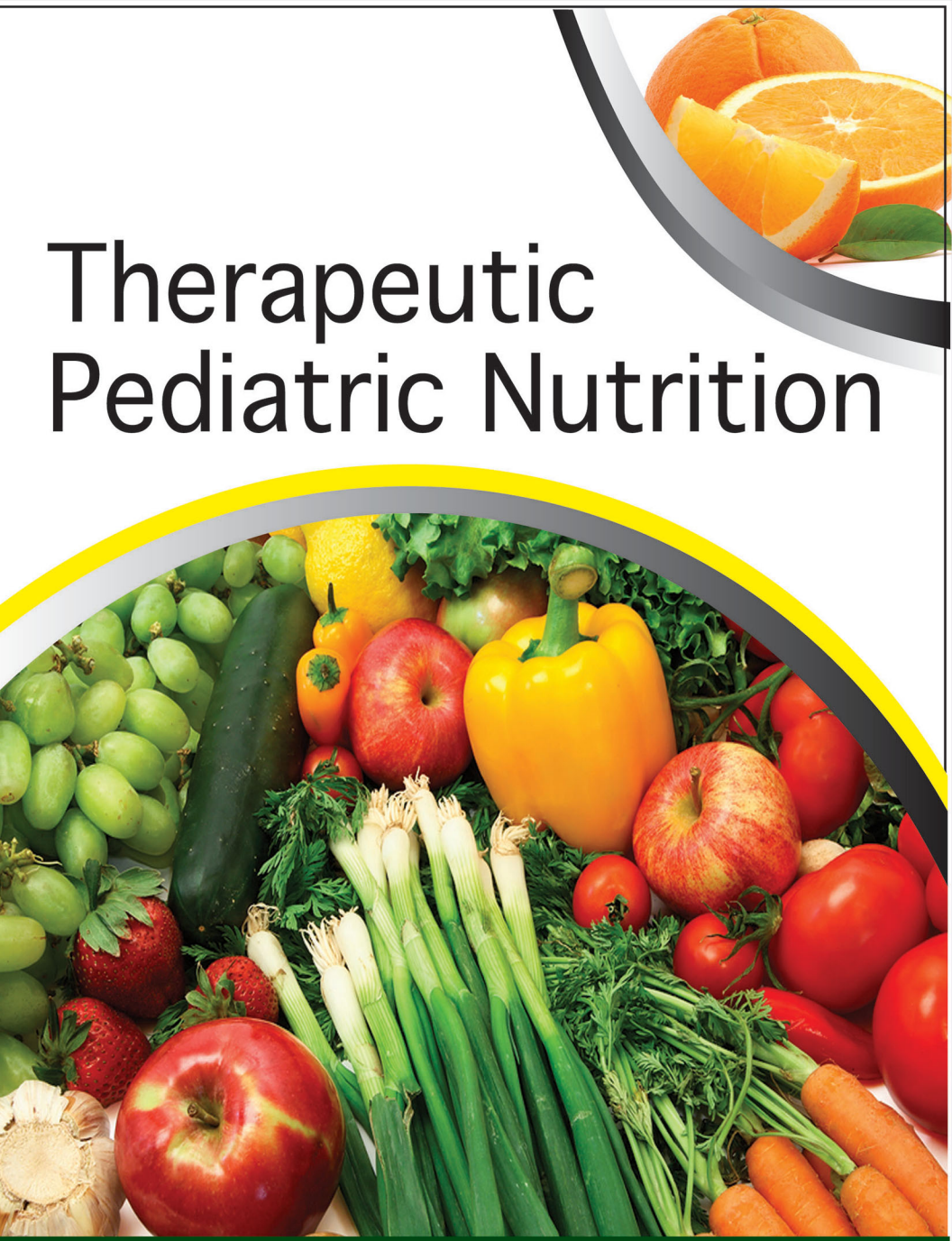

Therapeutic Pediatric Nutrition

Madhu Sharma

Foreword
BNS Walia

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Chapter 4

Nutrition in Diarrheal Diseases

Diarrhea in children can be consequent to infections too besides chronic problems as malabsorption as discussed in Chapter 3. In industrialized societies, this still remains a significant cause of postneonatal morbidity and mortality. It accounts for nearly 40 percent of childhood morbidity and mortality and is highest during the weaning period up to the second year of life. Overcrowding, poor sanitation, and poor feeding hygiene like bottle feeding are the main predisposing factors for acute diarrhea leading to malnutrition.

