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Review Article

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The Effect of Oral Nutritional Supplements in Improving the Condition of Children with Diarrhea: A Systematic Review

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ABSTRACT

Despite advances in the understanding of disease pathogenesis and treatment, diarrhea remains the primary cause of death among children around the world. Nutrition plays a significant role in treating diarrheal diseases. Malnourished children who have infectious diarrhea are at great risk of developing prolonged and more severe symptoms. The objective of this study was to review the effects of oral nutritional supplements on children with diarrhea. A systematic search for information was conducted using specific keywords in several databases. The results showed that oral food supplements are effective in reducing the symptoms of diarrhea, and the success rate with some formulations reached 100%. The rate of success and failure of formulas of oral nutritional supplements is dependent on the ingredients and foods used: Supplements high in zinc and fiber, as well as the foods yogurt and lactose-free milk, had the greatest impact on the success rate. Oral nutritional supplements are an effective way to reduce the duration and symptoms of diarrhea and can be used to treat diarrhea.

Keywords: Diarrhea; Signs and symptoms; Dietary supplements; Food; Formulated; Infant formula; Child

INTRODUCTION

Despite significant advancement in our knowledge of the pathophysiology and management of diarrhea, it continues to be one of the world's top causes of infant mortality [1]. Diarrhea, the second most common cause of mortality worldwide in children under 5 years, claims the lives of 2,195 children per day, mostly in developing and middle-income nations. The prevalence of the disease is disproportionately high in south-east Asia and Africa [2].

Diarrhea-related mortality has decreased globally in the last 30 years, but it is still a leading cause of death in children [3,4], who are especially prone to diarrhea and dehydration. According to the Centers for Disease Control and Prevention, globally, approximately one in nine child deaths occur each year as a result of diarrhea and its consequences [5]. The most frequent causes of acute and chronic diarrhea are viral infections, bacterial infections,

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traveler's diarrhea, drug interactions, and side effects. Norovirus link and rotavirus link are two viruses that can cause diarrhea. Acute diarrhea is frequently brought on by viral gastroenteritis [6].

Rotavirus is the most common cause of acute diarrhea in the world. According to the Centers for Disease Control and Prevention, rotavirus infection causes hospitalization in 40% of children under the age of 5. Worldwide, most deaths caused by diarrhea are brought on by contaminated water sources and poor sanitation. Diarrhea can be broken down into three basic categories: inflammatory, watery, and fatty (poor absorption). Three categories of watery diarrhea exist: osmotic, secretory, and functional [7,8].

With chronic diarrhea, the signs and symptoms of the disease remain for at least 4 weeks and may be ongoing or intermittent. Acute diarrhea often lasts 1 to 2 days and resolves on its own. Persistent diarrhea lasts longer than 2 weeks but less than 4. Symptoms of chronic diarrhea could last for more than 4 weeks [9,10]. Many cases of diarrhea are brought on by an infection in the digestive tract, which can be caused by bacteria, viruses, or parasites. The bacteria that most typically cause acute diarrhea are *Shigella*, *Campylobacter*, and *Salmonella* [11].

Various viruses can cause diarrhea, including the Norwalk virus (also known as the norovirus), enteric adenoviruses, astroviruses, and cytomegaloviruses, as does viral hepatitis. Rotavirus also causes acute diarrhea in children [12]. Rotavirus, calicivirus, as well as enteropathogenic and enterotoxigenic *Escherichia coli* account for the moiety of all diarrheal deaths in children aged 5 to 14 [13]. In the industrialized world, functional diarrhea is most frequently caused by irritable bowel syndrome, with inflammatory bowel disease being a secondary cause of chronic diarrhea [14].

Nutrition is an important factor in diarrheal diseases. Children who are malnourished and have ongoing diarrhea are more likely to experience prolonged and serious illness. Extreme diarrhea can cause weight loss. Although serum albumin or other protein fractions are unaffected by acute or chronic diarrhea, fecal protein loss increases significantly [15]. As a result of increased awareness of the nutritional complications of diarrhea, greater emphasis is now placed on managing an appropriate diet [16]. If the nutritional needs of a person cannot be met through food alone, oral nutritional supplements (ONSs) offer a means to take in extra nutrients, such as protein and energy. A lack of appetite, reduced dietary intake, increased nutrient requirements, or poor nutrient absorption brought on by illness may result in nutritional needs not being met [17].

