An incomplete diet has an influence on the brain as well as the body. An individual suffering from Undernutrition can have troubles with concentration, suffer from a lack of interest in surroundings, and have distress retaining new information as well as remembering old. Iodine is one of the key nutrients in brain function and development, without it, an individual can develop a compromised thyroid, a growth imbalance and difficulties performing tasks at school or work.

The immune system is often highly compromised by undernutrition. The individual may be more susceptible to viral infections and colds, and less likely to be able to fight off a bacterial infection. He or she may be more likely to develop severe diarrhoea, dehydration, or pneumonia, leading to death. In adult women who suffer from Undernutrition, the condition can severely affect the life of an unborn baby. If it does not prove deadly, a baby born to an undernourished mother has a higher chance of birth defects, low birth weight, and suffering resulting from developmental disabilities. Before birth, the child relies on the mother's diet to supply vitamins and nutrients; if good diet is lacking, mother and child can suffer irreversible damage.

Undernutrition is the opposite of overnutrition, meaning that it is a nutrient deficiency from not eating enough nutritious food. Undernutrition usually affects the balance of all the nutrients in your body. Nonetheless, problems relating to a deficiency in carbohydrates and fats will manifest first and most acutely. Initially, the body starts using its glycogen - or sugar - reserves, stored water and body protein. Then, your body consumes stored fatty acids and lean muscle. These two effects of undernutrition result in a dramatic decrease in body weight. Short-term undernutrition is possible if you inexplicably lose at least 10 percent of your body weight over three to six months. Malnutrition occurs in people who are either undernourished or over-nourished. Undernutrition is a consequence of consuming too few essential nutrients or using and excreting them more rapidly than they can be replaced.

Infants, young children, and teenagers need additional nutrients and the something applies to women who are pregnant or breastfeeding. Nutrient loss can be accelerated by diarrhoea, excessive sweating, heavy bleeding (haemorrhage), or kidney failure. Nutrient intake can be restricted by age-related illnesses and conditions, excessive dieting, food allergies, severe injury, serious illness, a lengthy hospitalization, or substance abuse.

The leading cause of death in children in developing countries is protein-energy malnutrition. This type of malnutrition is the result of inadequate intake of calories from proteins, vitamins, and minerals. Children who are already undernourished can suffer from protein-energy malnutrition (PEM) when rapid growth, infection, or disease increases the need for protein and essential minerals. These essential minerals are known as micronutrients or trace elements.

Two types of protein-energy malnutrition have been described—kwashiorkor and marasmus. Kwashiorkor occurs with fair or adequate calorie intake but inadequate protein intake, while marasmus occurs when the diet is inadequate in both calories and protein.

About 1% of children in the United States suffer from chronic malnutrition, in comparison to 50% of children in Southeast Asia. About two-thirds of all the malnourished children in the world are in Southern Asia, with another one-fourth in Sub-Saharan Africa. In modern challenges of healthcare, nutrition plays massive critical role.

2.1.2 Overnutrition

Overnutrition is defined as the overconsumption of nutrients and food to the point at which health is adversely affected. Overnutrition can develop into obesity, which increases the risk of serious health conditions, including cardiovascular disease, hypertension, cancer, and type-2 diabetes. Until recently, overnutrition had been viewed as a problem that only affected developed nations. However, overnutrition is a growing problem worldwide. The WHO describes the current problem: "In the poorest countries, even though infectious diseases and Undernutrition dominate their current disease burden, the major risk factors for chronic diseases are spreading. The prevalence of overweight and obesity is increasing in developing countries, and even in low-income groups in richer countries. Overnutrition is progressively becoming a menace and aggregating even in countries where hunger is prevalent. In 2002, the WHO reported that the levels of overweight and obese women in the Eastern Mediterranean region and North Africa exceed those in the United States, while levels of overweight and obese women in Eastern Europe and Latin America are similar to those in the United States. Overnutrition is frequent or habitual overconsumption of nutrients by eating too much food to the point that it becomes dangerous to your health. Nutrients are all compounds necessary for bodily function, including minerals, vitamins, fats, carbohydrates and proteins. Although most nutrients can be harmful in excess, the danger of overnutrition relates mostly to carbohydrates and fats. Overeating differs conceptually from overnutrition, although they are essentially the same thing in action; whereas overeating is a compulsion considered a psychological disorder, overnutrition is volitionally choosing to eat more food than you need, even if you do not realize it.

In the United States, nutritional deficiencies have generally been replaced by dietary imbalances or excesses associated with many of the leading causes of death and disability. Overnutrition results from eating too much, eating too many of the wrong things, not exercising enough, or taking too many vitamins or other dietary replacements.

Risk of overnutrition is also increased by being more than 20% overweight, consuming a diet high in fat and salt, and taking high doses of: nicotinic acid (niacin) to lower elevated cholesterol levels; vitamin B6 to relieve premenstrual syndrome; vitamin A to clear up skin problems; iron or other trace minerals not prescribed by a doctor.

Nutritional disorders can affect any organ system in the body and the senses of sight, taste, and smell. They may also produce anxiety, changes in mood, and other psychiatric symptoms. Malnutrition begins with changes in nutrient levels in blood and tissues, alterations in enzyme levels, tissue abnormalities, and organ malfunction may be followed by illness and death.

2.2 Children

Traditionally preschool children have been considered as one of the most vulnerable segment when discussing undernutrition. Underweight rates in under-five years have been widely used

as one of the indicators of food insecurity. Even today, over 40 per cent of preschool children in India are underweight (IIPS 2012).

Middle childhood is a term that generally describes children between the ages of 5 and 10 years. This stage of growth and development is also referred to as school-age. Pre adolescence is generally defined as the ages 9 to 11 years for girls and ages 10 to 12 years for boys (Judith and Brown 2005). Pre-adolescence is normally the continuation stage of developmental process after middle childhood. Every stage at this phase of development is essential in terms of feeding and growth. In other words, it can also be termed as a school age year. During this school age years, a child growth is steady but the growth pace is not as great as it was during infancy or as great as it will be during adolescences. The average annual growth during school years is 3 to 3.5 kg in weights and 6cm in height (Behrman, Kliegman and Jenso 2004). This is a very serious stage that needs constant assessment and monitoring to help sustain optimal development of children. Children at this age continue to have spurts of the growth that usually coincides with periods of increased appetites and intake. Children at this stage are more active and energetic and that plays an important role of sudden increase in appetite as well as their rapid growth. On the other hand, during periods of slower growth, the child appetites and intake will decrease. Periodic monitoring and evaluating of growth continues to be important in order to identify any abnormalities in the child growth pattern.

2.2.1 Physiological Development

During middle childhood, muscular motor coordination and stamina increase progressively (Behrman et al. 2004). Children are able to implement more difficult pattern movement, therefore affording the opportunities to participate in the activities such as dance, sports, and other physical activities.

Healthy nutrition includes balanced diet that nourishes the body. For Children, nutrition also makes the way for critical early neurological and physiological development meaning that, proper nutrition facilitates brain and body growth. Apart from providing energy and fuel for the body, foods such as cereals and vegetables contain particular nutrients essential for some bodily functions. Lack of those nutrients may delay growth in cell tissues and in organs.

