Review Article

Malnutrition in Children: Analysis of Epidemiology, Risk Determinants and Advances in Management

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Abstract

Malnutrition in children is one of the major health challenges faced worldwide but more frequently in South Asian countries including Pakistan. The objective of this review is to analyse the situation of malnutrition, its risk determinants, assessment and management strategies. This review is based on information collected from PubMed, Google scholar, Medline, World Bank, World Health Organization (WHO), United Nations Children's Fund (UNICEF) websites and books. It is concluded that malnutrition status is improving but at a slower pace. Pakistan has a high prevalence of wasting, stunting, and micronutrient deficiencies.

Keywords: Child malnutrition, wasting syndrome, growth charts, growth disorders, micronutrients.

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Introduction

Globally, malnutrition is one of the primary attention-seeking health issues in children under five years of age. Over decades, no substantial change has been observed in morbidity and mortality caused by under nutrition. Reports have shown that almost 50% of deaths under five years are due to malnutrition[1]. In developing countries, the main causes of morbidity and mortality in malnourished children are infections and micronutrient deficiencies[2]. Nearly 3.1 million deaths in less than five years of age are due to malnutrition, accounting for 45% of all deaths occurring in this age group[3]. This situation has not changed much especially in developing countries like Pakistan.

Although under five mortality rate has reduced from previous years but the major determinants including under nutrition and infections are still not being dealt with effectively.

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Prevalence of stunting has shown slow improvement worldwide. According to the United Nations Children's Fund (UNICEF) more than 220 million children less than five years of age in developing countries had impaired growth while in 2011, 165 million children were stunted[4].

In South-East Asian countries, including Pakistan, the picture is bleak. Earlier reports showed that 34% of all child deaths occurred in South Asia and the region shares almost two-third of the global burden of malnutrition[5]. A survey done in 2006-2009, in Pakistan, of over 12,000 school children, showed that stunting was present in 14%[6]. However, this data was from healthy school children throughout the country in all the provinces, with complete immunisation and no history of hospitalisation for any illness.

Previous national survey reported that stunting increased from 42% to 44% and wasting also increased from 14% to 15% from 2001 to 2011[7]. Recent World Health Organization (WHO) data shows that stunting has increased to 45% and wasting to 11% whereas underweight population has remained static over the years at 32%[7,8]. In Pakistan, under nutrition status among children has worsened.

Reasons for surge of malnutrition in Pakistan are multiple, including poverty, inadequate feeding practices, lack of parental education and maternal malnutrition. Although some progress has been attained by implementation of various assessment and management programs, but still there is enough room for improvement. Keeping in view the grave situation, this review was done to determine the epidemiology, risk determinants and advances in management of malnutrition in children less than five years of age.

This review will add to the existing literature by highlighting the key issues and possible solutions to reduce morbidity and mortality due to malnutrition.

Methods

This review is written after gathering available information on malnutrition from national, regional and internationally published literature, online data and reports available on Medline and PubMed. All available researches on epidemiology, risk determinants and management strategies were scrutinized; further data from the WHO, UNICEF and reports from newspapers and books were also reviewed and recapitulated.

Situation Analysis

Malnutrition, in the less than five year population is considered as one of the major underlying causes of morbidity and mortality worldwide and nearly half of these children belong to Pakistan, India and Bangladesh[9].

Pakistan has not achieved targets set in the millennium development goals; performance is especially lagging in achieving MDG 1, which was to reduce hunger and poverty. Prevalence of underweight in under five and proportion of population below minimum level of dietary consumption is still very high in all the provinces[10]. Health indicators in Pakistan have shown improvement in previous years but at a slower pace. Crucial economic, governance and security challenges have impeded the development all over the country. Cultural barriers to development are compounded by poorly functional health system leading to failure in provision of these services at primary level.