Diarrhea is a disease with a microbial origin and, in humans, it can be caused by different microorganisms. ONSs, among the treatments prescribed to reduce and alleviate the symptoms of diarrhea, are generally formulated with different compounds [18].

Treating diarrhea in patients with the right rehydration therapy and ongoing feeding of a nutritious diet is best [19]. Therefore, intravenous administration of fluid is advised for initial recovery from dehydration due to diarrhea, followed by oral rehydration therapy (ORT) with an oral rehydration solution (ORS) to adjust for fluid losses. ORSs are used to treat diarrheal dehydration and replace lost fluids in cases of mild to moderate dehydration caused by diarrhea [20,21].

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The choice of feeding formula can affect intestinal function and benefit a person's nutrition. Such formulas can change the physiology of the intestine by altering intestinal transit, secretory capacity, and absorption, which will change the flora in the intestine [22,23].

A low FODMAP1 formula may reduce the possibility of diarrhea developing in patients who are enterally fed: FODMAPs are short-chain carbohydrates that are poorly absorbed and have an osmotic effect. The formula's fiber content can help prevent diarrhea and help colonocytes to create short-chain fatty acids. SCFAs are produced by the unabsorbed carbohydrates of the colonic microbiota and are absorbed by the colonic epithelial cells, leading to stimulation of sodium-dependent liquid absorption. These acids therefore play a role in regulating intestinal movement and maintaining the integrity of the intestinal barrier [24-26].

To lessen or avoid diarrhea, ingesting prebiotics, nonviable probiotics, or probiotic derivatives should be attempted [27-30]. Drinking fluids—such as an ORS—containing water, salt, and sugar is the primary method of treating diarrhea [31]. Some of the best probiotic strains for treating diarrhea include *Lactobacillus rhamnosus* GG and *Saccharomyces boulardii* [32].

ONSs have been developed as food for typical medical aims to manage disease-related malnutrition. The goal of using an ONS is to increase dietary intake without cutting back on meals or other forms of feeding assistance [33]. However, no systematic reviews investigating the effect of ONS on children with diarrhea have been conducted. The purpose of this study was to determine the effect of oral nutrition and food products with the greatest effect on reducing the symptoms and complications of diarrhea in children.

MATERIALS AND METHODS

Search method

A systematic search was conducted using the keywords, listed in the table below, across the three databases of PubMed, Science Direct, and Web of Science on November 11, 2022.

Eligibility criteria, article selection, and data collection

The study population was determined to be children under 5 years old. Therefore, any studies on adults were excluded from the present review. The intervention that we investigated

Databases	Keywords
Web of Science	(((((((((TS=nutrition functional foods)) OR TS=("medical foods")) OR TS=("food supplement")) OR TS=("nutrition supplementation")) OR TS=(ONS)) OR TS=("long-term supplementation")) OR TS=("nutritional adequacy")) OR TS=("enteral feeding")) OR TS=("nutritional support")) OR TS=("protein calorie malnutrition")) OR TS=("nutritional status")) OR (((TS=(formulation)) OR TS=(food formula)) OR TS=(oral nutritional supplementation)) OR TS=("nutritional supplement") AND ((TS=diarrhea) AND ((TS=(children)) OR TS=(infant)) OR TS=(kid)
PubMed	(((diarrhea[Title/Abstract]) OR (diarrhea[MeSH Terms])) AND ((("children"[Title/Abstract] OR "child" [MeSH Terms] OR "kid"[Title/Abstract]))))) AND ((((((((((((((((((((nutrition functional foods[Title/Abstract]) OR (medical foods[Title/Abstract])) OR (nutraceutical[Title/Abstract])) OR (food supplement[Title/ Abstract])) OR (nutrition supplementation[Title/Abstract])) OR (ONS[Title/Abstract])) OR (RUTF[Title/ Abstract])) OR (ready to use therapeutic food[Title/Abstract])) OR (liquid oral nutritional supplements[Title/Abstract])) OR (long-term supplementation[Title/Abstract])) OR (nutritional adequacy[Title/Abstract])) OR (enteral feeding[Title/Abstract])) OR (nutritional support[Title/Ab- stract])) OR (protein calorie malnutrition[Title/Abstract])) OR (supplement[Title/Abstract])) OR (nutri- tional status[Title/Abstract])) OR (oral nutritional supplementation[Title/Abstract])) OR ("nutritional supplement"[Title/Abstract]))) OR (((formulation [Title/Abstract] OR food formula [Title/Abstract])))
Science Direct	((diarrhea)) AND (("children")) AND ((((((("liquid oral nutritional supplements")) OR ("long-term supple- mentation")) OR ("nutritional adequacy") OR ("protein calorie malnutrition")) OR (supplement)) OR ("nutritional status")) OR ("oral nutritional supplementation") OR ((formulation) OR (formula))