During the early childhood years, body fat percentage reaches a minimum of 16% in females and 13% in males. The increase in body fat percentage turns to have great effect on the physiologically and that boost adolescent growth rate. This increase in body fat percentage which frequently occurs at 6.0 to 6.3 years of age is called adiposity rebound or BMI rebound and is reflected in the BMI-for-growth charts (Dietz 1994). Moreover, the effect of this increase in body fats finally leads to puberty, a stage of growth which is earlier and greater in females than males. During middle childhood, boys have more lean body mass per centimetre of height than girls. These differences in body composition become more pronounced during adolescence (Story et al. 2000).

2.2.2 Cognitive Development

The main development achievement during middle childhood is self-efficacy, the knowledge of what to do and the ability to do it. Self-initiative is very important as it portrays developmental progress and rate of growth. What to do and what not to do is critical due to the wide range of exposure. During the school age years, children move from a preoperational period of development to one of concrete operation (Behrman et al. 2004). This stage is categorized by being able to concentrate on several aspects of a situation at the same time, which is being able to have more sensible cause-effect of reasoning by being able to classify, reclassify, generalize and decrease in egocentrism which allows the child the ability to see another's point of view. Schoolwork becomes gradually complex as the child gets older. School-age children also enjoy playing strategy games which exhibits' their growing cognitive and language development.

During this stage, the child is developing a sense of self. Children become increasingly independent and are learning their roles in the family at school and in the community (Story et al. 2000). Peer relationships become increasingly important and children begin to separate from their own families by spending the night with friends or relatives house. More and more time is spent watching television or playing videogames. Older children may be able to walk or ride a bicycle to neighbourhood store and purchase snack items.

3 PURPOSE OF STUDY

The purpose of this study was to find out and describe the vulnerability of Sub-Saharan Africa and Southern Asia malnutrition predicaments and its impacts on children.

Research Question

What are the effects of malnutrition among children in Sub-Saharan Africa and Southern Asia?

4 SYSTEMATIC LITERATURE REVIEW

Systematic literature review is defined as concise summary of the best available evidence that address sharply defined clinical questions (Cook, Mulrow and Haynes1997).

One of the main features of literature review is that reviewers follow a strict protocol to ensure that the review process undertaken is systematic by explicit and rigorous methods to identify, critically appraise and synthesize relevant studies in order to answer predefined question (Aveyard2007).The reviewer then develop a comprehensive search strategy, leaving no stone unturned in the search for relevant literature, and do not regard the process complete until the search is exhausted.

In writing this paper, systematic literature review was used. We read and analyses materials and literature related to effects of malnutrition among children in Sub-Saharan Africa and Southern Asia, and to identify many different ways that nursing personnel can better assess and intervene when caring for malnourished children. Literature was sought across a range of health care settings. Electronic databases were accessed.

Literature review can further be explained as the comprehensive study and interpretation of literatures that relates to a particular topic .Through summarizing and analyzing the related research results, literature review seeks to present an overview picture of this research field (Aveyard2007).When literature review is undertaken, the research question must be identify and then look out to answer to the question by searching and analyzing relevant literatures related to the research question by using a systematic approach.

Research is used in nursing to promote evidence-based nursing, with the purpose of presenting strong information and knowledge based on scientific evidence in order to improve the nursing care practice. Literature is reviewed through the identification, selection, critical analysis and written description of existing information (Polit and Beck 2004).

4.1 Literature Search

Literature search is a method of data collection that comprises of identification and examination of research reports, published papers, and books. The literature search was implemented systematically to certify the best available evidence was gathered by finding articles that were mostly relevant to the purpose of the study and the research questions.

The databases were selected from publications of health journals. The process includes literature search, screening and selection of data, and data analysis. The databases used in this study were: EBSCO (CINAHL), EBSCO (Academic Search Elite), Sage journals, Emerald insight database and ProQuest central.

At step 1(Figure 1), the titles and/or abstracts were analyzed for relevance of the study according to the research task. In the search the operators OR and AND were used, and the terms were” malnutrition, children and effects”, “malnutrition children in Sub-Saharan Africa”, ”malnutrition, children in Southern Asia” malnutrition and effects, malnutrition effects in Sub-Saharan Africa and ”malnutrition effects in Southern Asia ” . The first search combin-

ing “malnutrition and effects” retrieved all citations where either one or both terms were found. The citation set was too large with combined result of 3432 hits. After several sets of terms the search term combination “malnutrition, children and effects” AND “”malnutrition and effects” turned out to be the most useful. The number of search results was manageable and they were from most of the selected databases. The combined result for the search was 6488 potential articles, but only 12 of the articles were included in the literature review (Table 1). The 10 articles were saved in “Nelli” and they were also printed to allow closer reading and inspection.

TABLE 1:Database showing corresponding number of articles and combination of keywords with the main concepts.

Database	malnutrition, children and effects	malnutrition children in Africa	malnutrition children in Southern Asia	malnutrition and effects	malnutrition effects in Africa	malnutrition effects in Southern Asia
EBSCO (CINAHL)	32	16	5	91	4	1
EBSCO	645	393	180	2,405	17	17
sage journals	1	0	0	0	0	0
Emerald	634	349	262	887	217	217
ProQuest central	32	13	11	49	5	5
Combined results	1344	771	458	3432	243	240

TOTAL: 6488

4.2 Data Screening

The screening of data was done by applying the inclusion and exclusion criteria. Literature search was narrowed to articles published from 2004 to date so as to put up the most recent articles that were important to the research study. The publications were to be in English, full texts and free. Publications which were not scientific journal articles, theoretical books or national reports were excluded. Publications that did not conflict with the previously mentioned exclusion criteria were therefore accepted as the data for analysis. The data obtained during the literature search was likened to the above inclusion and exclusion criteria (Table

2). The standard was used to determine which data would then be collected and analyzed. Overall, we selected twelve articles for this review as shown in Table 3.

TABLE 2: Tabularized illustration of the inclusion and exclusion criteria.

INCLUSION	EXCLUSION
Articles published after 2004	Articles published before 2004
Full text studies	Studies not in full text
Article published in English	Articles published in other languages
Studies relevant to the purpose of this study	Studies not relevant to the purpose of this study

