



DIARRHEA AND MALNUTRITION IN CHILDREN IN INDIA: HOW TO BREAK THE NEXUS?

Pediatrics

Viraat Harsh*	Neurosurgery, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India*Corresponding Author
Chewang D Bhutia	Pediatrics, Sikkim Manipal Hospital, Gangtok, Sikkim, India
Ravikant Narayan	Anatomy, All India Institute of Medical Sciences, Patna, India
Sukriti Jha	Anesthesiology, All India Institute of Medical Sciences, New Delhi, India
Amar Verma	Pediatrics, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, India

ABSTRACT

Diarrhea is defined as the passage of three or more loose or liquid stools per day. It is the second most common cause of death in children less than five years of age. Around 1.7 billion cases are being reported every year. It can be acute, persistent or chronic depending upon the duration. Chronic diarrhea in developing countries is often due to intestinal infection that lasts longer than expected. In developed countries chronic diarrhea due to infectious cause is less common and its etiology is more diverse. It may be secretory or osmotic based on the underlying mechanism. Diarrhea per se can lead to malnutrition in children. With each episode their malnutrition status worsens. On the other hand, malnourished children having impaired immunity are at more risk to develop life threatening diarrhea. Most children with fatal diarrhea, dying from severe dehydration and fluid loss, often have underlying malnutrition as well. Diarrhea is both treatable and preventable. In developing countries like India it is mostly related to gastrointestinal infection and can be prevented by measures such as provision of safe drinking water, improved sanitation, personal hygiene, health education, promoting breastfeeding and rotavirus vaccination. Diarrhea can be treated by rehydration with ORS solutions along with zinc supplementation and by intravenous fluids in conditions associated with severe dehydration and shock.

KEYWORDS

INTRODUCTION

The indisputable datum that diarrhea and malnutrition are grave threats to adequate child health necessitates towing of medical attention in both developed as well as developing countries, to break the vicious cycle between the two. There can be no dissent that persistent diarrhea leads to malnutrition which if persists, the frequency of diarrhea will increase, which again will lead to mal-nutrition[1].. About 3.5 million children below 5 years of age die of diarrhea in Asia [excluding China], 80% in the first 2 years of life[2].

Excessive loss of fluid and electrolyte in the stool is defined as diarrhea and it can be acute with sudden onset of excessively loose stool of more than 10 ml/kg/day in infants and more than 200 g/24 hr in older children, which lasts less than 14 days and if it lasts more than 14 days it is called chronic or persistent diarrhea. Based on primary mechanism of it, diarrhea can also be classified as secretory, osmotic, exudative disease type or due to malnutrition[3,4].

Malnutrition comprises of both undernutrition and overnutrition but usually malnutrition is equated to undernutrition in bodies like World Health Organization [WHO] and United Nations Children's Fund [UNICEF][4]. Malnutrition can be classified using Gomez, Waterlow, IAP or Wellcome criteria. The most standard classification for Protein Energy Malnutrition [PEM] is the WHO classification which is modified version of previously mentioned criteria. PEM can be mild, moderate and severe based on multiple parameters such as weight for height [W/H] and height for age [H/A]. Malnutrition can also be classified as Acute, Chronic or Acute on Chronic[5].

Infections, and the malnutrition associated with them, are responsible for a significant proportion of the 13 million deaths among infants and children under 5 years of age worldwide each year. Viral diarrhea caused by viruses such as rotavirus, constitutes one of the most common cause. Vaccines for rotavirus are now available. Common bacterial causes include Escherichia coli [Enteropathogenic E. coli, Enterotoxigenic E. coli, Enteraggregative E. coli etc] and Shigella[6]. Earlier, 'rice water stools' diarrhea due to bacteria Vibrio cholerae was very common[7]. It was controlled by oral vaccines, a nexus thus broken, and a major milestone to diarrhea control in children[8]. Other infectious causes include amoebic [e.g. Entamoebahistoltyca] diarrhea.

Wasting as a component of malnutrition can play a role in the prediction of duration of diarrhea[9]. Studies have shown that if weight for age is less than 70%, it is associated with persistent diarrhea[10]. Many articles and books use the term PDM [Persistent diarrhea-malnutrition syn-drome] to describe this interaction between diarrhea and malnutrition[11].