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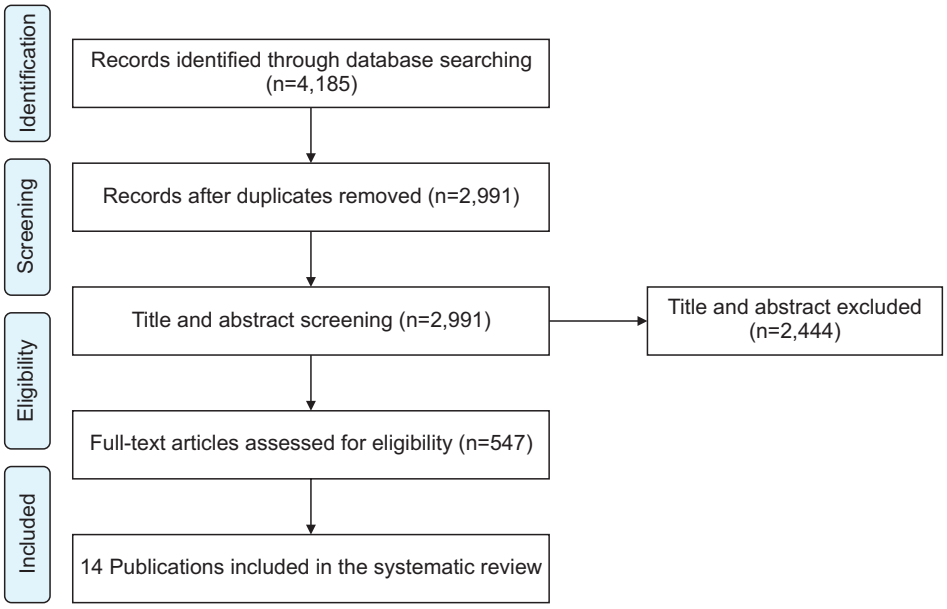

Fig. 1. Flowchart showing the selection process for studies.

was that of oral nutritional supplementation; therefore, supplements that were formulated and administered in parenteral or enteral form were also excluded. Also, we examined commercially available formulated food supplements; therefore, studies in which homemade prepared food supplements or supplements in the form of medicine or even probiotics were administered were excluded (**Fig. 1**).

RESULTS AND DISCUSSION

The results of the studies (**Table 1**) [16,19,34-45] showed that ONSs had a significant effect on reducing the complications of diarrhea and improving the condition of patients. Some studies reported failure rates ranging from 2.35% to 13.2%, which is different to that of the formulated food item. What was evident was that nutritional supplements showed significant effects on reducing stool in children with diarrhea, as well as on both increasing the absorption of macronutrients and body weight.

Therapeutic dietary supplementation

Alternative approaches to controlling critical diarrhea in infants through nutrition include providing oral nourishment during the critical phase of illness, withholding food during illness, and compensatory overfeeding during recovery. From a public health perspective, frequent feeding appears to be the preferred option, especially for populations with high rates of diarrhea and secondary malnutrition [16]. Eating foods with high osmolality after presenting with diarrhea and vomiting can increase the frequency of diarrhea and vomiting [40].

Dehydration is the primary concern with diarrhea; however, negative nutritional effects can also occur if management of nutrition is not properly implemented. Several factors cause acute diarrhea to have a detrimental impact on the nutritional status of affected children: Firstly, anorexia and food withdrawal can hinder the adequate intake of nutrients. Additionally, carbohydrates, fats, proteins, and micronutrients are often poorly absorbed.