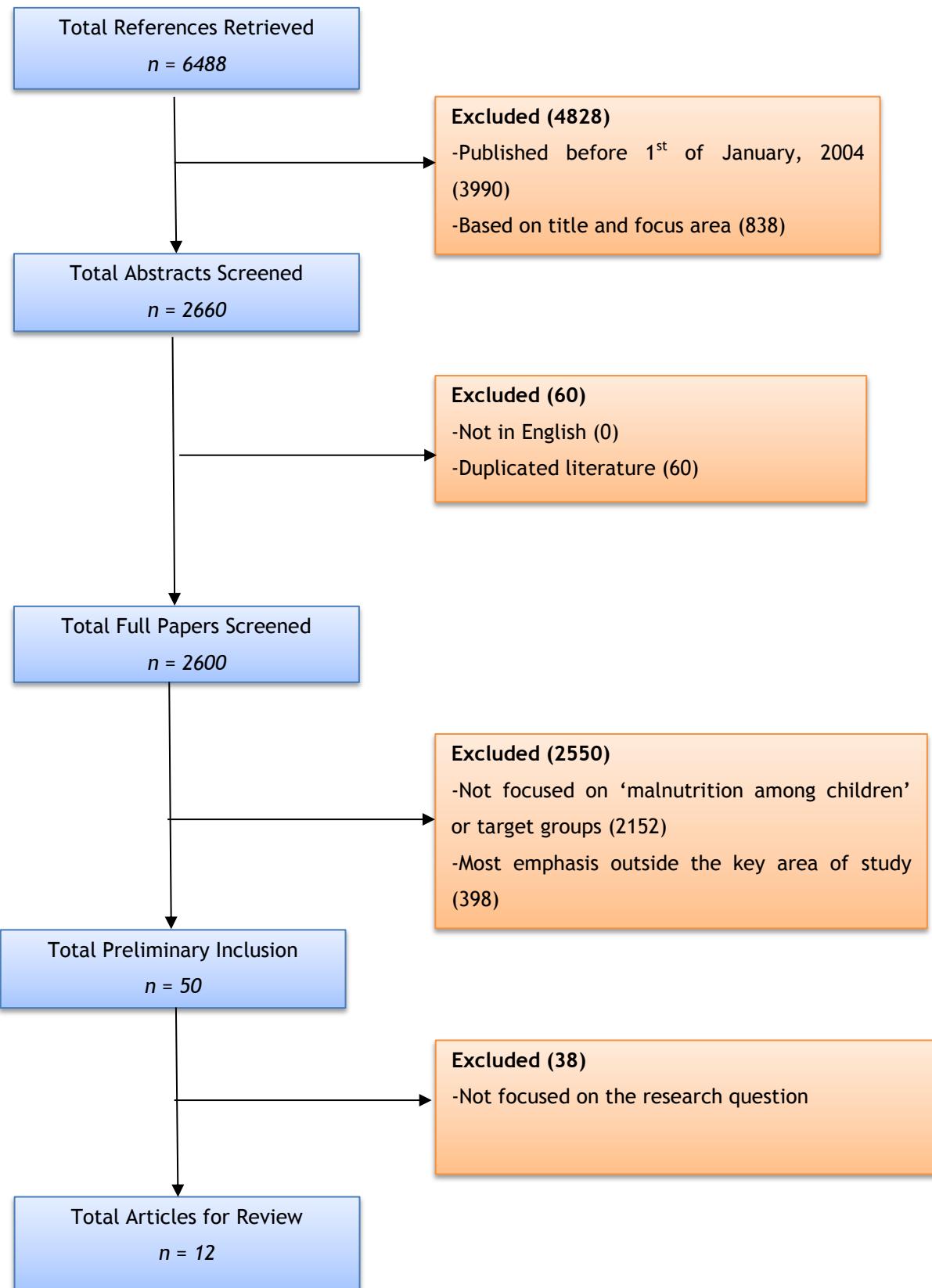


Figure 1: Flow chart of the data selection process. Step-wise systematic selection of the studies included in this review using the predefined inclusion/exclusion criteria at each stage

TABLE 3: List of selected literature

No.	Author & Year of Publication	Publication	Title of the Article
1	Marx et al.(2014)	BMC Public Health 2014	Geographic information analysis and web-based geoportals to explore malnutrition in Sub-Saharan Africa: a systematic review of approaches
2	Gordon et al. (2007)	International Journal of Dental Hygiene	Oral health care for children attending a malnutrition clinic in South Africa
3	Ehrhardt et al.(2006)	Journal of Infectious Disease	Malaria, Anemia, and Malnutrition in African Children—Defining Intervention Priorities
4	FarookJahoor(2012)	International Life Sciences Institute(Blackwell publishing limited)	Effects of decreased availability of sulfur amino acids in severe childhood undernutrition
5	Guerrant et al. (2008)	International Life Sciences Institute(Blackwell publishing limited)	Malnutrition as an enteric infectious disease with long-term effects on child development
6	Ece et al.(2007)	Pediatric Nephrology	The effect of malnutrition on kidney size in children
7	Kandala et al. (2011)	BMC Public Health	Malnutrition among children under the age of five in the Democratic Republic of Congo (DRC): does geographic location matter?
8	Prema Ramachandran. (2013)	Indian Journal of Medical Research	Food & nutrition security: Challenges in the new millennium
9	Canpolat et al. (2013)	Pediatric Nephrology	Malnutrition and its association with inflammation and vascular disease in children on maintenance dialysis
10	Yun Li (2009)	China Agricultural Economic Review	Iron deficiency and its impact on academic achievement
11	Ali Khan et al. (2011)	Journal of Economic Literature Classification	Malnutrition in primary school-age children: A case of urban and slum areas of Bahawalpur, Pakistan
12	Rani et al. (2010)	Nutrition & Food Science	Dietary diversity as an indicator of micronutrient adequacy of the diet of five to eight year old Indian rural children

After carefully reading through the twelve selected research articles as illustrated in table 3, we discussed and concluded on the contents on the data extraction form that is article's title, authors, publication details, data code, extracted data. At the end of each stage, a spread of the data was achieved through joint agreement after in-depth reflections and negotiations (Appendix 1 for 'Data extraction form'). During the data extraction process, maximum emphases have been given to ensure that the data extracted answers directly the research question.

4.3 Data Extraction

The most relevant articles to the purpose of the study were selected after screening the data, since some of the search engines gave back many articles, some of the articles still covered broader topics on the study, therefore articles deemed relevant were those that met both the inclusion and exclusion criteria from the data screening. From the process, 50 articles were identified and saved in library work space portal. To further narrow the scope of the data and to ensure full relevance, data extraction was done by considering the purpose statement, research question and the aim of the study.

A total of twelve articles were selected which were used in the data analysis. They have been described in the appendices by: Author, year of publication, title, publication place (journal), purpose of the article, key findings of the article and the significance of the article to the study (e.g. Judith E. Brown, Nutrition through the life cycle 2nd Edition 2005, carried out a study on nutritional development and effects of malnutrition throughout lifecycle). The data was collected from questionnaires from school children to find out their satisfaction with the programme of school feeding, the findings significantly showed that school children were highly satisfied at (92% refer to book)and would not only use the programme again but also recommend it to others. The data realized from the extraction process is shown below.

TABLE 4: A sample table of the three-stage data extraction process

	Reference(Author, year, title)	Data code	Data1	Data code	Data2	data code	Data3
1	Marx et al.(2014).Geographic information analysis and web-based geo-portals to explore malnutrition in Sub-Saharan Africa: a systematic review of approaches	1.1	childhood malnutrition is a serious challenge and a major underlying cause of death	1.1.1	cause of death among children	1.1.2	leads to death
		1.2	malnutrition related studies could be beneficial to deepen the understanding		Excluded		
2	Gordon et al. (2007). Oral health care for children attending a malnutrition clinic in South Africa	2.1	malnutrition status increases their risk of oral diseases	2.1.1	malnutrition is part of the causes of oral diseases in children	2.1.2	causes oral diseases

4.4 Data Analysis

The data collected was analyzed using qualitative content analysis. It includes the systematic reading of the articles, publications, figuring out the significant areas, determining the main meaning of the content, assembling the core meanings of the data from the articles and interpretation of data (LoBiondo-Wood & Haber 2006). The content of the data is read through and examined thoroughly to understand the important contents to the study. In this thesis work, the selected articles were analyzed using qualitative inductive content analysis. Content analysis is a research technique which can be used for objective, systematic and qualitative description of documentary evidence. (LoBiondo-Wood and Haber, 2006). The core purpose in data analysis is to get familiar with the data. It is therefore significant to understand the data before classifying them so as to come up with relevant categories. The data collected were read carefully and categorize into relevant groups. Information was mainly retrieved from the abstract, findings and discussions parts of the articles. The main goal in qualitative analysis of data is to organize the gathered information to attain a conclusion and data conveyed in a research report. The analysis began by reading through the articles numerous times and relating them to the purpose statement and research question of the thesis; during the reading process, short phrases that were relevant were developed. The phrases realized were further read through and analyzed, where those that had close similarity and relation were grouped together and a relevant descriptive phrase given to them. A main title was then made up for the descriptive phrases. For instance, the expression weakens the immune system, increases enteric infection, dental disorders, kidney size, Anorexia; clinical syndromes were grouped together and described as health effects. Other expressions realized were, Motor and Mental development, Academic achievement as child developments. The diagram below illustrates the data analysis process.

