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Prevalence and Clinical Profile of Functional Gastrointestinal Disorders in Children Based on Rome IV Criteria at a Tertiary Care Hospital South India

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Abstract

Aim and Context: The objective of this study was to evaluate the clinical profile and estimate the prevalence of functional gastrointestinal disorders (FGID) in children based on recent Rome IV criteria.

Settings, Design, Methods and Materials: Using Rome IV diagnostic criteria, the questionnaire was prepared and a cross-sectional study was done on children attending pediatric department to assess the clinical profile of FGIDs in children under the age of 18.

Statistical Analysis: Categorical data were analyzed using the Fisher's exact test, and continuous data were analyzed using a two-sided t-test. Values of $P < 0.05$ were considered significant.

Results: The results showed that 1448 children (40%) fulfilled the criteria for having at least one FGID. FGIDs were found in 47% of infants between 1-48 months, 28% between 4 and 11 years, and 42% between 11and18 years. Functional constipation (53%) was the most prevalent FGID in children under the age of four, followed by infantile regurgitation (18%) and infantile colic (15%), and although functional constipation was the most common FGID in children aged four to eighteen. However, in older children aged 4 to 18, functional abdominal pain disorders and functional defecation disorders are about equal in prevalence. When it comes to subtypes, functional constipation (15%) outnumbers irritable bowel syndrome (5.5%) and functional abdominal pain (5%).

Conclusion: FGIDs are common in pediatric outpatient clinics. These disorders can be identified using the Rome IV criteria. Parental education and reassurance should be the first steps in managing FGIDs.

Keywords: Rome IV; Regurgitation; Constipation; Infantile colic; Abdominal migraine; Cyclic vomiting syndrome.

Key Messages: Rome IV criteria was proposed in May 2016 and very few studies are available basing on this criteria. This study estimated the prevalence of FGIDs basing on new criteria.

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Introduction

FGIDs are caused by a complex interplay of genetic, psychological, and social variables that predispose, trigger, and/or prolong the brain-gut axis. The difference between FGIDs in younger children (Infants/Toddlers) and older children (Child/adolescents) was delineated in the pediatric Rome IV criteria. Many of Rome IV suggestions were based on evidence-based medicine and experience gained over the last decade. The term "no evidence for organic disease" was withdrawn from all

definitions and replaced with "after appropriate medical evaluation, the symptoms cannot be attributed to another medical condition"; and FGIDs can co-occur with other medical diseases that cause GI symptoms themselves.[1,2] FGIDs are seen in children throughout the world, with variable frequency. According to the Rome IV criteria introduced in May 2016, there are seven clinical entities of FGIDs in this age group which are shown in Table I.[1, 2]

Table I: Shows the Rome IV classification of functional gastrointestinal disorders in infants and young children up to 4yrs.

	Rome IV Nomenclature	Age	Frequency	Duration
G1	Infant Regurgitation	3wks –12mths	2 or more times per day	3 or more weeks
G2	Infant Rumination Syndrome	3-8 months	–	At least 2 months
G3	Cyclic Vomiting Syndrome(CVS)	–	≥2 episodes lasting hrs-days	Within 6mths
G4	Infant Colic	< 5mths	3 or more hrs per day	≥3 days in a wk
G5	Functional Diarrhea	6-60 months	≥4 per day	More than 4wks
G6	Infant Dyschezia	< 9mths	>10 minutes straining	–
G7	Functional Constipation(FC)	Upton 4 yrs	≤2 defecations per week ≥1 incontinence per wk	1 month

The most prevalent is infant regurgitation (G1), while infant rumination (G2) is the least common. Avoidance of meals or reduced food intake in infancy or early childhood can lead to a variety of feeding disorders, such as pica, rumination disorder, and other disorders classified in the International Classification of Disease (ICD) and Diagnostic and Statistical Manual (DSM) systems. CVS (G3) is defined as repeated, stereotypic attacks of severe nausea and vomiting that range from hours to days and are separated by symptom-free intervals. Toddlers are more likely than infants to suffer from CVS. The most prevalent illness that causes parents to consult a doctor is infant colic (G4) "Crying for three hours or more on at least three days in at least three weeks," according to Wessel's classic definition of colic. The symptoms of functional diarrhea (G5) disappear on their own by the time a child reaches school age, and they are not linked to failure to thrive or poor nutritional intake. In an otherwise healthy newborn under 6 months of age, infant dyschezia (G6) is defined as a minimum of 10 minutes of straining and crying before the successful passage of soft stools. One of the most prevalent reasons for parents to seek gastroenterologist opinion is functional constipation (G7).[2] The FGIDs are classified into 3 categories in the child/adolescent Rome IV chapter[3]: (H1) nausea and vomiting disorders; (H2) abdominal pain-related disorders; and (H3) defecation problems, as indicated in Table II.