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Table 1. Formulation of dietary supplements administered to children with diarrhea and outcomes

Conclusion	Outcome	Formula	Year	Reference
Infants fed a cereal-based diet without milk had significantly lower energy intake and weighed less than infants fed cow's milk.	The average weight increase between hospitalization and recovery days was significantly lower in group A (2.0±4.2 g/kg/24 hours) compared to group B (5.8±7.8 g/kg/24 hours), with a *p*-value of less than 0.05.	Rice+lentil+coconut oil sugar+dried milk.	1988	(34)
Eating a CSO diet during the first healing period provides good nutritional outcomes.	Of the patients, 93% were effectively managed and treated according to their prescribed treatment protocol.	A dietary formula containing casein, sucrose, maltose and dextrin (dextrin-maltose) with vegetable oil yielding 110 kcal/kg body weight/day (CSO-110).	1988	(16)
Chicken formula was an effective alternative to expensive elemental formulas for continued enteral feeding in malnourished children with chronic diarrhea.	The mean ratio of diarrhea was similar in both groups.	Two formulas made for two groups: Chicken formula and LAD formula with enteral feeding.	1989	(35)
The carbohydrate concentration in the baby formula tested had a significant impact on fecal output, as well as on the absorption of fat and energy.	No significant differences were observed between the high carbohydrate and low carbohydrate feeding times in terms of weight gain, peak respiratory hydrogen levels, or stool osmolality.	Two formulas with a base of corn syrup solid, glucose, starch, medium-chain triglyceride, corn, and high-oleic safflower were made in carbohydrate level difference.	1990	(36)
Ready-made supplements may be a good alternative to commercial samples.	Fecal outputs were higher for the PM group than for the other groups.	The WP group were given wheat flour, toasted pea flour, carrot flour, vegetable oil, and cane sugar; the SF group were given a lactose-free, soy protein isolate formula; and the PM group were given a mixture of potato flour, dry whole milk, and the same carrot flour, vegetable oil, and sugar.	1991	(37)
Diluted cow's milk was less tolerated by infants with severe diarrhea, whereas Portagen was more effective.	Patients with Portagen had very few bowel movements within 72 hours of refitting and required minimal amounts of intravenous fluids.	No detail of the formulas is provided, only that participants were divided into five groups, each receiving cow's milk with different types.	1991	(38)
The MCP diet can be safely used in children with acute, watery diarrhea without risk of therapy failure or increased fecal output.	The stools of children in the MCP group were significantly less loose.	Maize-cowpea-palm oil diet (MCP group).	1994	(19)
The blended diet had better clinical results than the lactose-free soy protein isolate formula.	Six cases of therapy failures were noted in the SF group. The period of diarrhea in the MD group was significantly shorter than that in the SF group.	Rice+chicken+carrots+beans+vegetable oil (MD group) or a soy formula (SF group).	1994	(39)
Early feeding of high-energy protein foods should be essential in treating undernourished children with diarrhea and may be essential in preventing malnutrition and undernutrition.	The rates of weight gain were similar between early and late supplementation but, at 28 days, infants receiving supplementation showed greater weight gain than those receiving early supplementation.	Maize-soybean+flour+vegetable oil+dried skimmed milk+sugar +water.	1996	(40)
Feeding adequate amounts of yogurt as a semisolid diet to undernourished children with severe diarrhea provides no clinical usefulness compared with milk.	The median percent weight gain of infants fed milk formula was increased at the end of the 72-hours study (p=0.04) and during recovery (p=0.02).	Prepared formula or yogurt, rice, and lentil oil gruel.	1998	(41)
The period of antibiotic-induced diarrhea was greatly reduced in infants fed soy formula with added soy fiber.	The mean duration of diarrhea was 25.1±5.2 hours for infants fed formula with added fiber and 51.6 ±10.7 hours for infants fed conventional formula.	Commercial soy formulas with or without added soy fiber.	2001	(42)
Adding Benefiber to a chicken-based diet improved recovery in children with chronic diarrhea, suggesting a potential treatment for chronic diarrhea.	The duration of diarrhea was significantly reduced in children who received the study dose.	Comminuted chicken-based diet supplemented with Benefiber.	2001	(43)
A reasonable and globally accessible yogurt-based diet is suggested as the first choice for the nutritional control of mild to moderate persistent diarrhea.	Infants fed a yogurt-based diet (diet 1) or an amino acid-based diet (diet 4) experienced a significant decrease in stool production and duration of diarrhea.	Diet 1, yogurt-based formula; diet 2, soy-based formula; diet 3, hydrolyzed protein-based formula; and diet 4, amino acid-based formula.	2009	(44)
Special treatment of hospitalized infants with very poor feeding, when combined with lactose-free, low-carbohydrate breast milk, does not improve clinical outcomes.	Side effects did not differ between groups.	Low-carbohydrate F75 milk	2019	(45)

CSO: casein, sucrose, and vegetable oil, LAD: hydrolyzed lactalbumin, PM: potato flour, dried whole milk, carrot flour, sucrose, and oil, MCP: maize–cowpea–palm, MD: rice+chicken+carrots+beans+vegetable oil, SF: soy formula.