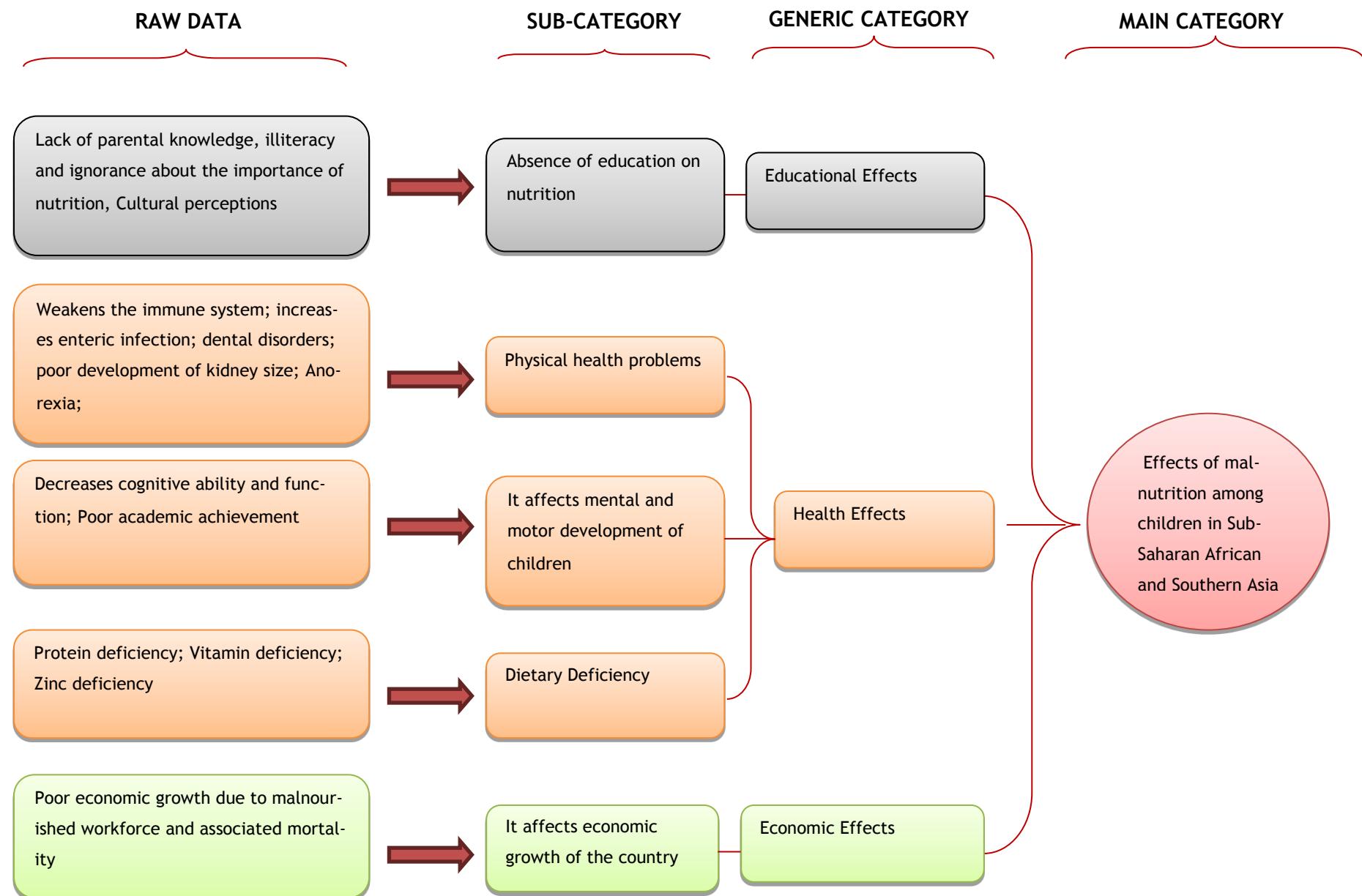


Figure 2: Flow chart of the three main themes and the sub-categories derived during the analysis of data.

5 FINDINGS OF THE STUDY

After a detailed inductive content analysis process of the twelve selected articles by the researchers of this thesis work, the three categories found by the data in response to the research question include: educational effects problems, health effects and economic effects.. In this section, the findings of our review of the selected articles will be presented in three major themes.

5.1 Educationaleffects

From our articles, lack of education and cultural perception contributes to effects of malnutrition among children in Sub-Saharan Africa and Southern Asia. Some countries in Sub-Saharan Africa such as Ghana, in some cultures in certain communities, mothers believe that fathers should get greater portion of fish or meat whiles children get less because fathers are those who work hard and bring money home. So they need to enjoy by having greater portion of the protein.

According to Kandala et al. 2011, the mother's education not only plays the role to enhance the health status of children but also decrease the gender disparity in children's health. In addition educated mothers are expected to break away from traditions and become less fatalistic about illness. They undertake alternative measures of good nutrition that become available with the change in society. When parents are educated, they are more capable of using the medical advice when children are sick and can help in quick recovery by taking care of nutrition and food. An emphasis on parental education for improvement in child nutrition should be integrated for in overall development policy.

Most parents lack the knowledge on the importance of nutrition in the life of their children. They do not know the nutritional implications of food consequently leading to malnutrition. The parents' education, precisely mothers' education, can play a vital role for child's nutritional status. Parents' education is expected to play a significant role to determine the children's welfare and nutritional status. For the mothers, educational accomplishment may affect children's nutritional status directly through her capability to find and retain health information, and indirectly through the parent's capability to earn income and contribute to resources for child's welfare including health, nutrition and recreation.

5.2 Health effects

Malnutrition is the fundamental factor contributing to malaria associated morbidity and anemia. Resistance to infectious diseases and childhood anemia has been closely connected to the nutritional status of children. According to Ehrhardt, Burchard, Mantel, Cramer, Kaiser, Kubo, Otchwemah, Bienzle, and Mockenhaupt (2006), malnutrition contributes to malaria associated mortality worldwide, about 50% of infant death is attributable to malnutrition. Malnourished children have weak immune system responds and are easily exposed to pathogens. Malnourished children have less than 2% fold higher risk of dying from malaria than non-malnourished children. Malnutrition and underweight is a risk factor for fever and anemia. Malnutrition is highly prevalent, particularly in poorer communities with stunting noted as the most common nutritional disorder. Children in poorer communities may thus experience the double burden of malnutrition and oral health problems in addition to other consequences of poverty (Kandala, Madungu, Nzita and Cappuccio 2011).

