International Journal of Community Medicine and Public Health
Babonji MS et al. Int J Community Med Public Health. 2021 Jun;8(6):3146-3150
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20211949

Review Article

Common malabsorption syndromes in different pediatrics age

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Received: 01 May 2021
Accepted: 17 May 2021

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ABSTRACT

The process of digestion involve many organs that include the small intestine, pancreas, gall bladder, related blood vessels and lymphatics. The small intestine which constitutes a large surface area of the gastrointestinal tract (GIT). The presence of the villi, absorptive spaces and enzymes directly contribute to the absorption of almost all elements. On the contrary, malabsorption syndromes is a condition that prevent the absorption of certain nutrients and fluids. Our present literature review mainly aimed to discuss the common malabsorption syndromes and their related etiologies in pediatric patients. We have classified our discussion based on the deficient nutrients for easy delivery and based on the specification of the etiology per each nutrient. Many studies have shown that some disease have been previously commonly reported with the development of different malabsorption syndromes such as inflammatory bowel diseases, celiac disease, autoimmune enteropathies and other congenital disorders. Furthermore, patients with malabsorption syndromes usually present with diarrhoea, steatorrhea and other GIT symptoms such as idiopathic pain and flatulence, but there are no specific symptoms associated with any of these syndromes. Efforts should be directed to understand more about the pathophysiology of some disorders, especially the congenital and idiopathic ones in order to achieve a better management and to enhance the prognosis of the affected patients.

Keywords: Malabsorption, Pediatric, Gastrointestinal, Diarrhea

INTRODUCTION

The major function of the GIT is to absorb nutrients and minerals such as proteins, fats, carbohydrates and vitamins. The definition of malabsorption is the lack and absence of the ability of any part of the tract to absorb certain nutrients while maldigestion usually refers to the inappropriate or the reduction of digestion of nutrients at some point of the GIT within the lumen. It is well-known, however, that absorption and digestion are two relevant keywords while maldigestion and malabsorption are totally different from each other.[1] Among studies in the literature, it has been found that causes of malabsorption

have been regularly overlapped with maldigestion.[2,3] On the other hand, previous investigations specified the etiology of malabsorption as factors influencing the digestive and absorptive capacity of the small intestine, gall bladder and pancreas.[4]

Causes of malabsorption are hugely variable as many factors can cause either maldigestion or malabsorption. A study has shown that there are some factors that might lead to malabsorption which includes congenital factors which might impair the transporting ability of the small intestine across the membranes; impaired digestion and absorption of some nutrients; reduced intestinal motility; disorders causing significant damage to the intestinal mucosa; infections, impaired functions of the intestinal flora, compromised lymphatic drainage and impaired blood flow.[2,5] These causes might stand alone or might be multiple affecting small or universal parts of the intestine which lead to malabsorption of one or multiple elements of the ingested nutrients and minerals.[6]

The process of digestion involve many organs that include the small intestine, pancreas, gall bladder, related blood vessels and lymphatics. The small intestine which constitutes a large surface area of the GIT. The presence of the villi, absorptive spaces and enzymes directly contribute to the absorption of almost all elements.[7] For proper digestion to occur, solid integration of the functions of these parameters must be present. In addition, good performance of other factors such as enzymes, motility and mucosal integrity must obtain the best outcomes from digestion and absorption. The presenting manifestations of malabsorption syndromes are not specific and are hugely variable.

However, diarrhea, GIT pain and steatorrhea are the most common symptoms that patients usually present with. In pediatric patients, the severity of the disease cannot be ignored as it might cause skeletal deformities, developmental delays, anemias and weight loss.[8,9] Besides, the management of malabsorption can be challenging and it depends on the underlying etiology.[9] Therefore, a proper diagnosis is the key element to proper management.[10,11] Our present literature review mainly aimed to discuss the common malabsorption syndromes and their related etiologies in pediatric patients.

METHODOLOGY

A systematic search was conducted to identify relevant studies in the following databases: PubMed, Medline, Web of Science, Embase, Google Scholar and Scopus. The following search terms were used (malabsorption or malabsorption syndrome) and (pediatric or children or infant or adoloscents or baby). The reference lists were manually searched to identify additional relevant studies meeting inclusion criteria. We included any study that reports common malabsorption syndromes and their related etiologies in pediatric patients. No restrictions were applied.