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Even with mild infections, excessive loss of nitrogen is likely to occur through the urine and stools. Moreover, metabolic demands are generally high when fever and systemic illness are present. Repeated gastrointestinal tract infections can result in long-term consequences such as stunted growth, malnutrition, and potentially impaired cognitive development. However, the nutritional effects of diarrheal illnesses on well-nourished individuals in developed countries are less severe and have not been extensively studied [46].

Two conflicting approaches to managing the nutrition of individuals with acute diarrhea exist. In one approach, reducing oral intake during illness is recommended to prevent diarrhea caused by intestinal malabsorption. The alternative approach supports continued feeding to avoid negative nutritional consequences. However, studies conducted in Arizona and Peru provided compelling evidence that children who were treated orally had shorter recovery times, depending on the duration of the illness [46]. When all children were fed orally, the success rates were similar to those achieved when children were fed intravenously (91.5% vs. 97.1%) [16].

General agreement has been reached that breastfeeding should be continued during episodes of acute diarrhea. Moreover, the importance of utilizing ORTs to substitute fluid and electrolyte losses during episodes of acute diarrhea is now recognized. However, the selection of foods to feed non-breastfed infants with severe diarrhea is controversial. In children, carbohydrate intolerance is a common complication after infectious diarrhea, especially in those infected with a rotavirus and *E. coli* [38].

Previous studies have shown that the causes of infectious diarrhea may aggravate certain types of bowel disease. For example, Sack et al. [16] reported greater loss of carbohydrates in the feces with rotavirus infection than with enterotoxigenic diarrhea. Malnourished infants with severe and chronic diarrhea often have malabsorption of carbohydrates and monosaccharides. Absorption of macronutrients was improved when the low carbohydrate formula was consumed and, compared to formulas high in carbohydrates, significantly less total fecal energy was noted; this was the result of lower carbohydrate excretion, greater fat absorption, and a significantly greater absorption coefficient for fat [36,37,47]. High levels of visceral fat are observed when infants are fed formula containing carbohydrates. When infants are fed a low carbohydrate, high fat formula, intestinal secretion may increase because hydroxy fatty acids are produced by intestinal bacteria using the fat that was not absorbed. This issue does not seem to frequently occur. Carbohydrate content has a greater effect on formula tolerance and absorption of macronutrients in infants with chronic diarrhea than fat content [36].

Amount of energy

In general, except for children with kwashiorkor, those with protein-deficient, non-edematous malnutrition should begin nutritional rehabilitation with an initial energy intake of approximately 100 kcal/kg/day (e.g., with F-75 formula). The energy supply should then be gradually increased over the following days, typically reaching 150 kcal/kg/day by day 4 or 5. Once clinical stabilization is achieved and the rehabilitation phase begins, children may be allowed to feed ad libitum, with energy intakes of 150–200 kcal/kg/day, which are generally well-tolerated and associated with weight gains exceeding 10 g/kg/day (WHO Pocket Book; WHO Nutrition Guideline; related clinical studies) [48-50].

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Diarrhea treatment

Approximately 1.7 billion cases of diarrhea in children occur each year. Diarrhea is a common gastrointestinal disease with multiple causes that negatively impacts quality of life. Although most patients recover on their own, targeted intervention could enhance self-healing and alleviate discomfort [51].

Important dietary differences are associated with the type of dietary management implemented. Increased basal intake not only improves nutritional status during and after recovery, but is also directly related to the net absorption of macronutrients. Although patients undergoing intravenous treatment have shown a decrease in stool during the first 48 hours of hospitalization, their stool output showed a similar increase to that of other groups after oral dosing was initiated. This study observed that children who received oral treatment produced nearly double the amount of stools than those who received intravenous treatment [16].

