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COMORBIDITIES OF CHILD MALNUTRITION IN LOW AND MEDIUM INCOME COUNTRIES : A SYSTEMATIC REVIEW

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Absract

Background: *Malnutrition can be illness-related (one or more diseases or injuries directly result in nutrient imbalance), or it can be induced by environmental and behavioural variables associated with decreased nutrient intake and/or delivery. Comorbidities were shown to be related with child malnutrition in the study.*

Aim: *The goal of this study is to showed comorbidities of child malnutrition in low and medium income countries.*

Methods: *By comparing itself to the standards set by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. So, the experts were able to make sure that the study was as up-to-date as it was possible to be. For this search approach, publications that came out between 2013 and 2023 were taken into account. Several different online reference sources, like Pubmed and SagePub, were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.*

Result: *In the PubMed database, the results of our search brought up 109 articles, whereas the results of our search on SagePub brought up 76 articles. The results of the search conducted for the last year of 2013 yielded a total 22 articles for PubMed and 11 articles for SagePub. In the end, we compiled a total of 16 papers, 13 of which came from PubMed and 3 of which came from SagePub. We included five research that met the criteria.*

Conclusion: *In addition to nutritional rehabilitation, malnourished children also require the timely detection and treatment of co-morbidities such as acute respiratory tract infection, diarrhoea, anaemia, and micronutrient deficiencies in order to break the undernutrition-disease cycle.*

Keyword*:* *Child; Comorbidities; Malnutrition; Low and medium income countries*

INTRODUCTION

According to the American Society of Parenteral and Enteral Nutrition (ASPEN), the definition of paediatric malnutrition is as follows: "an imbalance between nutrient requirement and intake, resulting in cumulative deficits of energy, protein, or micronutrients that may negatively affect growth, development, and other relevant outcomes".[1] On the basis of its aetiology, malnutrition can be illness-related (one or more diseases or injuries directly result in nutrient imbalance), or it can be induced by environmental and behavioural variables associated with decreased nutrient intake and/or delivery.[2] Primary acute malnutrition in children is the result of inadequate food availability, which is driven by socioeconomic, political, and environmental reasons; this kind of malnutrition is most typically encountered in low- and middle-income nations.[3] The inability of households to provide enough nutrition, poverty, inadequate nutrition for pregnant women, intrauterine growth restriction, low birth weight, inadequate breastfeeding and inadequate complementary feeding, frequent infectious illnesses, poor quality water, poor hygiene, and so on are all factors that contribute to this problem.[4–6]

As a result, primary acute malnutrition is mostly always caused by social factors rather than by biological ones, but it is also caused by a number of different factors. For instance, a condition known as "environmental enteropathy" is one of the factors that contributes to acute malnutrition in children. Poor water quality, sanitation, and hygiene practises are increasingly recognised to be the cause of this condition.[7] The repeated exposure to pathogens in the environment produces small intestinal bacterial colonisation, which is followed by the accumulation of inflammatory cells in the small intestinal mucosa, the degradation of intestinal villi, and, as a consequence of all of these things, malabsorption of nutrients, which leads to malnutrition.[4]

Secondary acute malnutrition is typically the result of abnormal nutrient loss, increased energy expenditure, or decreased food intake, and it frequently arises within the context of underlying diseases that are predominantly chronic. Some examples of such diseases include cystic fibrosis, chronic renal failure, chronic liver diseases, childhood malignancies, congenital heart disease, and neuromuscular diseases.[4,8,9] Acute malnutrition kills roughly 30% of children under 5 and produces intellectual or cognitive impairment in survivors. 101 million children (weight-for-age Z score < −2) are underweight worldwide, 16%. Acute and severe malnutrition in children under 5 exceeds the World Health Assembly target of 5% by 2025. Comorbidities were shown to be related with child malnutrition in the study.[10]

The purpose of this research is to demonstrate the comorbidities of child malnutrition in low and medium income countries.