Table II: Shows the Rome IV classification of FGIDs in children and adolescents (4-18yrs)

	FGID	Frequency/Features	Duration
H1	Functional Nausea and vomiting disorders		
H1a	Cyclic vomiting syndrome	≥2 episodes lasting for hrs to days.	With in 6 months. Normal between episodes.
H1b	Functional nausea and functional vomiting	≥2 episodes of nausea or ≥1 episode of vomiting per week	2 months
H1c	Rumination syndrome	Begins after meal absent during sleep	2 months
H1d	Aerophagia	Air swallowing, distension, repetitive belching/flatus.	2 months
H2	Functional Abdominal pain disorders		
H2a	Functional Dyspepsia	4 days per month	2mths
H2b	Irritable bowel syndrome	4 days per month (changes related to defecation, change in form or consistency)	2mths
H2c	Abdominal Migraine	Episodes lasting 1hr or more are separated by wks to months	2 within 6mths
H2d	Functional Abdominal pain	4 per month	2 months
H3	Functional defecation disorders		

H3a	Functional constipation	≤2 defecations per week ≥1 incontinence per week	2mths
H3b	Non- retentive fecal incontinence		1mth

Cyclic Vomiting Syndrome (H1a) can affect anybody from infancy to adolescence, with 46 percent of people experiencing symptoms at or before the age of three. Cyproheptadine is recommended for children under the age of five, and amitriptyline is recommended for children beyond the age of five. For children of all ages, the second-line treatment is propranolol prophylaxis. Functional nausea and vomiting (H1b) are now included in Rome IV, based on clinical experience, particularly in children suffering from anxiousness or depressed mood. H1c rumination syndrome can affect anyone at any age; however, it appears to be more common in adolescent girls. Gastroparesis or other motility problems, such as persistent intestinal pseudo-obstruction, might be mistaken for H1d Aerophagia. For clinical and scientific purposes, the committee believes it is critical to distinguish between various forms of FAPD (H2a-H2d). We now use the terminology functional abdominal pain not otherwise specified for children who do not fit the criteria for IBS, Functional defecation disorders, or abdominal migraine (NOS). Functional constipation, not irritable bowel syndrome, affects children whose pain disappears (H2b). IBS in children can be classified similar to adults based on the predominant stool pattern (IBS with constipation, IBS with diarrhea, IBS with constipation and diarrhea, and unspecified IBS). Similar triggers (such as stress, exhaustion, and travel) as well as accompanying symptoms (such as anorexia, nausea, and vomiting) and alleviating factors are reported by children with abdominal migraine (H2c) (eg, rest and sleep). Weekly stomach pain is reported by 35 percent to 38 percent of primary school students. Only roughly a third of these children match the Rome IV criteria for FAP (H2d) diagnosis. The inherent desire to withhold defecation because of discomfort or social reasons is most likely the triggering event for functional constipation (FC, H3a). Non-retentive fecal incontinence (NFI, H3b) differs from FC in that patients have normal defecation frequency and colonic and anorectal motility characteristics.[4] 41 percent of India's population is under the age of 18, and the country is undergoing fast economic and cultural globalization. It is well recognised that the prevalence of FGIDs varies by culture, race, ethnicity, and geographic location. The goal of this study is to use Rome IV criteria to assess the prevalence of various FGIDs in children under the age of 18 in an OPD of a tertiary care hospital in South India.