Lactose-free milk powder

Liu et al. [49] investigated the potential use of lactose-free formula as a treatment for diarrhea. In their study, a rat model of diarrhea was created using a combination of clindamycin, ampicillin, and streptomycin. The rats with diarrhea were then treated with either regular formula or lactose-free formula; the effects and mechanisms of lactose-free milk powder on diarrhea were assessed through enteric pathology and analysis of the gut microbiota. The results showed that administering lactose-free milk powder accelerated recovery from antibiotic-associated diarrhea by improving the gut microbiota and integrity of the intestinal barrier [51].

In one study, well-nourished Apache infants were given either a full-strength, lactose-free, soy-based formula immediately after rehydration or gradually reintroduced to formula after 48 hours of ORS administration. The group given the full-strength formula experienced a 50% reduction in stool output and duration of diarrhea compared to the group with gradual reintroduction [46,52].

Similarly, in Peru, four different feeding regimens were compared in children with acute diarrhea. The groups initially given ORS or intravenous fluids followed by formula feeding had significantly less stool output in the first 48 hours, but this difference disappeared once food was introduced. Moreover, the duration of diarrhea and failure rates were similar across all four groups. Importantly, the level of dietary energy intake was positively correlated with nitrogen balance, energy absorption, weight gain, and changes in arm circumference and skinfold thickness [46,53].

These findings strongly support the recommendation that full-strength, lactose-free formulas can be safely introduced immediately after rehydration therapy, leading to improved nutritional outcomes and reduced stool output [46]. In 1994, Maulén-Radován et al. [39] found that all treatment failures occurred in the soy milk group, possibly due to adverse intestinal effects caused by the diet or the combination of the diet and soy milk. Soy formula may cause adverse reactions due to contamination by microorganisms during preparation, storage, or feeding, or intolerance to certain ingredients [39].

Lactose, rather than sucrose or dextromaltose, is better tolerated in soy protein formulas. Data suggest that the digestibility, absorption, and tolerability of lactose may vary with different types of milk, with the worst outcomes achieved with unmodified cow's milk. Breast

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milk, which is relatively high in lactose, is well tolerated by infants with severe diarrhea. Infants with severe diarrhea do not tolerate diluted cow's milk well during the early stages of illness. A formula containing casein, a high proportion of medium-chain triglycerides, and corn syrup solids has been found to be effective [38].

Yogurt

Patients randomized to a yogurt or amino acid-based diet showed less diarrhea and shorter stool duration. Besides enhancing stool production and reducing the duration of diarrhea, another important aspect of effective diets is to avoid altering the initial diet to align with the new diet. These diets have a success rate of 100%. Foods based on casein and hydrolyzed amino acids have a digestive advantage over other foods and, in conditions associated with malabsorption, their use may result in better and shorter recovery times. However, according to a study by de Mattos et al. [44], published in 2009, this effect was only shown when the amino acid-based diet was used; use of the yogurt-based diet produced better results than use of the casein hydrolysate diet [54].

The protein source in yogurt-based formula is whole milk protein—known worldwide as the most allergenic protein for infants and children—and does not interfere with patient recovery. This nonallergenic PD pattern could be explained by the probiotic effects of yogurt and the presence of enzymes that promote intraluminal digestion [44,55].

One study compared full-strength milk to yogurt: The lactose in yogurt was better absorbed, as evidenced by the high proportion of children in the milk group with 1% or more stool reducing substances. However, this did not lead to an increase in stool weight or a long duration of diarrhea. Milk intolerance was rarely observed in a hospital during diarrhea in children. Although this was not significant, stool weight was 16% higher in the dairy group. Results of this study suggest that no significant clinical benefit can be gained by replacing yogurt with several small meals with other semisolid foods in children with severe diarrhea associated with malnutrition. In developing countries, milk is more readily available; therefore, it may be better tolerated and more likely to facilitate weight gain than yogurt [41].

The yogurt diet should be the diet of choice for children with mild to moderate PD. If a satisfactory response cannot be achieved with a yoghurt-based diet, an amino acid-based diet should be considered as a second option for nutritional management. Due to the low fiber intake from dietary supplements used in this study, dietary fortification showed no effect on the fiber content of the dietary supplement. Loose stools were made more solid, providing the child with relief and easing parental concerns regarding the return of children to daycare, particularly if the diarrhea persisted [44,55].