Micronutrient deficiencies, like vitamin A and Zinc are also widespread and responsible for 0.6 million and 0.4 million deaths respectively in children under five[11]. Prevalence of iron deficiency anaemia in children and women has worsened in the last decade[7]. Nearly 40% to 50% children have iron deficiency. Similarly, vitamin D deficiency is quite frequently reported in mothers and children[12,13]. Almost one billion children across the globe are either suffering from vitamin D deficiency or insufficiency[14]. In Southeast Asia, prevalence of rickets was 15% to 18% whereas in various studies from Pakistan it is reported to be in between 55% to 80%[15-17]. Future health policies planning may affect maternal and child mortality rate as a report from WHO highlighted the fact that almost 50% global burden of deaths in under five by the year 2030 will occur in five countries and Pakistan is one of them accounting for 8% of these deaths[8].

Risk Determinants

Malnutrition is primarily due to inadequate dietary intake and poor health according to the conceptual framework developed by UNICEF (Fig 1).

Numerous studies conducted globally have highlighted the nutritional status of under five children and related factors. Lack of maternal education, low income, dwelling in urban areas and lack of clean water supply were found to be major risk factors for malnutrition. In developing countries including Pakistan lack of immunisation also plays a pivotal role in causing malnutrition in children due to infections like measles, diarrhoea and pneumonia[18-20].

Suboptimal breast feeding is also one of the cardinal determinants of under nutrition[21,22].

Growth and development of children relies mainly on good maternal health. Maternal undernutrition contributes to nearly 800,000 neonatal