DISCUSSION

Fat malabsorption

Fat malabsorption is a type of malabsorption syndromes that remains one of the most common types that results from the inappropriate absorption and/or digestion of fats within the intestinal lumen. The main process of fat digestion and metabolism is called emulsification which refers to the process where fats are suspended in aqueous humor within the intestinal lumen to adequately increase the surface area of the exposed fats to the digestive enzymes. The process of emulsification starts when food enters the mouth as chewing and lingual lipase followed by gastric juice digestive processes which play important roles in this process. However, almost all of the ingested fats reach the duodenum intact and the main bulk of digestion and absorption takes place within the small intestine at the beginning of the duodenum. Pancreatic, gastric, enzymes and bile salts are also released into this process and play vital roles.[12] Many causes have been correlated with fat malabsorption and are discussed in the following section.

Zollinger-Ellison syndrome can reduce the absorption of fat by acidifying the medium within the duodenum through increasing the secretion of gastric acids. Reduced intestinal absorptive capacity is also another cause that has been previously reported to cause fat malabsorption. This might be attributable to many diseases as Crohn's, ulcerative colitis and coeliac diseases which all cause impairment of the intestinal mucosa and reduced absorption. Small bowel resection and the short-bowel syndrome have also been frequently reported among pediatric patients to cause fat malabsorption. Furthermore, diseases affecting bile acids synthesis and secretions might also impact the process of lipid digestion and absorption. Liver diseases such as hepatic viral infection, amyloidosis and hepatic cells cirrhosis lead to cholestasis which might affect the synthesis and release of the bile acids that lead to reduced fat degradation and digestion.[13-15] Bacterial overgrowth has also been previously reported to affect the normal physiological degradation of fats by impacting the functions of the bile acids. The phenomenon might be caused by various events as the presence of inflammatory bowel diseases and significantly impacted pH of the small intestine by drugs or disorders. Bacterial overgrowth should be differentiated from what happens with coeliac disease because the latter is probably diffuse and affects a large continuous portion of the small intestine.[16] The early identification of these problems is essential to achieve an excellent prognosis due to the increasing trends of bacterial resistance to antibiotics.[17] It has also been previously reported that disorders affecting the pancreatic exocrine functions are also relevant for causing fat malabsorption in pediatric patients as a result of the impaired secretion of important digestive pancreatic enzymes that are essential for lipid digestion and metabolism. Some of the disorders that might affect the

pancreas that include chronic pancreatitis which might be owing to chronic biliary obstruction, cystic fibrosis, resection of the pancreas, pancreatic cancer and Schwachman syndrome. In addition to cystic fibrosis, some other genetically determined disorders might also cause fat malabsorption syndrome. Lipoprotein and chylomicron impaired secretions have been previously reported as abetalipoproteinemia which has been directly linked to a mutation in the MTP gene.[12] Another common etiology for pediatric chronic diarrhea has been lymphangiectasia of the small intestine.[18,19] Moreover, whipple disease that is caused by *Tropheryma whipplei* has also been reported to cause significant weight loss and diarrhea which is a major link between the symptomatology and the prementioned symptoms of malabsorption.[10,20] This indicates that there was proper investigations for patients suffering from malabsorption. Symptoms should be considered due to the various etiologies that are associated with similar symptoms. There is a need to establish a proper diagnosis to achieve a better management and to enhance the prognosis of these patients.

Carbohydrate malabsorption

Carbohydrates represent a vast majority of the human dietary components while lactose, starch and sucrose can be easily digested into monosaccharides to be easily absorbed. Cellulose is not digested and passes with the stools unchanged and some of it might be fermented by the colonic flora and converted into fatty acids for utilization of energy. Therefore, symptoms of malabsorption related to carbohydrate metabolism might be specific to flatulence, bloating and excreting acidic stools.[12] Many causes have been reported in the literature to cause carbohydrate metabolism in pediatric patients and are discussed in the following lines. One of the main and common causes is the deficiency of pancreatic amylase which is essential for primary carbohydrate degradation. Reduced disaccharidase activities are also another important common factor that is correlated to some other etiologies which include trehalase, sucrase, and lactase deficiencies. Hypolactasia is the most common cause of disaccharidase deficiency.[21,22] Besides, decreased absorptive capacity of the small intestine is another common factor that can mainly contribute to the development of carbohydrate malabsorption syndromes. On the other hand, celiac disease is a major contributing factor for such events as the disease is associated with unexplained exaggerated sensitivity to gluten. Patients with this disease should not necessarily present with common GIT symptoms but anemia is a common finding.[23-25]