In the light of available studies and research establishing the link between diarrhea and malnutrition it is our moral as well as legal obligation to take active initiatives to break this vicious cycle increasing the mortality and morbidity in our society.

What are the consequences of diarrhea?

Diarrhea has two basic effects, acute and chronic. Acute effect leads to dehydration and chronic persistent diarrhea [duration 14 days] to malnutrition. Acute cases if left unattended may become chronic over time[11].

In chronic diarrhea, both nutrients and energy are lost. Besides appetite being impaired, quite often the food is also withheld from the child by the mother because of an erroneous belief that rest to bowel promotes early recovery. Some disaccharidases and absorptive mechanisms for glucose and amino acids may be compromised during viral diarrhea, leading to transient carbohydrate malabsorption[12]. Carbohydrates pass in unchanged form in the lower gut raising the intra luminal osmotic pressure and drawing water from gut by osmosis and thus increasing the severity of diarrhea. Intestinal transit time is increased. Resultant villus atrophy leads to zinc, selenium and cadmium deficiency[13]. Zinc is important for local immunity, which if hampered, will invite common and opportunistic infections[14]. The pauci-immune condition can turn out to be very dangerous by deteriorating the condition of the child severely and rapidly with presence of malnutrition. Iron and copper deficiencies also cause villus atrophy thus perpetuating the vicious cycle.

Malnutrition and its interaction with diarrhea

Malnutrition is a biologic manifestation of the combined effects of the inadequate dietary intake of a nutrient and the resulting disease, both of which are closely related to social and economic status. The patient suffers from loss of energy and weakness. There is a drop in the immune threshold of the body and gut villus atrophy, leading to opportunistic infections. In turn, villus atrophy leads to a high propensity to acquire diarrhea.

In India, more than half of the approximately 6000 child deaths per day are caused by malnutrition[15]. Although the exact relationship between malnutrition and diarrhea remains to be established, a few studies have found some connection in their occurrence. One of these studies stated that weight for age in children with persistent diarrhea [69.9%] was significantly lower as compared to that in population control [77.0%] and diarrheal control [76.2%], establishing that weight for age less than 70% is associated with persistent diarrhea[10]. Another study showed a 37% increase in frequency and 73% increase in duration in diarrheal illness and concluded that diarrhea burden [days of diarrhea] in malnourished children is doubled[16].

How to break the nexus?

As we see, malnutrition and diarrhea are causes as well as consequences of each other. Hence, the control over either will not fully restrain the other. Strategy to break the nexus should therefore be focused on both simultaneously. A proper supplementation of nutrients ensures that the loss is over-come. Oral rehydration solution [ORS] should be used with other drugs used for diarrhea treatment. However, the care should be more prophylactic rather than curative alone[17].

Preventive Measures

Preventive medicine urges actions at three levels- agent level, host level and at the level of the environment, enlisted as follows.

Agent level: There are around 20-25 pathogens which cause diarrhea in children, so vaccination, although an attractive strategy is almost impossible practically[18]. However, as the majority of diarrheal diseases are caused by *V. cholerae*, *S. dysenteriae* type-1, rotavirus and *E. coli* which have a high morbidity and mortality, vaccines against these organisms are essential for epidemic control[19]. Also, a recently developed oral cholera vaccine, found to be 6% safe in animal models is under-going human field trials[20].

Host Level: For the management of diarrhea there should be separate diarrhea management wards in all hospitals [21]. It should be well equipped with trained doctors and paramedical staff. The primary aim should be proper care of acute diarrhea cases so that chronic diarrhea and the resulting malnutrition are prevented altogether[22].

At level of the host, nexus breaking can be done by various ways. Methodological analysis has made working in this concern easier if rendered in tiers.

A] Individual level: Personal health and hygiene should be properly dealt with. A health seeking attitude by one and all is desirable. Interactive and efficient health care programs devised by the government should be attended by all and taken benefits from. One should take care of his diet. Parents and custodians should teach their children the importance of balanced diet. Even minor hygienic practices such as hair and nail cutting should be impressed upon. Children, especially in the village should be restrained from playing in dirt. Washing of hands and wiping with dry towel before taking meals is important. One should use only toilets for urination and defecation[23]. Locally producible, easily available cheap food should be encouraged. Food contamination sources include unclean hands, feces, polluted water, flies, pests, domestic animals, unclean utensils and pots, and an unsanitary environment[23]. Beliefs and practices, ignorance, taboos, poverty, insufficient food, social infrastructure, and shortage of fuel and time often make it more difficult to assure food safety[23].