METHODS

According to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 guidelines, the author of this study made sure it was up-to-date and met all standards. This step is very important because it makes sure that the results of the study are correct. This study found that hunger in children in low- and middle-income countries is linked to other problems. The most time-efficient way to reach this goal is to look at past study on the subject. Given the point of the essay, this part will focus on why the topics mentioned are important.

In order to take part in the study, researchers had to show proof that they met the following requirements: 1) For the paper to be published, it must be written in English and show how hunger affects children in low-income and middle-income countries. 2) Works that came out after 2013 but before the time of the evaluation are qualified. Research that can't be published includes editorials, applications without a DOI, review articles that have already been published, and entries that are almost the same as journal articles that have already been published.

We used between “comorbidities”; “child malnutrition”; and “low-medium income countries” as keywords. The search for studies to be included in the systematic review was carried out from June, 2nd 2023 using the PubMed and SagePub databases by inputting the words: *(("comorbid"[All Fields] OR "comorbidity"[MeSH Terms] OR "comorbidity"[All Fields] OR "comorbidities"[All Fields] OR "comorbids"[All Fields]) AND ("child nutrition disorders"[MeSH Terms] OR ("child"[All Fields] AND "nutrition"[All Fields] AND "disorders"[All Fields]) OR "child nutrition disorders"[All Fields] OR ("child"[All Fields] AND "malnutrition"[All Fields]) OR "child malnutrition"[All Fields]) AND "low-medium"[All Fields] AND ("income"[MeSH Terms] OR "income"[All Fields] OR "incomes"[All Fields] OR "income s"[All Fields]) AND ("countries"[All Fields] OR "country"[All Fields] OR "country s"[All Fields] OR "countrys"[All Fields])) AND ((y_10[Filter]) AND (clinicaltrial[Filter]))* used in searching the literature.