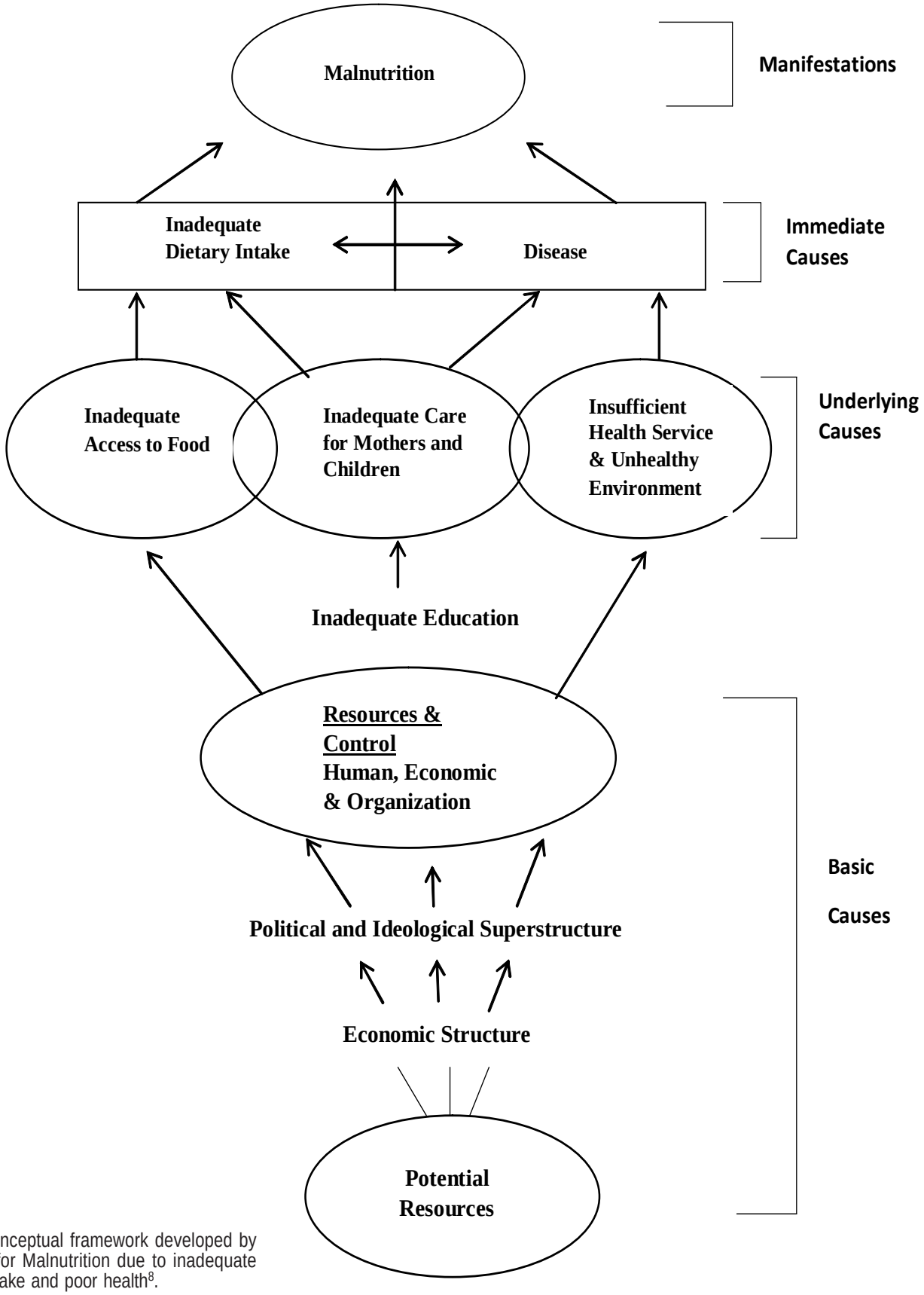

Fig 1. Conceptual framework developed by UNICEF for Malnutrition due to inadequate dietary intake and poor health[8].

deaths annually due to small for gestational age births[3]. Maternal mental status affects the nutritional status of the children. Reports have shown that being underweight and stunting is highly associated with depression and anxiety in mothers[23,24].

Another important determinant is gender inequality; male child preference to female leads to inadequate food supply to the girl child causing malnutrition in future mothers and their children[25]. Lack of women empowerment, women education and influentiality of women has significant impacts on the health of the family and the community. Studies have shown that children whose mothers were not autonomous in decision making were more severely wasted than those children whose mothers were autonomous in decision making[26]. This could be explained by the fact that the provision of joint care by parents requires joint decision on the care or treatment of their children in order to improve nutritional status.

Stunting is the chronic form of undernutrition and can be worsened due to infections like measles, diarrhea and respiratory tract infections. Stunting has an adverse impact on economic productivity and growth. It can reduce a country's gross domestic product by up to 3%[27].

Stunting also increases risk of diabetes, hypertension and stroke secondary to obesity in later life. Many factors contribute to stunting including poor maternal nutrition, inadequate infant and young child feeding practices and infections. Maternal undernutrition causes reduction in early growth and health of the child, reports have shown that intrauterine growth retardation secondary to poor maternal nutrition accounts for 20% of childhood stunting[28]. Other maternal determinants for stunting include short stature, lack of birth spacing and adolescent pregnancy which interfere with nutrient availability to fetus due to increase demands of maternal growing need. Early initiation of breast feeding for six months protects from GIT infections which can lead to severe nutrient depletion and stunting. Proper complementary feeding is also an important factor for prevention of malnutrition; reports suggest that greater dietary diversity and consumption of food from animal sources are associated with improved linear growth[29].

Assessment of Malnutrition

Nutritional status of children can be assessed using weight-for-height z-score or mid-upper arm circumference (MUAC). In the community setting, MUAC is easier as taking two parameters is cumbersome. A MUAC of less than 11.5 cm or a weight-for-height z-score <-3 is classified as severe acute malnutrition (SAM). MUAC is an age and sex independent parameter[30] and is not affected by hydration status[31]. Furthermore, it has been found to be better correlated with mortality[32,33]. Presence of generalized oedema is also classified as severe acute malnutrition. Stunting is indicative of chronic malnutrition. It is defined as weight for height that is more than two standard deviations below the World Health Growth Standard median.

Admission Criteria

All children who are severely malnourished and have complications need hospitalisation. These children have a high risk of dying and need emergency treatment. Children less than 6 months old are admitted if there is failure to gain weight and feeding issues, any pitting oedema or medical complications. SAM children with a good appetite and no complications can be treated in the community with good outcomes[34].