Based on duration of the diarrhea, we can discuss this problem under 2 categories:

A. Acute diarrhea.

B. Persistent diarrhea.

ACUTE DIARRHEAS (AD)

Acute diarrheas can be a result of acute infections as mentioned earlier in this chapter and is likely to resolve within a few days. But repeated episodes of AD can result in poor appetite, reduced intake and hence reduced absorption of nutrients. Nutritional management therefore is of prime importance to prevent the child from slipping into the cycle of infection and malnutrition.

Nutritional Management of AD

A common practice observed in the developing countries during acute episodes of diarrhea is to withhold feeding. This leads to increased losses which are not able to be met. It also delays the repair of the intestinal mucosa and reversal of digestive enzymes, besides malabsorption of important micronutrients. The concept that feeding increases the stool volume and length of illness is totally unfounded. A number of studies have demonstrated the beneficial effects of early feeding during the course of the illness and the resulting shorter duration of hospital stay. [1,2]

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Oral Rehydration Therapy (ORT)

The first step to consider in the management of AD is to tackle the dehydration if existing. ORT is the mainstay of the initial treatment. The oral rehydration solution (ORS) recommended by WHO contains 20 g glucose, sodium chloride, 3.5 g, sodium bicarbonate 2.5 g or sodium citrate 2.9 g and potassium chloride 1.5 g to be mixed in 1 liter of water.[3] However it was found that this composition of ORS proved to be hyperosmolar most of the time since the electrolyte content of noncholera stool is such that, it contains only about 56 mmol/lt of sodium and potassium of about 25 mmol. By using this ORS, a state of hyperosmolarity may be achieved which can only worsen the diarrhea. Some authors have also termed this solution as oral dehydration solution (ODS) instead of ORS.[4] Therefore, it would be prudent to assess the type of diarrhea before choosing the type of ORS. A more user friendly ORS has been formulated-the hypo-osmolar ORS and the super ORS, which is rice based

Among the hypoosmolar solutions available, two are more common:

a. With sodium 75 and glucose 75 mmol/lt.
b. With sodium 60 and glucose 24 mmol/lt

The super ORS solution contains starch 40 g instead of 20 g of glucose per packet.[4] The advantage of using super ORS is that it decreases the stool output by 25 percent, besides avoiding nutrient compromise in the child during the diarrheal episode. Normal feeding is otherwise affected during acute episodes, resulting in significant nutrient losses. By using super ORS which is rice based, some amount of feeding can be ensured. This has been aptly demonstrated by various studies, where a decrease in stool output too was reported by 28 percent and ORS consumption too decreased by 27 percent.[5]

Dietary Management

Adequate feeding during the episodes of diarrhea can not be over emphasized. Anorexia is a common feature observed during any illness but may vary on the type of illness. Febrile illnesses are more prone to lead to decreased intake especially in children. In diarrheal episodes, though there may not be frank anorexia, children and even mothers themselves, prefer to feed only plain liquids more than solids, e.g. water, clear soup, milk, lime juice or even fruit juice. Infants on breastfeeds must be allowed to continue on the same. In fact, it has been demonstrated that infants fed on breast milk during AD, gain weight better and are prevented from going into a state of malnutrition. Moreover, cessation of breastfeeds is known to exert a deleterious effect on the nutritional status

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of the child, besides increasing the risk of dehydration 5 times as compared to breastfed infants.[6]

In the acute diarrheal episode most children may be lactose tolerant, therefore, withdrawing of milk from their diet should be avoided, unless and until the child has had a history of lactose intolerance earlier. Bhan and his team have had a vast experience on the management of such children and have recommended a calorie intake of at least 125 percent of the normal required with nutrient dense foods and should be continued till the child achieves the preillness weight and normal nutritional status.[7]

WHO has formulated some guidelines for the feeding schedule of infants and children during AD episodes, which is tabulated as in Table 4.1.[8,9]

As evident from this table, stress has been made on continuation of breastfeeds in young infants. This also helps maintenance of lactation in the mother for a longer duration and also ensures better milk production due to the sucking stimulus. For older children or the nonbreastfed infants, animal milk can be offered but, it should be full strength, as soon as dehydration is corrected, as has been advocated by numerous authors.[9,10]

Older children can be fed on a mixed diet of cereal, pulse and vegetables, with addition of oil/ghee/butter for increasing the density without increasing the bulk. Milk cereal combinations are also well tolerated

Table 4.1: Feeding during acute diarrhea

Stage of hydration and feeding pattern	*Recommended schedule of feeding*
A. During rehydration phase	
• Breastfed infants	Continue breastfeeds
• Nonbreastfed infants	preferably give ORS till rehydration. Beyond 4 hours, animal milk/food
• In severely malnourished children	offer some food as soon as possible
B. After rehydration phase	
Breast fed infants	continue breastfeeds more frequently
Non breast fed infants	offer undiluted animal milk/formula as before
Infants 4-6 months	add energy dense cereal/pulse supplements
Older children	give energy dense thickened feeds with oil-pulse (K rich) and green leafy vegetables, carrots, etc. encourage feeding 6 times a day

(WHO, 1991).