Tropical sprue is another common etiology that has been reported among studies in the literature. The disease commonly affects all segments of the intestine and is usually associated with megaloblastic anemia, overgrowth of intestinal bacteria and is usually diagnosed among patients that reside in the tropical regions.[26-28] Another study has shown that autoimmune enteropathies have also been previously discussed to cause carbohydrate malabsorption among pediatric patients and they are usually a group of disorders that affect the GIT in addition to the presence of other related organic comorbidities.[29,30] As previously mentioned that fat malabsorption and intestinal lymphangiectasia can lead to carbohydrate malabsorption and to develop a related manifestations. Inflammatory bowel diseases as Crohn's disease and ulcerative colitis have also been previously reported among studies in the literature review to cause carbohydrate metabolism in pediatric patients diagnosed with secondary. As a result, it induce a serious damage to the intestinal mucosa such as decreasing the absorptive capacity and the functions of the affected areas.[31,32] Pediatric carbohydrate malabsorption might be also attributable to other causes. These include the presence of blind intestinal loops as entero-colic fistulas, leading to the secondary development of bacterial overgrowth and inflammatory bowel diseases.[33,34] Mural diseases affecting the motility of the intestine as systemic sclerosis can also reduce the absorptive capacity of the small intestine due to the widespread fibrosis and the potential formation of diverticula.[35,36] Small bowel resection and the ingestion of huge amounts of indigestible carbohydrates as cellulose and sorbitol are also another two etiologies that might be associated with disturbed normal functions of the intestine and the development of carbohydrate-related malabsorption presentations.[37]

Protein and other dietary components malabsorption

Protein metabolism is a complex process that needs the integration of the function of the different parts of the GIT for proper digestion, absorption and transportation. Digestion first begins in the stomach as proteolysis and with a suitable pH medium. Other parts of the intestine also take part in the presence of cholecystokinin, proteases and other pancreatic enzymes. Therefore, any impairment in the functions of any of the bowel segments can significantly impact the digestion and absorption of proteins. Among the common factors that can cause protein malabsorption are cystic fibrosis and chronic pancreatitis. They have been previously reported to affect the release and synthesis of the required pancreatic enzymes to complete the digestion process. Moreover, other factors as short bowel syndrome, inflammatory bowel diseases and intestinal lymphangiectasia have also been previously reported to cause protein malabsorption. All of the aforementioned diseases especially these related to fat malabsorption syndrome can also lead to develop vitamins and minerals malabsorption syndromes. Besides, acrodermatitis enteropathica has been reported to cause zinc deficiency as an autosomal recessive disorder.[38,39]

Among the reported etiologies to cause pediatric malabsorption, congenital glucose-galactose mal-absorption has been reported to cause malabsorption and chronic diarrhea before 6 months of age and it is usually

relieved by avoiding galactose and glucose in daily diets.[40,41] Similarly, chronic congenital diarrhea can also develop before six months of age and can present with manifestations related to excessive loss of water and electrolytes. However, both conditions are rare at being autosomal recessive. Moreover, cow's milk protein allergy can also develop as an idiopathic autoimmune disease due to the ingestion of cow's milk. There is no specific symptoms and no history-based diagnosis.[42]

CONCLUSION

In the present literature review, we have discussed the possible etiologies that were previously reported to cause different malabsorption syndromes including protein, fat, carbohydrate and other dietary-component malabsorption syndromes. No specific symptoms are associated with any of these syndromes. However, patients usually present with diarrhea, steatorrhea and other GIT symptoms as idiopathic pain and flatulence. Inflammatory bowel diseases, celiac disease, autoimmune enteropathies and other congenital disorders have been previously commonly reported with the development of different malabsorption syndromes. Efforts should be directed to understand more about the pathophysiology of some disorders especially the congenital and idiopathic ones to achieve a better management and to enhance the prognosis of the affected patients.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Babonji MS, Asiri LS, Alamri SM, Ajwa GI, Alsoliman RK, Ismail LN, et al. Common malabsorption syndromes in different pediatrics age. Int J Community Med Public Health 2021;8:3146-50.