B] Family level: Health education should be given to elderly so they can take care of their dependents[24]. Each and every family should send their children to school, appreciating the free schools run by the government. The importance of family planning should be realized. Girl child should be equally taken care of. The concept of women empowerment for decision making and earning should be realized to practical lives. The mother can then take care of herself and take decisions for proper care of her children and not entirely depend on the man of the family. Breast feeding should be impressed upon[25]. Infants fed on infant formulae have, in contrast to breast fed ones, very low degree of colonization with lactobacilli but high counts of Enterococci, Coli forms and Clostridia[25]. Nutritional supplementation should be done. Immunization of each and every child must be done at the right age as and when required[26]. Iatrogenic restriction of feeding in diarrhea is discouraged.

C] Community level: At community level, child health programs should be run. Schools should emphasize on personal hygiene. Proper advertisements and propaganda methods should be devised to teach about the prevention of diarrhea, use of ORS etc. Anthropometric indices [as Rao's and Kanawati's] and growth curves should be used to assess the development of the child [to exclude malnutrition][27]. Integrated health packages should be encouraged i.e. immunization, chemoprophylaxis against several infections should be given together. Nutritional education should be spread with enthusiasm. The importance of family planning should be taught about. Income generation activities should be encouraged to improve the economic status. Health care should reach village interiors as well.

D] National level: The aim of the government should be allocation of funds and seeing that these reach the hands which really need them. Education should be given importance. Nutritional planning i.e., increased food production and capacity of people to buy nutritious food in adequate quantity, should be done. National Nutrition Policy [1993] aims to improve nutritional status. Its strategies are - fortification of essential food; control of micronutrient deficiency; improving the dietary pattern through production and demonstration; land reforms; popularization of low cost nutritious food; public distribution system; prevention of food adulteration; health and family welfare; nutrition surveillance and communication and community participation[25]. Many non-governmental organizations are working towards the same cause.

E] Global level: UNICEF and WHO are jointly working on many projects to get safe water within reach of the common man[28]. WHO has worked a lot on promotion of ORS. Even women empowerment is being promoted. The World Bank has involved huge sums of money in public interest [28].

Environment level: At the level of environment, the most important is adequate water supply in both urban and rural areas. Care should be taken to supply clean water for both, drinking and bathing. In spite of 'Ganga Action Plan' and 'National River Action Plan' having been launched in India, for cleaning of Ganga water, safe water has not been ensured. In India, less than 40% of the population has access to safe drinking water[29]. Poor environmental sanitation is a major problem that should be dealt with. If sanitation is poor, both air and water get polluted. This leads to air and water borne diseases which may lead to diarrhea[30]. For its control, proper sanitary tanks should be made. There should be proper excreta disposal[30]. In India, lack of governmental concern is seen in this regard[30]. An important reason behind this is lack of adequate funds, in addition to inefficient reaching of allotted funds to the common man in form of the courtesies done by the government.

What Is The Role Of Oral Rehydration Therapy?

ORS was developed on the scientific basis that the absorption capacity of the small intestine remains intact in diarrheal diseases, including cholera and glucose enhances the absorption of sodium and water from the small intestine even during disease process[31]. Composition of Old standard ORS is sodium chloride-3.5, trisodium citrate dehydrate-2.9, potassium chloride-1.5, anhydrous glucose-20 [all figures in g/l], when dissolved in a liter of water has osmolarity of 311mmol/l[32]. The new reduced osmolarity ORS launched in February 2004, which is currently in use is composed of anhydrous glucose-13.5, sodium chloride-2.6, potassium chloride-1.5, trisodium citrate dehydrate-2.9 [all figures in g/l], when dissolved in a liter of water has osmolarity of 245 mmol/l [33]. ORS should be given in small sips. Large gulps may stimulate gastro-colic reflex resulting in quick passage of stools and vomiting [32].

The standard ORS solution was able to decrease the death count due to diarrhea from 5 million to 2 million annually, yet it was not found to be satisfactory enough, so there emerged a need for improved ORS solution in the past 20 years[33]. As compared to standard ORS the new reduced osmolarity ORS has been found to reduce stool volume by 25%, vomiting by 30% and the need for unscheduled IV therapy by more than 30% which has been a boon as it reduces the incidence of hospital acquired infection, less disruption of breastfeeding, decreased use of needles and less cost [33].