Materials and Methods

We performed this cross-sectional study on children less than 18 years of age attending outpatient clinics of MIMS general hospital Vizianagaram from Feb 2021 to Jan 2022. Questionnaires were prepared in the local language based on Rome IV diagnostic criteria on pediatric FGIDs for 0-48 month old and 4-18 year old children separately. Interns and residents at OP clinics invited all consecutive parents of children less than 18 years. The institutional ethics committee has approved the study. For participating children, informed consent was obtained from parents of children up to 10 yrs, and from the participants themselves for older children (11 to 18 years of age). The questionnaire was distributed to parents/caregivers and children to ensure confidentiality and privacy. They were given unlimited time to complete the questionnaire, and a member of the research team was available to answer any questions during the completion of the questionnaire. Subjects with symptoms related to organic medical disease and those more than 18 years of age were excluded. The original questionnaires and the back-translated questionnaires (both in English) were compared to ensure that the meaning was not modified during the translation process. The sample size was calculated using an estimated 10% prevalence for FGIDs. Assuming a confidence level of 95%, power of 80%, and precision found to the nearest 2%, a sample size of 1500 children between 1-48 months age (group 1) and 2000 school children and adolescents 4-18 years age (group 2) were considered adequate. Group 2 was further stratified for age according to the following categories 4-10 years and 11-18 years. SPSS Package Version 17 (IBM, Armonk, NY, USA) was used. Results were summarized as mean with range. Categorical data were analyzed using the Fisher's exact test, and continuous data were analyzed using a two-sided t-test. Values of $P < 0.05$ were considered significant.

Results

Out of the 4000 children enrolled in the study, 3624 completed questionnaires were received. Based on the age group, 1526 children were under the age of

48 months, 1067 children were between the ages of 4 and 11, and 1031 children were between the ages of 11 and 18. Males comprised 52 percent of the participants (1900). In the end, 1448 youngsters (40%) matched the criteria for having at least one FGID. 717 (20%) were under the age of four, while 731 (20%) were between the ages of four and eighteen. FGIDs were found in 47 percent of kids aged 1-48 months, 28 percent of children aged 4-11 years, and 42 percent of children aged 11-18 years. Children with and without FGIDs were compared in terms of sociodemographic, family, clinical, and environmental factors. The prevalence of FGIDs was considerably higher in children who were the only child in the family (P <0.003), children who were the firstborn (P <0.008), and children with divorced or separated parents. The family history of FGIDs did not effect on the prevalence of FGIDs in children (P = 0.5).

Functional constipation (53%) was the most common FGID in children under the age of four, followed by infantile regurgitation (18%) and infantile colic (15%). However, in older children aged four to eighteen, functional abdominal pain disorders (H2) and functional defecation disorders (H3) are nearly equal in prevalence. When it comes to subtypes, functional constipation (15%) is more common than irritable bowel syndrome (5.5%) and functional abdominal pain disorders (H3) (5 %). The prevalence of FGIDs was higher in boys (52%) than girls (48%) in this trial, although the difference was not statistically significant. The only conditions in which there is a statistically significant difference between genders are functional abdominal pain and functional constipation. Males are more likely to have functional constipation, while females are more likely to have functional abdominal pain ($p<0.05$). We've observed some children with multiple FGIDs but considered the most predominant one. Between the ages of 4 and 11, there is a higher prevalence of FGIDs than in toddlers and adolescents ($p<0.05$). More than one FGID was found in 6% of infants, with infantile colic and regurgitation being the most prevalent. Table III shows the prevalence of FGIDs in children aged 1 month to 48 months, and Table IV shows the prevalence in children aged 4 to 18 years.

Table III: Shows the prevalence of FGIDs in Infants and toddlers.

	Rome IV nomenclature	Age in months	Total children	Children with FGID	Percentage
G1	Infant Regurgitation	1-12	642	116	18
G2	Infant Rumination Syndrome	1-12	642	54	8.5
		13-48	884	16	1.8
G3	Cyclic Vomiting Syndrome	1-48	1526	43	2.8
G4	Infant Colic	1-5	292	44	15
G5	Functional Diarrhea	1-48	1526	9	0.6
G6	Infant Dyschezia	1-9	442	18	4
G7	Functional Constipation	1-12	642	135	21
		13-48	884	282	32
	Total	1-48	1526	717	47

Table IV: Shows the prevalence of FGIDs in school going children and Adolescents (4-18yrs)