According to Guerrant, Oriá, Moore, Oriá, and Lima (2008), malnutrition worsens enteric infections with implication for potential novel interventions. Malnourished children have greater incidence longer duration and increase severity of diarrheal illness. Malnutrition and repeated enteric infections reduce nutrient availability due to intestinal malabsorption, increased metabolic needs, increased losses (inflammatory secretory diarrhea).

Malnourished children have lower kidney length, smaller parenchymal width and renal volume smaller kidney (Ece, Gözü, Bükte, Tutanç, Murat, Kocamaz and Halil 2007). Malnourished children have higher relative kidney weight with decreasing body weight for height due to malnutrition. Nutrition is one of the most important factors that determine growth and size of the human body in childhood. Malnutrition is one of the most common health problems, involving hundreds of millions of children in the world. Kidney size is an important parameter in the evaluation of renal growth in children. Measuring renal dimensions gives an opportunity to evaluate whether growth of kidney is adequate or not according to age and anthropometric measurements of a child. When evaluating renal abnormalities, such as atrophy, hyperplasia in Southern Asia, hypertrophy or other malformations, kidney sizes are considerable parameters. Malnourished children had smaller kidneys than their healthy controls. Malnutrition generally describes a condition in which fat tissue is lost and lean body mass is initially preserved. Inadequate nutritional intake can lead to malnutrition, but several factors in the uremic milieu, including urinary protein loss, removal of amino acids in dialysate, and derangement in metabolic pay also play a role.

According to Kandala, Madungu, Emina, Nzita, Cappuccio, 2011, one of the key components of malnutrition is the effects and impact it lay down upon on child development. Worldwide, it is generally accepted that, nutrition or good health and education constitute significantly on human capability. From our research, we have found that, medical and social studies have instituted a negative correlation between iron deficiency (micronutrient under nutrition) and

children physical growth and cognitive development. This problem is not only affecting a large number of children and women in developing countries, but also remains one of the nutritional deficiencies widely spread in developing countries. Elementary school children are in the period of rapid growth with tissues and organs developing and maturing rapidly. According Guerrant et al 2008, malnutrition impairs the development growth of children. This induces high demand for iron and also makes fundamental school children susceptible to iron deficiency and iron deficiency anemia (IDA). IDA is defined as a condition when individual hemoglobin concentrations are declined to below-optimal level. Specifically: “ when individual hemoglobin levels are below two standard deviations(-2SD) of the distribution mean for hemoglobin in an otherwise normal population of the same gender and age who are living in the same altitude, iron deficiency anemia is considered to be present (WHO, 2001) “.Iron deficiency undesirably affects cognitive development, behavioral and physical of infants, pre-school and school-aged children. Iron deficiency is the foremost micronutrient deficiency encountered by children and adolescent. This is due to the fact that mild to moderate iron deficiency can impair body function. A number of studies, such as on infants in Indonesia, on pre-school and school-aged children in Thailand, India and Egypt, all indicates that iron deficiency anemia can cause slacker intelligence development and impair cognitive ability (Yun Li,2009). Malnutrition impairs development. Malnutrition prevents children from reaching their full physical and mental potential. Delay in their physical growth and motor development: lower intellectual quotient (IQ), greater behavioral problems and deficient social skills.

Protein deficient alone or both and calorie deficient diet responsible for the development of childhood malnutrition. Malnutrition is the most common health problems, involving hundreds of millions of children in the world. Micronutrients, which are nutrients that are only needed in minute's amounts, play leading roles in the production of enzymes, hormones, and other substances. They also help to regulate growth activity, cognitive development and functioning, and the activity of the immune and reproductive systems. Undernutrition includes stunting, wasting and deficiencies of essential vitamins and minerals which or that are collectively referred to as micronutrients. According to Yun Li, (2009), micronutrients deficiencies are caused by inadequate dietary intake, increase losses from the body, and or increased requirements. This micronutrient are specially important to children since they are in a growth and development phase and have nutritional requirement that vary according to the stage of growth, and that are greater and clearly differentiated from those of the adults. Micronutrients of known public health importance include the following; zinc, iron, iodine, selenium, copper, vitamins A, E, C, D, B2, B6, B12 and folate. Recent studies are emphasizing the importance of micronutrients in developing countries and among school-aged children in particular. Some of these school-aged children are vulnerable to inadequate consumption of nutrient-rich foods, dietary taboos, and lack of access to health care and inefficient utilization of available micronutrients. Growth retardation due to this condition generally occurs in chil-

dren of post weaning age, which maybe as a result of dietary deficiency. According to Rani, Arends and Brouwer (2010), micronutrients deficiency affects millions of people around the world, especially the most vulnerable groups, which are children and pregnant women in Sub-Saharan Africa in particular. Anemia, a deficiency as a result of lack of iron and malnutrition are major public-health challenges in pediatric populations in Sub Saharan Africa and in some quarters in contrast to Finland. Iron deficiency is one of the most pervasive nutritional deficiencies in the world. As the uppermost micronutrient disorder affecting children and adolescent, iron deficiency adversely affects children's physical growth, cognitive development and immunity function. Nutrition may be a factor in modulating morbidity and mortality, in that malnutrition has been suggested to influence susceptibility to and manifestation of certain infectious diseases and diseases like malaria in Sub-Saharan Africa. Such increased in susceptibility of young children to infections has been attributed to low levels of immunoglobulin, as a result of slow maturation of immunoglobulin, among other factors. Malnutrition contributes to some extent malaria associated mortality. Anemia is a fundamentally compulsory symptom of malaria, and severe anemia constitutes the most common defining symptom of severe malaria. Although, the interplay of malaria, anemia and malnutrition is complex, its understanding is nevertheless significant for our comprehending of childhood morbidity and for a development of efficient intervention strategies. In addition to this, dietary diversity is another factor influencing nutritional deficiency particularly in some part of Southern Asia. Dietary diversity is strongly associated with household economic status.

5.3 Economic effects

Worldwide, 50 percent of infants' deaths are attributed to malnutrition which tends to affect the economic growth of Sub-Saharan Africa and Southern Asia. In our findings we came across economic literature that recommended, health and nutrition may pay off in terms of economic growth as well as equity concerns by improving the educational performances of poor people in the developing world. According to Marx, Phalkey, Aranda, Profe, Sauerborn, Höfle 2014(2014), in many developing economies particularly Southern Asian countries, the fertility rate is comparatively high. The newborn needs intensive care and larger part of the household budget for all the children. So, age of child may affect the nutritional intake and care resulting in anthropometric outcome. Also, the mothers demographic characteristics like the current age, age at marriage, and marital status, (that's is currently married, divorced and widow) may affect the nutritional status of children as they reflect the extent to which resources, both in the form of time and money and physical strength for rearing the children available to her. For the children in the age group of five to ten children, the mother's age is especially important. Conceptually, the mother's age may impact the nutritional status of children in two ways. First and foremost, the mother gain more experience with age and child's nutritional status may increase due to maturity and experience. According to Rana, Ejaz, Ali, Toseef,, (2011) in our findings, we discovered that, children were at a higher risk

of moderate -to- severe malnutrition if their mothers were young. Secondly, by the increase in mother's age, there is a probability for a larger number of children due to higher fertility, which is a characteristic of developing countries; the child's nutritional status may decrease. Furthermore, parents' education is a significant factor in determining children's welfare including nutritional status. The effect of education works through increased awareness and scientific understanding of disease causation. Another important factor from our findings regarding the causation of malnutrition in the economy of developing countries is poverty. Poverty affects child's malnutrition, which is often the result of or long sequence inter-linked events ascribed to a wide range of biological, social, cultural and economic factors. In developing countries or economies, such events are usually part of the so-called poverty syndrome with its synergistic attribute of family income. Household per capita income is one of the most important determinants factors of malnutrition in children. Hypothetically, the higher the per capital income, the better the nutritional status of children and vice versa. Parents invest more in child quality when household per capita income increases. Malnutrition on this regard is subjected to low income which limits the capacity of families to purchase sufficient food.