Zinc supplementation

In new guidelines for treating diarrhea, the World Health Organization and the United Nations both recommend zinc supplementation (10–20 mg/day for 10–14 days) [44]. Interventional studies have demonstrated that administering zinc during acute diarrhea effectively decreases the length and intensity of the illness. Consequently, utilizing zinc as a therapeutic treatment has the potential to decrease the 2.5 million childhood deaths caused annually by diarrhea. A recent analysis combined data from multiple studies: The results revealed that when healthcare professionals administer zinc, a slight positive impact on the likelihood of continuation of diarrhea is observed. The overall reduction in

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the risk of prolonged diarrhea, defined as an episode lasting 7 days, was 20%, although the confidence interval was broad and included 1 [56].

Research has indicated that diarrhea can impact zinc levels due to the decreased intake of zinc through diet, as well as hindered absorption and increased loss of zinc through the intestines. Conversely, zinc deficiency, which is linked to compromised immune function, can also contribute to higher rates of diarrhea. Severe zinc deficiency is consistently associated with the presence of diarrhea, which can be rapidly resolved through zinc supplementation. Furthermore, even mild to moderate zinc deficiency has been reported to cause diarrhea in humans [57].

Maize–cowpea–palm oil diet

Children receiving MCP diets—a mixture of fermented maize flour, toasted cowpea flour, palm oil, and sugar—had lower stool output than those receiving control diets, although these differences were not statistically significant after controlling for baseline differences between the study groups. No clear evidence that dietary intake of MCP worsens diarrhea was reported [19].

After recovering from diarrhea, infants in the MCP group had a greater stool weight. This finding was unexpected because infants without diarrhea had a greater stool weight when fed beans, corn, or other fiber-rich diets compared to those fed a low-fiber diet. A main finding of the study was that the energy intake between food groups was significantly different. Children in the SF group (lactose-free, soy protein isolate formula) consumed approximately 20% to 25% more energy per kilogram of body weight than those in the MCP group. The reason for this finding was unclear, but possible explanations included the different tastes, fat contents, macronutrient profiles, and micronutrient densities, as well as differences in bioavailability. Some researchers have proposed that children may consume a greater quantity of a liquid diet compared to a semisolid mixture with the same energy density; however, the findings of this study showed that reducing the viscosity of milk had no positive effect on the total energy intake of infants without diarrhea. Recent studies suggest that dietary fiber may explain these differences in stool length [19,58].

Other supplements

Consuming wheat or potato noodles and cow's milk has been shown to provide up to 50% of energy in children with diarrhea without increasing the risk of medical complications. These foods have also been used to treat children aged 5 to 36 months with diarrhea. Compared to children who were fed soy milk powder, the mean duration of diarrhea was significantly shorter in children who were fed a combined diet of carrots, rice, chicken, beans, oil, and water, possibly due to the higher fiber content. Poultry meat has excellent digestibility and is a source of high-quality protein; it is also used to treat intractable diarrhea and acute diarrhea. When used in an ORS, rice is generally digested almost entirely to carbohydrates: This has been associated with modest reductions in the severity and duration of diarrhea.

Children with diarrhea respond well to beans, which are a good source of protein and energy [39,59,60].

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CONCLUSION

Diarrhea is a disease caused by microbial agents, which can be treated with oral food supplements. Using these supplements can reduce the duration and complications of the disease, and they can be provided as oral nutrition for patients. Food supplements are formulated using different food compounds, depending on the intended application. The number of calories in nutritional supplements varies according to the intended application. Using nutritional supplements that contain at least 75 kJ of energy reduces the risk of malnutrition and weight loss in patients after the disease period. Using oral food supplements according to prepared formulas reduces the duration of diarrhea and increases the absorption of macronutrients. Foods that show great effect in controlling diarrhea include fiber, zinc, short-chain fatty acids, lactose-free milk, and yogurt. Although these foods have a positive effect in treating diarrhea, short-chain carbohydrates have a negative effect.

LIMITATION

One limitation of the present review is that most of the studies included were conducted in developing countries that have weak healthcare systems. Acknowledging that the environmental and population characteristics in these regions may differ from those in other parts of the world is important. Therefore, the generalizability of the findings to more developed regions with strong healthcare systems may be limited. Considering these factors as potential limitations of this paper is crucial.

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