	ROME IV Nomenclature	Age 4-10 yrs (M+F) N=1067	Percentage (M+F)	Age 11-18yrs (M+F) N=1031	Percentage (M+F)
H1	Functional Nausea and vomiting disorders	35(17+18)	3.3(49+51)	62(36+26)	6(58+42)
H1a	Cyclic vomiting syndrome	5(3+2)	0.5(60+40)	9(6+3)	0.9(67+33)
H1b	Functional nausea and functional vomiting	2(1+1)	0.2(50+50)	4(1+3)	0.4(25+75)
H1c	Rumination syndrome	2(1+1)	0.2(50+50)	1(1+0)	0.1(100+0)
H1d	Aerophagia	26(12+14)	2.5(45+55)	48(28+20)	4.7(59+41)
H2	Functional Abdominal pain disorders	130(61+69)	12.2(47+53)	183(86+97)	17.7(47+53)
H2a	Functional Dyspepsia	2(1+1)	0.2(50+50)	8(6+2)	0.8(75+25)

H2b	Irritable bowel syndrome	42(24+18)	4(57+43)	76(36+40)	7.4(48+52)
H2c	Abdominal Migraine	28(13+15)	2.6(45+55)	52(24+28)	5(47+53)
H2d	Functional Abdominal pain	58(23+35)	5.5(40+60)	47(20+27)	4.5(44+56)
H3	Functional defecation disorders	133(76+57)	12.5(57+43)	188(102+86)	18.2(54+46)
H3a	Functional constipation	125(72+53)	11.7(58+42)	186(101+85)	18.1(54+46)
H3b	Non- retentive fecal incontinence	8(4+4)	0.75(50+50)	2(1+1)	0.2(50+50)
	Total	298(154+144)	100(52+48)	433(224+209)	100(52+48)

Conclusion

In paediatric outpatient clinics, functional gastrointestinal disorders are frequent, and they have a detrimental influence on the child's health, family's health, and quality of life. In infants and toddlers, functional constipation, infantile regurgitation, and infantile colic are prevalent, whereas, in school-aged children and adolescents, functional constipation and functional abdominal pain syndromes are prevalent. These disorders can be identified using the Rome IV criteria. Parental education and reassurance should be the first steps in managing FGIDs.

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Review Article

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Measles in Children

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Abstract

Rubeola, often known as measles, is a highly contagious viral infection. Measles is caused by infection with the measles virus. The measles virus is a non-segmented negative sense RNA virus that belongs to the morbillivirus genus of the paramyxoviridae family. It is spread through the air via respiratory droplets or aerosolized particles, and symptoms include fever, cough, coryza, and conjunctivitis, followed by an erythematous maculo-papular rash. Many organ systems are affected by measles complications, and pneumonia accounts for the majority of measles-related morbidity and mortality. Clinical presentation and laboratory test results, including the presence of anti IGM antibodies and/or viral RNA, are used to confirm a case. Vitamin A is given to measles patients as part of their treatment. Measles vaccines comprise of a live attenuated measles virus strains and great advance has been made to increase vaccination coverage in the world to decrease the incidence of measles from infection with measles virus.

Keywords: Measles; Measles virus; Fever; Vitamin A; Measles vaccine.

Introduction

Measles is a contagious disease that begins with catarrhal signs and progresses to a characteristic rash. Despite the availability of a reliable vaccination, measles remains a leading cause of illness and mortality in young children around the world. The measles virus causes the disease. The measles virus is a single-stranded RNA virus with a lipid envelope that belongs to the genus Morbillivirus and the family Paramyxoviridae.[1] The particle of the measles virus is pleomorphic. Two surface glycoproteins, fusion (F) and hemagglutinin (H), form a multimeric complex in the virus particle that promotes viral entrance.[2] Transplacental antibodies normally protect infants until they reach 9 months of age. Measles is characterised by a high fever and a rash on the skin, and it is frequently accompanied by cough, coryza, and conjunctivitis. The hallmark of measles, according to Briggita et al[3] is transitory immunological suppression, which increases vulnerability to opportunistic infections.