6 DISCUSSION

From the findings in the literature used, it was discovered that the effect of malnutrition among children affects the economy of countries in Sub-Saharan Africa and Southern Asia, eventually this countries need to import nutritional supplements to help eradicate the menace on children. Geographic Information Systems and geo information analysis methods are beneficial in identifying the most vulnerable parts of society in terms of malnutrition and living in poverty (Gauci 2005), (Graw and Hussmann 2012). Childhood malnutrition is spatially structured and rates remain very high in the provinces and countries that rely on the mining industry and comparable to the level seen in some part of Sub-Saharan Africa. Even in some provinces in Sub-Saharan Africa that produce food, childhood malnutrition is higher probably because of the economic decision to sell more than the population consumes. The strong indication of statistically significant difference of malnutrition between socio economic groups mainly between poorest, poorer and richer groups compared to the richest group confirms the reality that in Sub-Saharan Africa and Southern Asia, affording food for the majority of the population is still a challenge. consequently, in richer households, often children are well fed and cared for, and provided with a safe and inspiring environment, through which they are more likely to survive, to have fewer diseases and illnesses, and to fully develop thinking, language, emotional and social skills.

Nevertheless in poorer households, most children are affected by the renaissance of kwashiorkor, which is lack of proteins in the diet; figure 3, (page 32) shows statistics of under nutrition rate among children in Sub-Saharan Africa and Southern Asia.

Improving maternal and child nutritional status is essential for achieving, nutritional demands of the country particularly the pediatric population, to reduce child mortality rate in the affected countries. In Sub-Saharan Africa and Southern Asia, the acute or chronic food inadequacy at national, regional or household level is prevalent among the poor segments of the population. Taking this into consideration, food security is defined as the ability of a country or region to assure adequate nutritional supply for its current and projected population. Poverty and inability to purchase adequate food is leading to undernutrition and micro-nutrient deficiencies continuing even today among the poor segments of population. The occurrence of nutrition burden in all the countries with persistent inadequate dietary intake, under nutrition and over nutrition, results in low physical activity above requirements. In this case the two main elements of human nutrient requirements are body size and physical activity. The 1996 World Food Summit provided a comprehensive definition of food security bringing into focus the linkage between food, nutrition and health. The persistent high underweight rates in preschool children have been a matter of serious concern for policy makers and programme implementers. There is relatively good performance in most of this country's economic, agriculture, health sector, substantial investment in nutrition sector, but the country still lagged behind in addressing nutritional matters. The steep rise in underweight rates occurs between 3-23 months of age and is related to poor infant and young child feeding

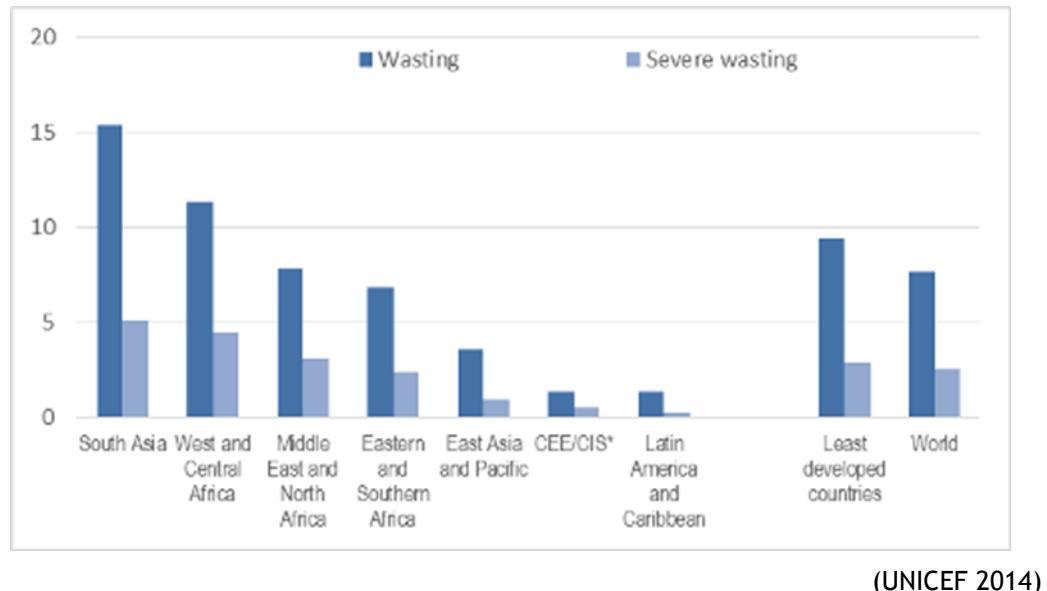
practices which are not directly linked to household food insecurity. In India and South Asia stunting rates in preschool children are high. Stunted children with appropriate weight for their height get misclassified as underweight. As both under-and over nutrition are associated with health hazards, perhaps time has come for use of normal BMI as the nutrition indicator for food security.

Malnutrition has effects on the immune system of children thereby making them prone to infectious diseases such as Malaria. Malnutrition prevents children from reaching their full physical and mental potential. Health and physical consequences of prolonged states of malnourishment among children are that there is a delay in their physical growth and motor development; lower intellectual quotient, greater behavioral problems and deficient social skills (FAO 2008).

Malnutrition is a serious challenge for the public-health system and “has been linked to a substantial increase in the risk of mortality and morbidity”(Blössner and de Onis 2005).Nutrition disorders are gradually becoming the leading cause of ill health today both in developed and developing countries. Figure 4 (page 33) illustrates the affected part of the globe as a result of malnutrition. Southern Asia and the Pacific with highest (over 500million) million affected, followed by Sub-Saharan African with (239million) of the populace. Developed countries have the lowest figure with (19million), then Near East and North Africa with (37 million) affected. Latin American and the Caribbean also affected (53 million) of the population.These figures (figure 4) demonstrate the gravity, seriousness and the pace at which malnutrition is developing globally.