An alternative strategy is use of Home Available Fluids [HAF][34]. Global Control of Diarrheal Disease [CDD] Programme [WHO; 1978] proposes a three-tier strategy for ORT [either ORS or HAF]

implementation at community level[35]. In first tier, mothers give HAF [which in India includes sugar-lemon solution with rice water, vegetable soups, lassi, fish or meat soups]. Village based trained health workers make the second tier. In most severe cases, the third tier, our health centers and hospitals, is called into action. The seventh National Five-year Plan formulated the basis of National Diarrheal Diseases Control Programme which emphasizes the use of HAF to cut down expenditure of Government funds for ORS supply[36].

Curative Measures

In diarrhea protein is lost as well[37], so the food given should be easily digestible and nutritionally balanced. Gut nutrients promote sodium and water absorption and hasten intestinal epithelial recovery, because food stimulates rapid cell turn over and lining epithelia renewal. Food should be enriched with fat-sugar-oil[37] [e.g. khichri with ghee or rice with milk] and contain less fiber.

The WHO approved safe drugs used in diarrhea are nalidixic acid, ciprofloxacin, ofloxacin and cotrimoxazole[32]. Lately, norfloxacin has been found to be superior to nalidixic acid in Shigellosis management[32]. Along with general treatment, special emphasis should be given on pro-biotic role of bacteria, which normalizes the gut micro flora colonization, as an alternative to anti-biotics, known as Microbial Interference Treatment [MIT][32] e.g. Salmonella typhimurium, Shigella, Clostridium, E. coli and Campylobacter.

Zinc replenishment is done in dose of 15-20 mg/day[32], whatever may be the age of the child. Single dose of 200,000 IU of Vitamin A can be given in deficiency[32].

Children with severe dehydration should be given IV fluid along with ORS [38]. Ideal IV fluid is Ringer's lactate solution with 5% extra dextrose [38]. Normal saline [0.9% sodium chloride] may also be used. Reassessment should be done continually until a strong radial pulse is obtained[32].

Novel agents like glutamine and its derivatives and arginine enhance mucosal recovery and hence recovery from diarrhea, but their role in management of PDM is not well established[38]. Trials with amino acid-based elemental feed [AAF][11] and super solution fortified with gly-cine[39] have reported positive results in the management. Treatment options with Ready-to-use Therapeutic food [RUTF] is also being experimented for its efficacy[40].

CONCLUSION

With the upcoming 21st century and dawn of new technological techniques it is evident that we have enough information about the causative agents, their transmission methods and management and prevention strategies for diarrhea control. The risk factors are well known and studies have shown that low family income, deprived mother's educational and awareness, unhygienic latrines, flies in domestic environment, dirty appearance of child and mother, unsanitary habits while bathing and washing hands, children defecating on floor, improper breast feeding, eating contaminated food, such as that on the floor by children, deviation from recommended weaning food are few important ones to be taken care of, which if ignored will lead to increased incidence of PDM syndrome[41]. Vaccination seems a promising hope in the future but for now, a mere persistent coordinated effort by the government, NGOs and also private practitioners is needed. Diarrhea-malnutrition interaction represents a dangerous web which can be detangled by prevention of disease transmission by promoting exclusive breast feeding, hygienic weaning practices, safe drinking water [by water harvesting] and hand washing, improved nutrition, vaccines against enteropathogens and promotion of standard case management with special emphasis on nutritional support and rehabilitation. While discussing about the interaction of diarrhea and malnutrition, E.D Nel [38] emphasized on managing them through measures which correct the morbid state of an individual by correcting dehydration, improvising specialized feeding formulas along with curative measures like Zinc supplement, Vitamin A supplement and introduction of novel agents. To add new initiatives to current strategies on managing the nexus of diarrhea and malnutrition we suggest a more holistic approach integrating activities at different strata of society and environment around us. Strong political will, improvement in sanitation, proper excreta disposal, health education, women empowerment etc. are prerequisites that would help to break the nexus. These preventive measures are to be organized at the level of

agent, host and environment. Beginning from the individual and family level and reaching upto the global level, awareness and measures to control the risk factors are needed. These along with curative measures including antibiotics, RUFT, zinc, vitamin A and newer novel agents together with a search for super solution in addition to usage of current ORS formulation for dehydration can bring a halt to this chain of morbidity. A single action is no good in achieving our purpose but bringing together all the components of this puzzle for managing this vicious cycle is needed.