Epidemeology

Measles is a disease that spreads both epidemically and endemically. Incidence is highest in the winter and spring. A single measles infection provides immunity for the rest of one's life. Measles is the most common vaccine preventable disease in the world, accounting for 38 percent of the disease burden. From 1997 to 2005, the number of reported cases decreased, but then increased dramatically in 2006. In India, the WHO began a measles surveillance effort in 2007. According to a WHO

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report published in 2008, there were 60751 reported cases of measles in India in 2006 and 52454 in 2005. According to an EPI data sheet, India's measles vaccination coverage was 67 percent in 2003 among children under the age of one year.

According to global estimates for the year 2013, measles was responsible for over 0.14 million deaths, or nearly 16 deaths each hour. According to research conducted by Anand et al[4] and Kumar R et al[5], India alone accounted for more than half of all global measles-related deaths. Sudfeld et al[6] conducted a systematic review of studies published over four decades in 12 Indian states and found that the median case fatality ratio was 1.63 percent. Bose AS et al[7] stated that furthermore, the higher case fatality ratio was reported among under-five children and children from the backward class. The number of measles cases has come down in 2019 to24076 cases from 69391 in 2018 according to WHO.

Transmission

The measles virus enters the body through the respiratory tract or conjunctiva after coming into touch with big droplets or small droplet aerosols containing the virus. From three days before the rash and four days after the rash , patients are infectious.[7-8]

Muhlebachet al.[9] found that Tracheobronchial epithelial cells are sensitive to Measles Virus infection, which is linked to bronchial and bronchiole epithelial damage.

Pathology

The measles infection results in respiratory tract epithelial necrosis and a lymphocytic infiltration. On the skin and oral mucosal membranes, measles causes a small vessel vasculitis. Intracellular oedema and dyskeratosis are seen on histology of the rash and exanthem. Within these massive cells, viral particles have been discovered. Multinucleated giant cells, the warthinfinkedly gigantic cells that are pathognomic of measles, are formed when infected cells fuse.[10] According to Briggita et al[11], Measles Virus replication in B-cell follicles was found in lymphoid tissues of experimentally infected Non-human Primates.

Pathogenesis

There are four stages in the measles infection. The incubation period, prodromal sickness, exanthematous phase, and recovery are all factors to consider. Measles virus migrates to regional lymph nodes during incubation. A primary viremia develops, allowing the virus to spread throughout the reticuloendothelial system. A secondary viremia is when the virus spreads to the surface of the body. The prodromal disease follows secondary viremia and is characterised by epithelial necrosis and the production of large cells in bodily tissues. In the prodromal phase, viral shedding begins.Antibody production begins with the onset of the rash, and viral replication and symptoms begin to fade. Yanagi et al[12] found that alveolar macrophages, dendritic cells, and lymphocytes are the first targets for the measles virus, which are infected via CD150. Attachment to PVRL4 receptor (nectin 4), which is expressed on cells in the trachea, oral mucosa, nasopharynx, and lungs, is the mechanism of infection of respiratory tissues.

Clinical Manifestations

High fever, exanthem, cough, coryza, conjunctivitis, are all symptoms of measles infection. The prodromal phase begins with a slight fever, followed by conjunctivitis with photophobia, coryza, a pronounced cough, and a growing fever after an incubation period of 8 to 12 days. Koplik spot, is a pathognomonic symptom of measles that appears 1 to 4 days before the rash Rash appears on the forehead, behind the ears, and on the upper neck. In up to 50% of patients, it spreads throughout the chest and extremities, reaching the palms and soles. Symptoms of the rash tend to fade as soon as it appears. The rash dissipates in about 7 days, following the same pattern as it appears. Cough is the most persistent of the primary symptoms in measles, lasting up to ten days. Generalized lymphadenopathy may be observed in severe cases, with the cervical and occipital lymph nodes being particularly prominent. According to a recent modelling study by Mina et al[13], higher susceptibility to infections can last for up to 3 years after measles.

Complications

- ***Gastrointestinal:*** Diarrhoea is the most prevalent gastrointestinal problem, affecting about 8% of patients. Gingivostomatitis, gastroenteritis, hepatitis, mesenteric lymphadenitis, and appendicitis are some of the other gastrointestinal problems. Measles-induced stomatitis and diarrhoea, according to Demmelon Harrison et al, can lead to

nutritional deficiency in resource-limited situations.