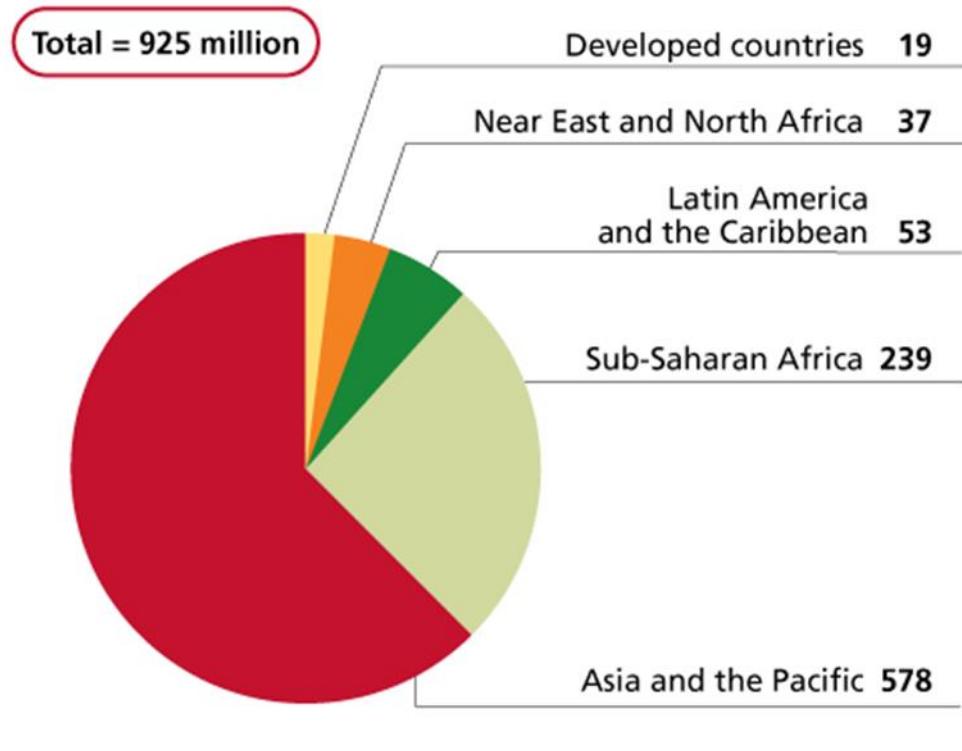
Undernutrition is an underlying causes of malaria morbidity and mortality in children less than five years old (Caulfield, Richard and Black 2004) Worldwide, 50% of infant deaths are attributable to malnutrition. The deleterious effect of malnutrition has been shown for measles, pneumonia, diarrhea, and malaria (Caulfield et al. 2004).It is imperative that malnutrition be understood, at least in part, as an enteric infectious disease that not only exacerbates other enteric infections but has the potential to negatively impact other leading infectious causes of morbidity and mortality and their therapy. Only with this understanding can we adequately address the vicious cycle of infection and malnutrition. It was founded that under nutrition is more common through children in Sub-Saharan Africa and Southern Asia than other developed countries. Geographically, the majority of the under nutrition burden exists in Sub-Saharan Africa and South-Central Southern Asia (Bhutta and Salam 2012). Figure 3 below illustrates affected part of the globe as a result of malnutrition with less effect in developed countries. Southern Asia and the Pacific have the highest figures followed by Sub-Saharan Africa.

Figure 3: Under nutrition rate among children in Sub-Saharan Africa and Southern Asia



(UNICEF 2014)

Figure 4: Illustration showing the affected part of the globe as a result of malnutrition with less effect in developed countries. Southern Asia and the Pacific have the highest figures followed by Sub-Saharan Africa.



Source: FAO.

UNICEF, WHO, World Bank: Levels and Trends in Child Mortality: UNICEF- WHOWorld Bank Joint Child Malnutrition Estimates.2012. UNICEF: New York, WHO: Geneva,
<https://www.wfp.org/hunger/malnutrition-oldread> 15.4.2014

6.1 Trustworthiness

The databases used in this study were: EBSCO (CINAHL), EBSCO (Academic Search Elite), Sage journals, Emerald insight database and ProQuest central and the data used was freely available, for this reason the data used was acknowledged to be valid. Legitimate research is research that consists of trustworthy findings and to some extent is an indicator of successful research methodology (Graneheim and Lundman 2004).

The articles from the data used in this study were compared against each other to form different themes, issues of common themes were grouped together during analysis, this showed that different articles were based on the same theme and came up with an almost similar conclusion. The method used in this research study was systematic literature review, the data collected and analyzed were from articles that were assumed here to have undergone thorough selection to meet the criteria to be published in journals of reputation in the healthcare field and were therefore consistent and realistic.

Credibility requires that the data is interpreted in an appropriate manner and that an adequate volume of information was considered to draw final conclusions (Graneheim and Lundman 2004). The articles from the data used in this study were compared against each other to form different categories, issues of common information were grouped together during analysis, this showed that different articles were based on similar information and came up with an almost similar conclusion; this in effect proved that the articles were reliable and valid.

Validity establishes whether or not the research addresses the purpose of the research (Long & Johnson 2000).

6.2 Ethical Considerations

The ethical considerations undertaken during this literature review consisted of the assumption that the articles chosen and used in the analysis followed ethical guidelines by making sure that participant's anonymity and confidentiality was upheld and informed consent was obtained, it was also assumed that the appropriate procedure of the methodology used in writing the articles was strictly followed. Researchers are unconditionally responsible for the honesty of the research process. The power to produce knowledge requires responsibility for honesty in the production. (O'Leary, 2004, 50)

According to Silverman (2000, 201) ethical problems can be avoided by choosing what is the purpose of the research, examining which individuals or groups might be interested or affected by the research, and considering what are the implications for these parties of framing the research topic in the way it is done. The references for the data used are recognized and documented in the reference page. The final study findings were based on the scientific articles and the writers' views were not included.

At the beginning of the study, the authors of this document informed the supervisors at Laurea University of Applied Sciences concerned with research projects about the study, and sought permission to carry out this study; the supervisors granted the permission sought.

6.3 Limitations

There were limitations to the research carried out; this comprises of inadequate results from some of the search databases in Metasearch, language barrier when finding articles. Some of the articles read during the research were of great benefit but did not contain full text articles which did not make it possible to use in the collected data (See table 1 pg. 10). Using certain combination of key words produced too many literatures while others produced very few which is time consuming and difficult to retrieve the correct balance between articles and the required amount. Another limitation is that some articles were written based on a certain country or a certain way of lifestyle hence the tendency to generalize.

The imitational factor of websites search was a problem due to either website malfunction or language barrier. A lot of literature was founded but with very little significance if any to the search words.

6.4 Recommendations

There has been a lot of research in this field in the past with suggested recommendations. The findings in the literature and the discussion part of this thesis have opened up a lot of suggestions and recommendations despite the limitation encountered during this thesis writing. There are two goals of optimum nutrition which the researches of this thesis are recommending: variety and moderation. Variety assures that humans avoid toxic levels of compounds in particular foods as no one food is eaten every day in large quantities. Moderation also assures that humans obtain all the essential nutrients they need as no one food can provide all of these nutrients. In other words, the content of what one eats is extremely vital than what one is just eating. We will also recommend to family's living in the developing world to try to give education to their children. Illiteracy, ignorance and poverty have cost the lives of so many innocent children as a result of malnutrition consequences. The consequences of malnutrition are serious, including increased complications like pressure ulcers, infections, and falls among others, longer hospital stays, increased cost of care, more frequent readmission and above all higher mortality rate. Although multiple clinical guidelines specify different care processes, malnutrition is still overlooked and underrated. Attention to nutrition during a stay in a hospital or long-term care facility is important for quality care, post discharge nutrition planning and follow-up care. We are recommending also hospital stay nutrition. The quality of nutrition during hospitalization in developing countries is not good enough as compared to developed countries like Finland. Studies have shown that, optimal nutrition can improve a patient's clinical outcomes, and reduce health care cost. Successful diets over time have allowed adequate digestion and absorption of nutrients, contained ade-

quate calories for growth and development, and included foods with adequate protein quantity and quality.