Inpatient Management of Severe Malnutrition

All SAM children are at risk of becoming hypoglycaemic. Blood glucose should be checked immediately and if level is less than 3 mmol/L, a bolus of 50 ml of glucose by mouth or by nasogastric tube is given. In obtunded patients, an intravenous bolus of 10% dextrose is given. Further hypoglycaemia is prevented by early institution of feeding with F75, a special formula, in a dose of 100-130 ml/kg in oedematous and wasted children respectively in 2 hourly doses. Breast-feeding is re-established for children under 6 months or replacement feeding in case of failure. Formula 75 (F-75) and Formula 100 (F-100)are therapeutic milk products designed to treat severe malnutrition. To pre-

vent deaths feeding should begin as soon as possible with F-75 as the starter formula. Hence, F-75 is used by paediatricians during initial management of malnutrition beginning as soon as possible and continuing for 2-7 days until the child is stabilised. Constituent amount per 100 ml. in F-75, F100: Energy, 75 kcal (315KJ), 100 kcal (420 kJ). Depending upon the clinical condition of the child these formulas can be given by nasogastric tube or by cup and spoon methods. F-75 or diluted F-100 formulas are provided as a supplement to children without oedema and F-75 to those with oedema[35].

These children have a predilection for hypothermia because of decreased body mass and fat stores. Presence of infection is an additional factor contributing to hypothermia. All children coming to the emergency room should initially have their temperature recorded. Any temperature reading less than 35ºC is considered to be hypothermic. Steps should be taken to keep the baby warm. Blood sugar should be maintained and intercurrent infection should be treated.

Infections are common in SAM. Diarrhoea is one of the commonest infections[36]. Dehydration in SAM is difficult to assess, as clinical indicators of dehydration are similar. A history of diarrhoea and decreased urine output may help in diagnosis. Septic shock and dehydration are also difficult to differentiate and can co-exist.

A child presenting with dehydration should not receive intravenous hydration unless in shock, in which case 15 ml/kg of Ringer's lactate with 5% dextrose or 0.45% saline with 5% dextrose is given over an hour followed by the same in case of response[35]. Failure of response to first bolus is managed with blood transfusion considering septic shock. All children with shock should initially receive a bolus of 5 ml/kg of 10% dextrose[37].

Severe dehydration is treated with ReSoMal rehydration solution for malnourished children, which has a lower solute load in a dose of 5 ml/kg per hour for 2 hours in severe cases followed by 5-10 ml/kg slowly over 12 hours.

In case of non-availability of ReSoMal, standard WHO low osmolarity oral rehydration solution dissolved in 2 litres instead of 1 litre is used, except in case when cholera is suspected.

Signs of infection are subtle and all children with SAM are presumed to have infection and started with antibiotics. Recommended drugs include ampicillin and gentamycin, although changes can be made according to local antibiotic sensitivities.

Children have to be assessed for micronutrient deficiencies. Iron deficiency anaemia is the most common. Iron is usually given in the second week after resolution of acute infection. Transfusion is done if haemoglobin is less than 4 gm/dl as blood transfusions in severe malnutrition increase the risk of dying[38].

All children should receive adequate amounts of mineral and vitamins. Two doses of vitamin A are given to all SAM children on alternate days in doses of 50,000 IU to infants, 100,000 IU to children until 1 year and 200,000 IU to children above 1 year in those who are not provided with therapeutic foods fortified with Vitamin A. Folic acid is given in a dose of 5 mg on day 1 and 1 mg subsequently. Zinc is given in a dose of 2 mg/kg/day[37].

Discharge Criteria from Hospital

The children are discharged from the hospital once the medical condition is treated; they are eating well and are alert.

Community Management

The subsequent management is done in the outpatient. All SAM children without complications and those with moderate malnutrition are also treated in the community till their MUAC is >12.5 cm or weight-for-height z-score is $\geq$-2 SD and there is no oedema for at least 2 weeks. The same anthropometric parameter used for admission, either MUAC or weight-for-height z-score, is used for discharge from treatment[37].

Children are provided with ready to use therapeutic food, which is energy-dense for rehabilitation.

Children are also given antibiotics to treat infections. Moderate acute malnutrition (MAM) children do not need routine antibiotics.

Conclusion

There is considerable improvement in the nutritional status of children under five year all over the world. Pakistan has a high prevalence of wasting, stunting and micronutrient deficiencies including, iron, vitamin A and vitamin D. Nutritional specific interventions in assessment and management have shown good outcomes. There is further need of devising policies, which should include strategies of provision of micronutrients to mothers and children, promotion of breast feeding and appropriate complementary feeding with adequate perinatal and neonatal care.

Conflict of Interest

Authors have no conflict of interests and no grant/ funding from any organisation for this study.

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