- ***Pulmonary:*** Pneumonia is the most prevalent cause of measles-related death in children, accounting for about 6% of all cases. Bronchopneumonia, laryngotracheobronchitis (croup), and bronchiolitis are pulmonary consequences of measles virus infection. Measles has also been linked to the development of bronchiectasis, a lung disease that can lead to recurrent respiratory infections. In one retrospective analysis of measles mortality in South Africa, 85 percent of cases were ascribed to pneumonia, indicating that bacterial superinfection may occur in up to 5% of cases (due to viral or bacterial infection). Streptococcus pneumoniae, Streptococcus pyogenes, Haemophilus influenzae, and Staphylococcus aureus were found in a series of 182 cases with measles-associated pneumonia, according to Halonen et al.[14]
- ***Neurological:*** Neurologic Encephalitis, acute disseminated encephalomyelitis, and subacute sclerosing panencephalitis are among the neurologic sequelae linked with measles. Acute measles-induced encephalopathy in the setting of human immunodeficiency virus infection was described by Ross et al.[14]
- ***Other Complications:*** Keratitis (a common cause of blindness) and corneal ulceration are two ocular consequences of measles.
- Myocarditis and pericarditis are two cardiac consequences of measles.
- Haemorrhagic measles, often known as black measles, is a severe form of measles that is rarely encountered nowadays. It appears as a haemorrhagic skin eruption and is frequently lethal.

Clinical Variants

- ***Modified measles:*** Modified measles is an attenuated infection that occurs in people who already have immunity to measles (either via wild-type disease or vaccination). The clinical signs are often milder, and the incubation period is longer than with classic measles (17 to 21 days). Modified measles patients are not particularly contagious.[15]
- ***Atypical measles:*** This term refers to measles virus infection in people who were inoculated with the killed virus vaccine in the United States between 1963 and 1967; atypical measles is now uncommon. The dead virus vaccine made the recipient sensitive to measles virus antigens but did not provide complete protection.[15]

Laboratory Findings:

- Clinical and epidemiological findings are usually often used to diagnose measles. In the acute phase, laboratory findings include a fall in total white blood cell count, with lymphocytes decreasing more than neutrophils. ESR and CRP levels are normally normal in cases of measles that are not exacerbated by bacterial infection.

Diagnosis

In a patient with a febrile rash illness and clinically compatible symptoms (e.g. cough, coryza, and conjunctivitis), the diagnosis of measles should be considered, especially if there has been recent exposure to someone with a febrile rash illness or travel to a high-measles-prevalence area, especially in the absence of measles immunity. Patients who are being tested for measles should be kept apart.

A significant rise in measles IgG antibody between acute and convalescent titres, isolation of measles virus in culture, or detection of measles virus RNA by reverse transcription polymerase chain reaction are all used to diagnose measles virus infection (RT-PCR). Depending on the incidence of measles in a given region, several approaches to diagnosis are used. The anti-measles virus IgM assay should be read with caution, according to Ross et al, as both false-positive and false-negative results have been observed.

Treatment

Because there is no specific antiviral drug approved for the treatment of measles, management is supportive. The goals of therapy are to maintain hydration, oxygenation, and comfort. Antipyretics are helpful in reducing fever. Airway humidification and supplementary oxygen may be beneficial for patients with respiratory tract involvement. Respiratory failure caused by croup or pneumonia may necessitate the use of a ventilator.In most situations, oral rehydration is sufficient, but severe dehydration may necessitate intravenous therapy. Antimicrobial prophylaxis to prevent bacterial infection is not recommended. In

immunocompromised persons, measles infection is highly fatal. In vitro, ribavirin is effective against the measles virus.

Vitamin A

Vitamin A deficiency has been linked to an increased risk of death from a range of infectious diseases, including measles, in children in underdeveloped nations. Vitamin A therapy is recommended for all measles patients. Vitamin A should be given once a day for two days at doses of 200,000 IU for children 12 months and older, 100,000 IU for infants 6 months and older, and 50,000 IU for infants younger than 6 months.