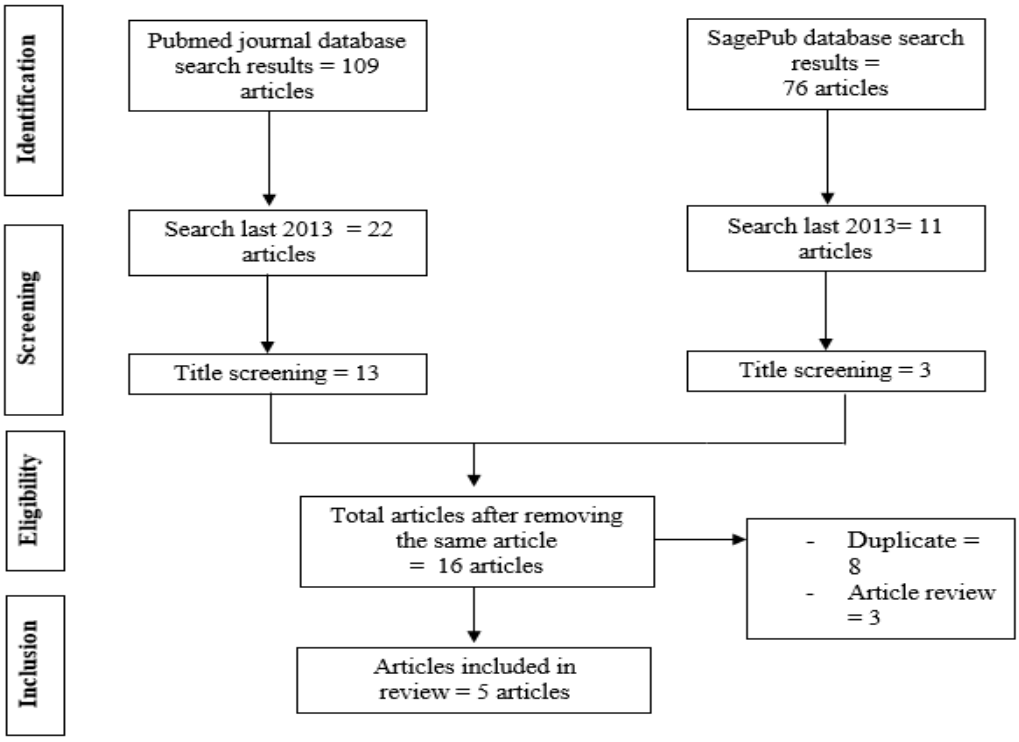

Figure 1. Article search flowchart

We examined both the abstract and the title of the study to determine its credibility. They reviewed a greater quantity of historical documents. Multiple studies employing the same methodology support this finding. Commenting necessitates the use of English that has never been published before. In the systematic review, only those works meeting the predetermined inclusion criteria were included. There are fewer search results displayed. Lack of investigation and analysis. This section provides an assessment. Subjects, authors, date, location, topic, and parameters are all specified in the research paper. The article includes both the author's name and the date of publication. Endnote removed any duplicates it found.

Two evaluators evaluated the article titles and abstracts submitted. Their extensive articles were reviewed to ascertain if the research could be conducted and to collect data. Other health issues have been the focus of conferences and research in addition to GWAS. The conclusion was reached by the evaluators. Before deciding which papers to investigate, each author reviewed the abstracts and titles of all available studies. Then, all eligible articles that satisfy the inclusion criteria will be evaluated. After concluding the fundamentals instruction, we will choose review topics. Using this technique, research and review articles are selected.

RESULT

In the PubMed database, the results of our search brought up 109 articles, whereas the results of our search on SagePub brought up 76 articles. The results of the search conducted for the last year of 2013 yielded a total 22 articles for PubMed and 11 articles for SagePub. In the end, we compiled a total of 16 papers, 13 of which came from PubMed and 3 of which came from SagePub. We included five research that met the criteria.

Dadhich, et al (2019)[11] conducted a study with 200 SAM patients. They showed out of 200 children having severe acute malnourished (SAM) 55.00% children were having one co-morbidity, 27.00% were having two co-morbidity and 10.00% were having more than two co-morbidty. Co-morbidities in these youngsters must be investigated and planned for. A high index of suspicion for these co-morbidities in acute severe malnourished children reduces mortality and improves outcomes.

Table 1. The litelature include in this study

Author	Origin	Method	Participant	Result
Dadhich, 2019[11]	India	Prospective cohort study	200 severe acute malnourished children	It is of the utmost importance to investigate and plan for the possibility of co-morbid conditions in these children. In children who are suffering from acute severe malnutrition, having a high index of suspicion for these co-morbidities is the key to

				reducing mortality and having a better result.
Baskaran, 2018[12]	India	Cross sectional study	200 children	Comorbidities need to be identified as soon as possible in hospitalised children with SAM. This will make it easier for the children to be treated, which will ultimately lead to improved results.
Garg, 2017[13]	India	Cross sectional study	125 severe acute malnourished	If several co-morbidities are identified and treated in a timely manner, it is conceivable that the cycle of undernutrition and disease can be broken, leading to a reduction in mortality and an improvement in outcome. Patients with SAM almost universally have insufficient levels of vitamin D. Therefore, a vitamin D supplement must to be administered to each and every SAM sufferer.
Gupta, 2015[14]	India	Prospective cohort study	421 severe acute malnourished	It is of the utmost importance to investigate the possibility of and plan for co-morbid conditions in these youngsters. In children who are suffering from acute severe malnutrition, having a high index of suspicion for these co-morbidities is the key to reducing mortality and having a better result.
Kumar, 2014[15]	India	Cross sectional study	104 severe acute malnourished	If several co-morbidities are identified and treated in a timely manner, it is conceivable that the cycle of undernutrition and disease can be broken, leading to a reduction in mortality and an improvement in outcome.