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even among the slightly lactose intolerant children. Amylase rich factor (ARF) can be made use of to reduce the viscosity of the feeds.

NUTRITIONAL MANAGEMENT OF PERSISTENT DIARRHEA

Persistent diarrhea (PD) or protracted diarrhea is defined when the duration of passage of stools exceeds 14 days. The state of hydration may or may not be preserved. Growth faltering and severe malnutrition are characteristic features in this condition. This is due mainly to inadequate intake and in most cases with malabsorption.

PATHOGENESIS OF PERSISTENT DIARRHEA

The pathogenesis in PD may involve digestion and absorption of all the nutrients—carbohydrates, proteins and fats.

In carbohydrate malabsorption usually there is disaccharide deficiency due to the decreased luminal amylase resulting in impaired exocrine pancreatic function. Lactose enzyme is the one which is mostly affected, leading to secondary lactose intolerance. This condition is frequently encountered following rota viral diarrheas where the villous tip cells are partially damaged. Lactose enzyme being the first to be affected is also the last to be restored for adequate absorption of lactose.

Sucrase enzyme too can be affected leading to malabsorption of sucrose in protracted diarrheas. These can lead to ineffective villous repair or prolonged mucosal injury in malnourished children. This in fact also can be the cause of PD.

Steatorrhea is often associated in PD due to insufficient pancreatic lipase or due to the defect in bile acid metabolism. Similarly protease activity in the pancreatic secretion may also be compromised, especially in children with PD.

Cow's milk protein intolerance (CMPI) is sometimes associated with PD and can be seen in children below 6 months of life. The β-lactoglobulin fraction in cow's milk is the cause for CMPI in such children. Milk antibody and IgE are increased in the mucosa in this condition, and this itself can lead to PD also. Such children may also be known to be intolerant to soya protein and may present with blood and mucus.

Finally, PD can also result from abnormal bacterial colonization in any part of the gastrointestinal tract. Breastfed babies are however prone to be protected from such attacks. It is mostly the older children who are on mixed diet or formula feds, who may be affected by such over growth of bacteria. Common examples are the *Clostridium difficile* and bacteriodes.

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DIETARY MANAGEMENT

As emphasized earlier, infants below 6 months already on breastfeeds should be continued on the same. Older infants will however not be satisfied with breast milk alone nor will their nutritional needs be met with only breast milk.

Dietary manipulation in older children presenting with diarrhea depends upon the malabsorptive state of the child. They may be partially lactose intolerant to sucrose besides lactose. Children presenting with PD generally might already have been fed on milk based diets for the first week or ten days. In such children the lactose load can be decreased by substituting curd for milk or buttermilk too can be offered also. For older infants beyond 6 months, cereal and milk based formulae can be used where the total quality of milk used is quite less. Rice is the most preferred cereal used. Rice can be made into flour which makes it easier to cook into porridge or gruel form. Some of the formulae used have been recommended by the Indian Academy of Pediatrics as shown in Tables 4.2 and 4.3. These provide approximately 80 cals./100 ml and about 2.5 g/100 ml of protein.

These feeds can be given by nasogastric route also in cases where oral feeding is difficult to achieve. It is generally observed that children who are difficult to feed and are put on tube feeding, generally regain their appetite within 5-6 days and if oral feeding is restored over a period of time nasogastric feeds can be stopped.

Table 4.2: Low lactose diets for infants (milk with rice) (4-12 months)

Ingredients	*Amount*	*Calories (%)*	*Proteins (g %)*
Milk	75 ml	52	2.6
Rice	5 g	17	0.4
Sugar	2.5 g	10	-
Water	100 ml		
Total		79	3

Lactose content-4.5 g percent.
(IAP, 2006).

Table 4.3: Curd with rice feed

Ingredients	*Amount*	*Calories (%)*	*Protein (g %)*
Curd	75 ml	45	2.3
Rice	5 g	17	-
Sugar	2.5 g	10 ml	-
Water	100 ml	72	2.7

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At this stage, the feeds can be made slightly thicker, to make them more calorie dense, by either increasing the amount of cereal or addition of oil proportionately. Coconut oil, a good source of medium chain triglyceride (MCT), can be used successfully to avoid further deterioration of malabsorption. Older children can be given a mixed cereal pulse based family diet, e.g. 'khichdi', which is traditionally used even otherwise in Indian families. Banana is a good calorie dense supplement and also potassium rich, and hence can be used for most children.