Prevention

The measles vaccine is an effective way to prevent the disease. Transplacentally acquired maternal antibodies protect the newborn baby. Beginning at the age of six months, the antibodies begin to diminish, and the infant becomes susceptible to measles. The majority of newborns become sensitive between the ages of 9 and 12 months. Three doses are recommended; one as MR/MMR at the age of 9 months, second as MMR at 15 months, and third as MMR at school entry (4-5) year or at any time 8 weeks after the previous dose.

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Review Article

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Nutritional Requirements for Children

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Abstract

The supply and utilisation of nutrients are of greater biological relevance during early childhood than during any other period of life. The nutrient supply must cover maintenance requirements and the needs for physical activity. Children need large additional energy and substrate intakes for body growth. Healthy new-born infants double their body extremely rapidly in only 4–5 months after birth, and in preterm infants even in only about 6 weeks, which requires a very high substrate supply per kg bodyweight. The quantity and quality of nutrient supply during early life modulates the differentiation of tissues and organs and has short- and long-term consequences for health.

The rapid growth of infants and children, who double their body weight within only 6 weeks in utero and within 4–5 months after birth, respectively, depends on very large nutrient supplies per kg body weight. Healthy young infants need about 3 times more energy per kg body weight than adults, primarily due to the added metabolic requirements for growth. Premature infants who grow at rates similar to normal intrauterine growth have even greater metabolic needs.

Keywords: Macronutrients; Micronutrients; Deficiency; Injurious impact; CHO; Fats; Protein; Minerals.

Introduction

Nutrition is the science that interprets the interaction of nutrients and other substances in food in relation to maintenance, growth, reproduction, health and illness of an organism. Poor diet may have an injurious impact on health causing deficiency diseases. Nutrition the process of providing or obtaining the food necessary for health and growth.

Nutrients

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Nutrients are of Two Types

- Macronutrients, which are needed in larger amounts (CHO, fats, protein and water).
- Micronutrients, which are needed in smaller amounts (minerals and vitamins)

Nutrients Primary Functions

- ***Water:*** Dissolvesand carry nutrients, removes waste and regulates body temperature.
- ***Protein:*** Builds new tissue, antibodies, enzymes hormones and other compounds.
- ***CHO:*** Provides energy.
- ***Fat:*** Provides long term energy insulation and protection.
- ***Vitamins:*** Facilitate use of other nutrients involved in regulating growth and manufacturing hormones.
- ***Minerals:*** Helps in growth of bones and teeth, aid in muscle function and nervous system activity

Nutritional Requirements in Children

Water and Calories

Age Range	Water Requirements	Calories Requirements
3 Days	80 – 100 ml/kg	120 cal/kg
3 – 10 Days	125 – 150 ml/kg	120 cal/kg
15 Days – 3Month	140 – 160 ml/kg	120 cal/kg
3 – 12 Months	150 ml/kg	105-110 cal/kg
1 – 3 Years	125 ml/kg	100 cal/kg
4 – 6 Years	100 ml/kg	90 cal/kg
7 – 9 Years	75 ml/kg	80 cal/kg
10 – 12 Years	50 ml/kg	70 cal/kg
13 – 15 Years	50 ml/kg	60 cal/kg
16 – 19 Years	50 ml/kg	50 cal/kg

Proteins

Age Range	Protein Allowance
0 – 3 Months	2.3 (Milk Protein)
3 – 6 Months	1.8 (Milk Protein)
6 -9 Months	1.65 (Mixed Protein)
9 – 12 Months	1.5 (Mixed Protein)
1 – 3 YEARS	1.83gm/day
4 – 6 YEARS	1.52gm/day
7 – 9 YEARS	1.48gm/day
MALES	
10 – 12 YEARS	1.40gm/day
13 – 15 YEARS	1.31gm/day
16 – 18 YEARS	1.45gm/day
FEMALES	
10 – 12 YEARS	1.46gm/day
13 – 15 YEARS	1.33gm/day
16 – 18 YEARS	1.21gm/day

Carbohydrates

- CHO are main source of energy and supply bulk in the diet.
- They contribute taste and are essential for digestion and absorption of other foods.
- Carbohydrates play an important part, in infant nutrition as they spare proteins to be fully utilized for growth and various repair process.
- All CHO are ultimately oxidized and converts to glucose.
- Glucose is used as fuel by brain and muscle or converted to glycogen and stored in liver and muscle.
- Sources of carbohydrate in infants' diet is found in the form of lactose in both human and cow's milk that should be provided up to 6 months.
- Lack of adequate CHO may produce symptoms of starvation,undernutrition, constipation, loss of body protein.