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Figures

Figure 1: Flow chart of the data selection process.....	18
Figure 2: Flow chart showing three main themes and the sub-categories	23
Figure 3: undernutrition rate among children in Sub-Saharan Africa and Southern Asia.....	31
Figure 4: Illustration the affected part of the globe as a result of malnutrition	32

Tables

Table 1: Database showing corresponding number of articles and combination of keywords with the main concepts.....	16
Table 2: Showing inclusion and exclusion criteria.....	17
Table 3: List of selected literatures.....	19
Table 4: A sample table of the three-stage data extraction process.....	21

Appendices

Appendix 1: Data extraction form showing all three stages of data extraction

	Reference(Author, year, title)	Data code	Data ¹	Data code	Data ²	Data code	Data ³
1	Marx et al. (2014). Geographic information analysis and web-based geoportals to explore malnutrition in Sub-Saharan Africa: a systematic review of approaches.	1.1	childhood mal-nutrition is a serious challenge and a major underlying cause of death	1.1.1	cause of death among children	1.1.2	Leads to death
		1.2	malnutrition related studies could be beneficial to deepen the understanding		Excluded		
2	Gordon et al. (2007). Oral health care for children attending a malnutrition clinic in South Africa	2.1	malnutrition status increases their risk of oral diseases	2.1.1	malnutrition is part of the causes of oral diseases in children	2.1.2	Causes oral diseases
3	Ehrhardt et al.(2006). Malaria, Anemia, and Malnutrition in African Children—Defining Intervention Priorities.	3.1	Resistance to infectious diseases and childhood anemia have been closely connected to the nutritional status of children	3.1.1	Malnutrition can causes anemia and resistance to infectious diseases in children	3.1.2	Causes anemia and resistance to infectious disease
		3.2	malnutrition contributes to malaria associated mortality	3.2.1	malnourished children with malaria death rate in children is high	3.2.2	Leads to high death rate
		3.3	malnourished	3.3.1	Easily exposed	3.3.2	Causes weak

			children have weak immune system responds and are easily exposed to pathogens		to infections		Immune system health problems
		3.4	Malnutrition and underweight is a risk factor for fever and anemia	3.4.1	under nutrition is a high risk factor for anemia and fever in children	3.4.2	Leads to high risk in fever and anemia
4	Jahoor (2012).Effects of decreased availability of sulfur amino acids in severe childhood undernutrition.	4.1	metabolism in children with severe childhood undernutrition (SCU), slower erythrocyte GSH synthesis in children with edema was associated with lower concentrations of cysteine, the rate-limiting precursor of GSHsynthesis. This finding suggested a shortage of cysteine available for GSH synthesisin children with edematous SCU.	4.1.1	Health	4.1.2	Physical health problems
5	Guerrant et al.(2008). Malnutri-	5.1	Malnutrition worsen enteric	5.1.1	Malnourished children are at	5.1.2	Worsen enteric infec-

	tion as an enteric infectious disease with long-term effects on child development		infections with implications of optional novel interventions		high risk of enteric infections		tion
		5.2	Malnutrition impairs the developmental growth of children	5.2.1	Malnourished children have poor growth rate	5.2.2	Leads to poor growth
		5.3	Anorexia is one of the effects of malnutrition	5.3.1	Eating disorders	5.3.2	Leads to eating disorders
		5.4	Malnutrition aggravated by infection can reduce the availability of conditional amino acids	5.4.1	Amino acid deficiency	5.4.1	Causes amino acid deficiency
		5.5	Malnutrition and repeated enteric infection reduce the nutrient availability due to intestinal malabsorption, increased metabolic needs, increased losses and disturbed nutrient uptake and transport	5.5.1	nutritional deficiency	5.5.2	Dietary deficiency
6	Ece et al. (2007). The effect of malnutrition on kidney size in children.	6.1	Malnourished children have lower kidney length parenchymal width and renal vol-	6.1.1	Malnourished children have small kidney size.	6.1.2	Affects kidney size

			ume.				
		6.2	Malnourished children have higher relative kidney weight with decreasing body weight for height due to malnutrition.	6.2.1	Malnutrition effects the kidney weight of children	6.2.2	Affects kidney size
7	Kandala et al. (2011). Malnutrition among children under the age offive in the Democratic Re-public of Congo (DRC):Does geographic location matter?	7.1	Malnutrition prevents children from reaching their full physical growth and mental growth.	7.1.1	Delay children physical growth and motor development that is lower intellectual quotient, greater behavioral problems and social skills.	7.1.2	Delays child development
		7.2	Childhood mal-nutrition is spa-tially structured and rates re-main very high in the provinces that rely on The mining in-dustry and comparable to the level seen in Eastern prov-inces under conflicts.	7.2.2	Malnutrition effects the poorer com-munities	7.2.3	Affects poor communities
8	Ramachandran (2013). Food & nutri-tion security: Chal-lenges in the new	8.1	In the sixties of the last century the acute or chronic	8.1.1	Lack of food	8.1.2	lack of food

	mil-lennium		food inadequacy at national, regional or household level was widespread among the poor segments of Population. Taking this into account food security was defined as the ability of a country or region to assure adequate food supply for its current and projected Population.				
		8.2	Poverty and inability to purchase adequate food leading to under nutrition and micronutrient deficiencies persist even today among the poor segments of population	8.2.1	Malnutrition affects the poorer communities and also the nutritional status of children.	8.2.2	poor nutrition
9	Canpolat et al. (2013). Malnutrition and its association with inflammation	9.1	Malnutrition and inflammation may coexist in patients	9.1.1	Malnutrition may also lead to greater inflammation.	9.1.2	lead to greater inflammation

	and vascular disease in children on maintenance dialysis		with CKD.				
10	Yun Li (2009). Iron deficiency and its impact on academic achievement.	10.1	Iron deficiency is the Major micronutrient deficiency encountered by children and adolescents.	10.1. 1	Iron deficiency	10.1. 2	Iron deficiency ..
		10.2	Many medical and social studies have found a negative correlation between iron deficiency and children physical growth and Cognitive development.	10.2. 1	Delay children physical growth and motor development that is lower intellectual quotient, greater behavioral problems and social skills	10.2. 2	delays child development
11	Ali Khan et al. (2011). Malnutrition in primary school-age children A case of urban and slum areas of Bahawalpur, Pakistan	11.1	The parents' education, specifically mothers' education, can play an important role for child's nutritional status	11.1. 1	lack of parental education about nutrition	11.1. 2	lack of education
		11.2	Malnutrition is positively related with congestion in the household number of household members per room	11.2. 1	Family size is one of the cause of mal-nutrition	11.2. 2	Family size causes mal-nutrition

12	Rani et al.(2010). Dietary diversity as an indicator of micro-nutrient adequacy of the diet of five to eight year old Indian rural children	12.1	Measures of dietary diversity are relatively simple and associated with nutrient malnourished children adequacy and nutritional status.	12.1.	Malnourished children lack a lot of micro nutrients	12.1.	Lack of micronutrient
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