Baskaran, et al (2018)[12] conducted a study with 200 children. The median (interquartile [IQR]) age of 200 hospitalised SAM children was 15 (11-21.75) months, with 93 (46.5%) boys. The most prevalent comorbidity was acute gastroenteritis (57.5%), followed by pneumonia (44.5%), anaemia (27%), systemic disease (17%), worm infestation (13.5%), urinary tract infection (13.5%), sepsis (13%), skin infection (8%), measles (6%), vitamin insufficiency (4%), retroviral infections (3.5%), and tuberculosis (1%). The fatality rate in the case was 10.5%.

Garg, et al (2017)[13] conducted a study with 125 children. They showed 42% of those with this condition also had diarrhoea, and 27% of those with this condition also had acute respiratory tract infections. In 13% of the cases, tuberculosis was identified as the underlying cause. There was anaemia present in 86% of the patients. In 24% and 6% of the cases, respectively, there were visible signs of vitamin B and vitamin A deficiency. 97% of children have vitamin D levels that are insufficient.

Gupta, et al (2015)[14] showed the most prevalent co-morbidity among the 421 children with SAM (37.3%) is acute respiratory infection. Followed by acute gastroenteritis. Numerous adolescents suffered from urinary tract infections. A diagnosis of tuberculosis was made in 23% of infants. In 14.7% of cases, pyogenic cutaneous infections were identified. As a result of micronutrient deficiencies associated with Protein Energy Malnutrition, 28% of children were deficient in all vitamins A, C, D, and B, and 87% of children had anaemia. Malaria and measles were identified in a small number of study participants, but they were not regarded as significant co-morbid conditions.

Kumar, et al (2014)[15] showed 54% of patients were diagnosed with diarrhoea, while 27.8% were diagnosed with acute respiratory tract infections. In 22% of cases (60.8% of cases in children aged 6-12 months), tuberculosis was identified and diagnosed. Diagnoses of malaria and measles were found in 3.8% of patients, and HIV infection was found in 2.9% of patients. In 14.4% of the cases, and in 5.8% of the cases, respectively, there were signs of vitamin B and vitamin A deficiency. Both malaria and HIV were not shown to be significant co morbid diseases in this study.

DISCUSSION

Three biological mechanisms directly related to nutrition include recurrent bouts of diarrhea, soil-borne worm infections (Ascaris lumbricoides, Trichuris trichiura, Ancylostoma duodenale, and Necator americanus), and a subclinical condition of the gut called tropical, environmental or dysfunctional enteropathy environmental enteric dysfunction (EED). The effect of WASH on malnutrition is mediated by exposure to enteric pathogens and symptomatic or asymptomatic infections.[16]

Anaemia, acute respiratory infections, and diarrhoea were the three conditions that occurred most frequently as comorbidities. Previous research has demonstrated that children who are malnourished are more likely to suffer from bacterial infections of the gastrointestinal tract and the respiratory system. The overlapping nature of protein–energy malnutrition and micronutrient deficiencies were well established, and it was discovered that a lack of one micronutrient is frequently accompanied with a shortage of others.[12,14]

According to the findings of our research, anaemia was the most prevalent micronutrient deficiency that was connected with malnutrition. These findings are in line with those of prior investigations. It is possible that dietary variables, in addition to incidental helminthic infections, are to blame for the high prevalence of anaemia found in these children. Other micronutrient deficiencies, such as those revealed in this study, have also been documented in the past with a prevalence comparable to what was seen here.