Fats

- Fat supplies 40 - 50% energy needed for the infant.
- It provides protection and support for organs and insulation of the body as adipose tissue.
- It as carrier of fat-soluble vitamins.
- Fats and oils are concentrated sources of energy and make the foods palatable.
- Fats and oils are termed as lipids.

Saturated fats: Animal sources such as meat, eggs, milk and dairy products.

Unsaturated fat: Commonly found in plant and fish(poly unsaturated), peas, beans, whole cereals, nuts, cooking oil.

- Fatter intake in diet can cause indigestion as it remains longer in the stomach.
- Deficiency of all fatty acids may result in growth retardation, skin disorders, susceptibility to infections, neurological and visual problems.
- ICMR has recommended a daily fat intake of 25 gm/ day in young children and 22 gm/ day in older children.

Vitamins

Vitamins are organic substances and essential micro nutrients for maintenance of normal health. Vitamins enables the body to use other nutrients and help in maintenance and protection of good health.

Vitamins are Classified Into Two Groups

1. Fat soluble vitamins
2. Water soluble vitamins

- Vitamin requirement of individual child may vary with activity,age, body weight.
- Vitamin requirement is more in preterm babies; infant get adequate vitamins from mother during lactation.

Minerals

- Minerals are inorganic element a, required by human body for growth, repair and regulations of vital body functions.

- A well-balanced diet is a sufficient quality of minerals.
- Minerals are required for maintenance of osmotic pressure, supply of necessary electrolytes. Minerals are classified into microminerals when the daily requirement is 100 mg or and micro minerals when the daily requirement is less than 100 mg.
- Iodine 0.2 mg
- Sodium 2 meq/kg
- Potassium 1.5 meq/kg
- Zinc 0.3 mg/kg
- Copper 0.5 -1 mg/kg
- Fluorine 0.5 – 1 mg/kg

Importance of Nutrition

Guidelines for Pediatric Nutrition

- Infant should be exclusively breastfed for first 6 months.
- After 6 months provide nutrients which are easily digestible.
- Contains various antibodies which help to build immune systems.
- Never overfeed or force the child to eat.
- Introduce new foods at regular intervals to increase acceptance of few foods.
- Provide small frequent meals.
- Provide food in colourful and appealing way.
- Balance food with physical activity.
- Provide plenty of grains, fruits and vegetables, low fat dairy products
- Never stop breakfast.
- Involve the child in making food choices.

Nutritional Counselling for Children

The important responsibility of the paediatric nurse is to provide nutritional counselling and guidance to the parents and also to the children, with the goal of achieving optimum nutrition throughout the year of growth and development.

At 6 Months: Complementary feeding to be initiated with fruit juices and then new foods to be introduced with vegetable soup, mashed banana, mashed and boiled potato ect. Each food should be given with one or two teaspoons at first for 3 to 6 times per day.

6 to 9 Months: Food items given in this period include soft mixture of rice and dal, khichadi, pulses, mashed and boiled potato, bread or roti soaked in milk or dal, mashed fruits like banana, mango, papaya, stewed apple etc. Egg yolk can be given from 6 to 7 months onwards Curd or khir can be introduced from 7 to 8 months onwards.

9 to 12 Months: New food items like fish, meat, chicken can be introduced during this period. Feeds should be soft and well-cooked Spices and condiments to be avoided Breastfeeding to be continued.

12 to 18 Months: The child can take all food cooked in family and needs half amount of mother's diet. Number of feeds can be 4 to 5 times or according to the child's need. Breastfeeding to be continued, especially at night.

Conclusions

Adequate knowledge, attitude and practices of application of nutritional requirements must be the basis of infant feeding. The health and nutritional status of an infant and subsequent growth and development through childhood depends upon successful feeding practices. Nutritional counselling is the important responsibility of the nurse to promote the nutritional status of the children and to prevent nutritional deficiency diseases.

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