REFERENCES

- Opintan JA, Newman MJ, Ayeh-Kumi PF, Affrim R, Gepi-Attee R, Sevilleja JEAD, et al. Pediatric diarrhea in Southern Ghana: Etiology and association with intestinal inflammation and malnutrition. *Am J Trop Med Hyg*. 2010;83[4]:936-43.
- Pelletier J-G. Severe Malnutrition: A Global Approach. *Child Trop*. 1993;208-9.
- Gadewar S, Fasano A. Current concepts in the evaluation, diagnosis and management of acute infectious diarrhea. Vol. 5, *Current Opinion in Pharmacology*. 2005. p. 559-65.
- Katsilambros N, Dimosthenopoulos C, Kontogianni MD, Manglana E, Poulia K-A, editors. *Clinical Nutrition in Practice*. Wiley-Blackwell; 2010.
- The use of epidemiological tools in conflict-affected populations: open-access educational resources for policy makers [Internet]. London School of Hygiene and Tropical Medicine. 2009. p. 115. Available from: http://conflict.lshmt.ac.uk/page_115
- Gracey M. Diarrhea and malnutrition: a continuing pediatric challenge. *Saudi J Gastroenterol*. 1995;1[3]:145-51.
- Albert Balows BID. Topley & Wilson's microbiology and microbial infections. Vol. 92, *Transactions of the Royal Society of Tropical Medicine and Hygiene*. 1998. p. 470.
- Weekly epidemiological record No. 16, 20 APRIL 2001 [Internet]. 2001. Available from: <http://www.who.int/wer>
- Patwari AK. Diarrhoea and malnutrition interaction. *Indian J Pediatr* [Internet]. 1999;66[1 Suppl]:S124-34. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/11132459>
- Bhandari N, Bhan MK, Sazawal S, Clemens JD, Bhatnagar S, Khoshoo V. Association of antecedent malnutrition with persistent diarrhoea: a case-control study. *BMJ* [Internet]. 1989;298[6683]:1284-7. Available from: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1836499&tool=pmcentrez&rendertype=abstract>
- Amadi B, Mwiya M, Chomba E, Thomson M, Chintu C, Kelly P, et al. Improved nutritional recovery on an elemental diet in Zambian children with persistent diarrhoea and malnutrition. *J Trop Pediatr*. 2005;51[1]:5-10.
- Musher DM, Musher BL. Contagious acute gastrointestinal infections. *N Engl J Med*. 2004;351[23]:2417-2427+2466.
- Fuchs GJ. Possibilities for zinc in the treatment of acute diarrhea. *Am J Clin Nutr* [Internet]. 1998 Aug;68[2 Suppl]:480S-483S. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/9701164>
- Russell RM, Suter PM. Vitamin and Trace Mineral Deficiency and Excess. *Harrison's Principles of Internal Medicine* [Internet]. 2015; Available from: <http://mhmedical.com/content.aspx?aid=1107537981>
- Kotecha P V. Micronutrient Malnutrition in India: Let Us Say "No" to it Now. *Indian J Community Med* [Internet]. 2008 Jan;33[1]:9-10. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/19966988>
- Guerrant RL, Schorling JB, McAuliffe JF, De Souza MA. Diarrhea as a cause and an effect of malnutrition: Diarrhea prevents catch-up growth and malnutrition increases diarrhea frequency and duration. In: *American Journal of Tropical Medicine and Hygiene*. 1992. p. 28-35.
- A manual for the treatment of diarrhoea. Geneva. World Health Organization; 1980. 25 p.
- Weekly Epidemiological Record, No. 37. World Health Organization; 2007.
- Readings on diarrhoea : student manual [Internet]. Geneva; World Health Organization; 1992. 147 p. Available from: <http://www.who.int/iris/handle/10665/40343>
- Clemens JD, Sack DA, Harris JR, van Loon F, Chakraborty J, Ahmed F, et al. Field trial of oral cholera vaccines in Bangladesh: results from three-year follow-up. *Lancet*. 1990;335[8684]:270-3.