There are also a considerable percentage of children who may not tolerate lactose based and may need to be taken off milk/curd completely. This is evident from the perianal excoriation seen in children with continuous purging. In such cases, a total milk/curd free feed is advised, where in cereal pulse based diets like blenderized khichdi can be fed. Some of these feeds are shown in Tables 4.4 and 4.5.

Egg white based feeds along with rice powder, glucose and oil has also been formulated by WHO,[10] but in the Indian context, due to certain religious and cultural constraints, it may not be well accepted.

Only rice based formulae should be used for infants below 6 months of age at this stage. The gut malnutrition in terms of enzymes is more efficient after the age of 6 months and secondly too early introduction of variable proteins may also lead to hypersensitization in some cases. Rice is considered the least allergenic among the cereals, therefore, it is better to begin first with rice based feed alone and then gradually add other protein sources. An example of rice based formula is given in Table 4.6. This formula is slightly low in calories and also in proteins, but the

Table 4.4: Lactose free diets
cereal pulse based feeds (sweet)

Ingredients	*Amount*	*Calories (%)*	*Protein (g %)*
Rice	15	48	1.2
Moong dal	5	17	1.1
Sugar	2.5	10	-
Oil	2.5	22	-
Water	100	97	2.3

Table 4.5: Cereal pulse based feeds (salty)

Ingredients	*Amount*	*Calories (%)*	*Proteins (g %)*
Rice	4.0 g	13.8	2.7
Moong dal	6.0 g	21.0	14.7
Oil	5.0 ml	45.0	-
Water	100 ml	80	1.7

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Table 4.6: Rice gruel (sweet)

Ingredients	*Amount*	*Calories (%)*	*Proteins (%)*
Rice	5.0 g	17	0.3 g
Sugar	4.5 g	18	4
Oil	3.0 g	27	-
Water	100 ml	62	0.3

Table 4.7: Comminuted chicken feed

Ingredients	*Amount (g)*	*Calories*	*Proteins (g)*
Chicken	100	110	26
Glucose	50	200	-
Coconut oil	50	440	-
Water	1000	750	26

(Per 100 ml of feed contains 75 cal. and 2.6 g of protein).

energy can be increased by addition of more oil, preferably MCT, and the protein content can be enhanced by addition of any commercially available protein supplement like protinex. Most of the supplements available are skim milk based, therefore care should be taken to read the labels before using them in such feeds. Other lactose free commercial supplements available are soyal, prosoyal, zerolac nusobee and Simyl MCT. These contain in addition some essential micronutrients, like vitamins and minerals and varying amounts of taurine, carnitine and MCT.

It has been observed that some children, who are lactose intolerant, are also intolerant to soya protein, and therefore these children can not be offered such feeds. In such situations, the only option left is to use rice based feeds and pulses can be added in older infants comminuted chicken feeds may also be tried.

A small percentage of infants may not respond to even lactose free diets as they may be intolerant to sucrose also. In such cases, lactose and sucrose free formulae have to be used which are available commercially. These have been tried successfully in many centers.

Some centers also use comminuted chicken for lactose and sucrose free diets (Table 4.7), but due to religious issues, these are not very commonly popular.

Once the child is put on any of the above-mentioned feeds, the quantity can be gradually increased. Small frequent feeding, about 5-6 times a day helps ensure adequate nutrient intake and also in faster recovery. Older children can be fed with the home based solid diets without including lactose. It may be borne in mind, that once the child slips into a state of PD, the

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recovery also is a slow process. The lactose enzyme which is the first to be affected is also the last to return to normalcy. It is usually about 4-6 weeks by the time lactose foods can be reintroduced successfully. Therefore, low lactose diets may first be introduced, like curd, which can be tried initially and gradually milk based porridge or gruels can be initiated. The amounts may be small first and gradually increased as tolerance improves.

In case if a child with chronic or intractable diarrhea fails to respond to the above regimen, parenteral nutrition (PN) needs to be considered. The major part of energy is provided by the fat emulsion mixture, containing essential fatty acids. However, PN has its own disadvantages, if used over a prolonged period. Hence, it should be given only till the oral intake is restored.

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Therapeutic Pediatric Nutrition

Salient Features

- Deals with nutritional management of a sick child
- Outlines principles of therapeutic nutrition in ailments of different body systems
- Explains all therapeutic managements
- Useful tool of learning for students of nutrition and dietetics, nursing and also physicians dealing with ailments of pediatric population.



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