Our study, like many others, found acute gastroenteritis and pneumonia as prevalent comorbidities. Our study has a higher prevalence than 25–35% studies. Our study population also had increased UTIs and sepsis. Due to skin barrier, mucosal defence, phagocytic, and free radical scavenging abnormalities, SAM children have low humoral and cell-mediated immunity. SAM children are also prone to illness because poor carer cleanliness and handling. SAM children are more susceptible to life-threatening infections include acute gastroenteritis, pneumonia, UTI, and sepsis.[12,15,17]

The frequency of diarrheal diseases regardless of the cause is strongly correlated with growth disorders which shows a causal relationship between diarrhea and malnutrition because malnutrition can increase the likelihood and severity of diarrheal diseases. Repeated bouts of diarrhea cumulatively increase the risk of stunting. A number of specific diarrheal pathogens associated with malnutrition include Escherichia coli, Shigella, Giardia and Cryptosporidium. Soil-borne worm infections are preventable with sanitation and are strongly associated with childhood malnutrition.[16]

Cases of ascariasis and trichuriasis are associated with growth retardation in children. Hookworm infection during pregnancy can cause malabsorption of nutrients and maternal anemia associated with stunting at birth.[18] EED is strongly linked to symptomatic and asymptomatic enteric illnesses. Tropical Enteropathy (or jejunitis) was first described in the 1960s. The 1980s and 1990s name change to EED reflected the rising environmental importance. Asymptomatic EED produces persistent inflammation, impaired intestinal nutrition absorption, and weakened small intestine barrier function. These intestinal anomalies cause growth, development, and immune system problems in children.[16]

There is a complex interaction between the host response and the virulence of the organism in any lung infection that modulates the overall metabolic response and the degree and pattern of tissue loss. Nutritional state affects infection in various studies. For instance, studies in Indonesia, England, India, and Japan found that active pulmonary TB patients have lower nutritional status than healthy controls. Serum albumin is decreased in TB patients. Tuberculosis is a leading cause of severe malnutrition. In Uganda, TB patients had low nutritional status, and in India, they were 11 and 7 times more likely to have BMI <18.5 and arm circumference <24 cm.[19]

Chronic infections, for example, can increase energy requirements to maintain normal body functions, which are characterized by increased energy use at rest, retention energy expenditure (REE). This increase reaches 10-30% of normal people's energy needs.[20] This process causes anorexia due to increased production of leptin resulting in decreased intake and malabsorption of nutrients. Patients with chronic infections such as TB also experience increased proteolysis and lipolysis. Disturbances in intake and metabolic disorders interfere with endogenous protein and fat synthesis so that REE increases. This condition is referred to as a blockade of energy formation (anabolic block) and is associated with a wasting process resulting in malnutrition.[19,21]

Decreased muscle mass is associated with increased production of IL-lβ, IL-6. TNF-α and malondialdehyde (MDA) due to the inflammatory process. The inflammatory process activates the intracellular ATP-dependent ubiquitin protease proteolysis pathway and subsequently TNF-α regulated proteasome breakdown of protein. Increased production of IFN-γ, IL-6, and TNF-α, due to TB infection inhibits the activity of the enzyme lipoprotein lipase (LPL) in adipose tissue. LPL enzymes play a role in the process of cleaning triglycerides. The increase in this enzyme increases the clearance of triglycerides thereby reducing the process of fatty acid synthesis and increasing the process of lipolysis of fat in the tissues. An increase in TNF-α is also associated with anorexia resulting in disruption of nutritional intake which triggers and exacerbates malnutrition.[11]

TNF-α, interferon-γ and interleukin-1 directly inhibit the differentiation and proliferation of progenitor erythroid cells. In

addition, the limited availability of iron and decreased biological activity of erythropoietin cause inhibition of erythropoiesis and anemia occurs. In patients with anemia, malnutrition can cause a person to have abnormal body mass and worsen the patient's prognosis. In patients with anemia there are regulatory abnormalities and nutrition in the body. This nutritional disorder is in the form of a deficiency of albumin, folate, and micronutrients such as selenium, zinc, vitamin B12, vitamin D, and iron so that you have a body mass index below normal.[14]

CONCLUSION

In addition to nutritional rehabilitation, malnourished children also require the timely detection and treatment of co-morbidities such as acute respiratory tract infection, diarrhoea, anaemia, and micronutrient deficiencies in order to break the undernutrition-disease cycle.

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