- Guidelines for Cholera Control [Internet]. Geneva; World Health Organization; 1980. 68 p. Available from: <http://apps.who.int/iris/bitstream/10665/36837/1/924154449X.pdf>
- Clinical Management of Acute Diarrhoea, WHO and UNICEF Joint Statement. Geneva; World Health Organization and New York; United Nations Children's Fund; 2004.
- Wagner EG, Lanoix JN. Excreta Disposal for Rural areas and Small Communities [Internet]. Geneva; World Health Organization; 1958. 95 p. Available from: <http://apps.who.int/iris/handle/10665/41687>
- Green LW. National Policy in the Promotion of Health. *J Inst Heal Educ*. 1979;17[3].
- National Nutrition Policy. New Delhi: Government of India, Department of Women & Child Development, Ministry of Human Resource Development, New Delhi; 1993. 25 p.
- Towards a better future : maternal and child health [Internet]. Geneva : World Health Organization; 1980. 42 p. Available from: <http://www.who.int/iris/handle/10665/38978>
- Gopalan C, Chatterjee M. Use of growth charts for promoting child nutrition; a re-view of global experience. New Delhi: Nutrition Foundation of India; 1985. 120 p.
- UNICEF-WHO Joint Committee on Health Policy. Geneva; 1987.
- ICMR : Manual of Standards of Quality for Drinking Water Supplies--New Delhi: Indian Council of Medical Research. New Delhi Indian Council of Medical Research 1962; 1962.
- Kawata K. Environmental Sanitation in India. Lucknow Publishing House; 1963.
- SC DSCADPDDSSBJNPJ. Oral fluid therapy for cholera and non-choleraic diarrhoeas in children. *TT - J Commun Dis*. 1975;7[2]:124-8.
- Bhan MK, Mahalanabis D, Pierce NF, Rollins N, Sack D, Santosham M. The treatment of Diarrhoea: A manual for Physicians and other Senior Workers [Internet]. WHO/CDD/SE. Geneva : World Health Organization; 2005. 50 p. Available from: <http://apps.who.int/iris/bitstream/10665/43209/1/9241593180.pdf>
- New formulation of Oral Rehydration Salts [ORS] with reduced osmolality, UNICEF technical bulletin No. 9 [Internet]. 2001. Available from: https://www.unicef.org/supply/files/Oral_Rehydration_Salts%28ORS%29.pdf
- Yartey J, Harisson EK, Brakohiapa LA, Troph DO, Nkrumah FK. Carbohydrate and electrolyte content of some home-available fluids used for oral rehydration in Ghana. *J Trop Pediatr*. 1993;39[4]:234-7.
- World Health Organization. Treatment and prevention of acute diarrhoea: guidelines for the trainers of health workers. World Health Organization. 1985.
- Chaturvedi BK. Report of the Committee on Restructuring of Centrally Sponsored Schemes [Internet]. New Delhi; 2011. Available from: http://planningcommission.nic.in/reports/genrep/rep_css1710.pdf
- Bhatnagar S, Bhandari N, Mouli UC, Bhan MK, IAP National Task Force. Consensus Statement of IAP National Task Force: status report on management of acute diarrhoea.

- Indian Pediatr [Internet]. 2004 Apr;41[4]:335–48. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/15123862>
38. Nel ED. Diarrhoea and Malnutrition. South African J Clin Nutr. 2010;23[sup1]:15–8.
39. PATRA FC, MAHALANABIS D, JALAN KN, SEN A, BANERJEE P. In Search of a Super Solution: Controlled Trial of Glycine???Glucose Oral Rehydration Solution in Infantile Diarrhoea. Acta P???diatrica. 1984;73[1]:18–21.
40. Weber JM, Ryan KN, Tandon R, Mathur M, Girma T, Steiner-Asiedu M, et al. Acceptability of locally produced ready-to-use therapeutic foods in Ethiopia, Ghana, Pakistan and India. Matern Child Nutr. 2017;13[2].
41. Maung U K, Khin M, NyuntWai N, Win Hnlan N, TheinMyint T, Butler T. Risk factors for the development of persistent diarrhoea and malnutrition in burmese children. Int J Epidemiol. 1992;21[5]:1021–9.