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Feeding Healthy Term Infants

Resource Manual

Section F.

Other Nutritional Concerns

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Winnipeg Regional Health Authority
Caring for Health

Office régional de la santé de Winnipeg
À l'écoute de notre santé

F.1 Gastroesophageal Reflux (GER) and Gastroesophageal Reflux Disease (GERD)

Overview

Gastroesophageal reflux (GER) occurs when gastric contents pass into the esophagus with or without regurgitation ("spitting up").[1] It is due to temporary relaxation of the lower esophageal sphincter or inadequate adaptation of the sphincter tone to changes in abdominal pressure.[2] GER is a normal physiologic process that can occur several times a day in healthy infants.[1] Regurgitation occurs daily in approximately 50% of healthy term infants 0-3 months of age, 67% of infants 4 months of age and only 5% of infants by 10-12 months of age.[2] Most infants who regurgitate have no symptoms or complications and do not require treatment.[1] GER is relatively common in healthy infants and generally resolves between 6-12 months.[3]

Gastroesophageal reflux disease (GERD) occurs when gastric reflux leads to symptoms or complications.[1] Investigation of GERD is necessary when there is recurrent vomiting with poor weight gain, excessive crying or irritability, disturbed sleep, feeding problems or respiratory problems.[2]

Recommendations

a) Most infants with uncomplicated GER can be managed conservatively with parental education and reassurance regarding its natural course.
b) In otherwise healthy appearing infants with effortless regurgitation, a history and physical exam may be sufficient to diagnose uncomplicated GER. It is recommended that health care providers obtain a thorough feeding history, observe feeding behaviour and obtain measures of infant growth to assist in diagnosing and monitoring the severity of GER.
c) Breastfeeding should not be discontinued due to regurgitation.
d) For exclusively breastfed infants where a cow's milk protein allergy is suspected, a trial of cow's milk and egg avoidance in the maternal diet can be considered. In a subset of infants with cow's milk protein allergy, symptoms of vomiting may be indistinguishable from physiological GER.
e) For formula fed infants, the volume or frequency of feedings should not be decreased as this could compromise an infant's energy intake. In an infant who is overfed or fed large volumes at infrequent intervals, there may be a benefit to reducing the volume of formula to prevent overfeeding which can aggravate reflux.
f) For formula fed infants who are vomiting, GER may be associated with cow's milk protein allergy. A 2- to 4-week trial of extensively hydrolyzed protein formula may be beneficial in formula fed infants with vomiting.

g) If additional complications or concerns develop in formula fed infants including poor weight gain, excessive crying and feeding or respiratory problems, commercially thickened formulas can be used on the advice of a physician.
   - The choice of product can be determined based on individual preference, cost and availability.
   - The use of home-prepared thickened formula is not recommended.

h) Positioning therapy (using an upright position for 90 minutes postprandially) may be used, but is not as effective as using thickened feeds for formula fed infants. A supine position for sleeping (lying on back, not face down) is recommended to decrease the risk of sudden infant death syndrome.

i) If complications of GER persist despite formula changes in formula fed infants, an acid suppressant may be used on the advice of a physician. Follow up appointments every 4-8 weeks are necessary to assess the efficacy of the medication.

Evidence

- Uncomplicated gastroesophageal reflux (GER) is relatively common in healthy infants and generally resolves itself between 6 and 12 months of age. Gastroesophageal reflux disease (GERD) generally manifests in poor weight gain, esophagitis, occult blood loss, persistent respiratory symptoms or failure to thrive.[3] *[Level B Evidence]*
- A thorough history including feeding and dietary history, pattern of vomiting, medical history, medications, growth charts, and family medical and psychosocial history as well as a physical examination are generally sufficient to establish a diagnosis of GER. Other diagnostic tests are generally not required unless a gastrointestinal obstruction is suspected.[3] *[Level C Evidence]*
- A narrative review of GERD in infants suggests that for infants with symptoms of GERD such as poor weight gain, esophagitis (hematemesis), or respiratory symptoms, a referral to a pediatric gastroenterologist is required for further diagnostic tests.[3] *[Level C Evidence]*
- Limited data suggest that breastfed infants do not differ from formula fed infants with respect to the frequency of GER; however, breastfed infants may have shorter duration of reflux episodes. Symptoms of GER in infants are rarely severe enough to warrant discontinuation of breastfeeding. If a cow's milk protein allergy diagnosis is suspected in a breastfed child, maternal elimination of cow's milk and egg should be considered.[4] *[Level C Evidence]*
- There is inconsistent evidence regarding the effectiveness of decreasing the feeding volume for treating GER in formula fed infants. Current guidelines caution against decreasing the volume or frequency of feedings to treat GER, and indicate that this strategy could compromise an infant's energy intake. In an infant who is overfed or fed large volumes of formula at infrequent intervals, there may be a benefit to reducing the volume of formula.[4] *[Level C Evidence]*

- In infants who present with vomiting, GER may be associated with cow's milk protein allergy. A 2- to 4-week trial of extensively hydrolyzed protein formula may be beneficial.[4] *[Level B Evidence]*
- In most infants, GER symptoms do not decrease when there is a change from one milk formula to another or to soy protein formula.[4] *[Level B Evidence]*
- In healthy infants, thickened formula has been shown to be moderately effective in reducing clinical symptoms of GER (i.e. vomiting, regurgitation) and to promote weight gain in those with poor weight gain and recurrent vomiting. Thickened formula causes a decrease in visible reflux, but not a decrease in the frequency of reflux episodes. Side effects include increased risk of coughing and diarrhea. Thickened formula is recommended to decrease clinical symptoms of GER in infants who are formula fed and require treatment of GER.[4] *[Level B Evidence]*
- Thickened formula prepared at home by adding rice cereal is not recommended as it dramatically increases the caloric density of the formula, which may lead to inappropriate weight gain. As well, the implications of early introduction of rice protein into the diet are not known.[1]
- Commercially available pre-thickened formula does not change the caloric density of the formula.[3] Although some commercially available thickened infant formulas may be labelled as suitable for infants who spit up frequently, they should only be used for infants diagnosed with GERD on the advice of a physician.[1]
- There is a lack of data to show the greater effectiveness of one commercially thickened formula over another. If thickened formulas are recommended by a physician, the choice of product can be based on the family's preference, cost and product availability.[4] *[Level B Evidence]*
- Elevating the head of the bed in the supine position has no effect on reflux reduction. Positioning therapy (using upright position for 90 minutes postprandially) is not as effective as using thickened formula for formula fed infants. Some studies report that the prone position (lying face down) reduces reflux, compared with the supine position (lying on back); the supine position is recommended for infant sleeping, as it decreases the risk of sudden infant death syndrome.[4] *[Level B Evidence]*
- Persistent complications of GERD (despite formula changes in infants who are formula fed) may warrant pharmacologic therapy. Acid suppressants (i.e. histamine-2 receptor antagonist) are first-line therapies.[4] *[Level B Evidence]*
- To assess the efficacy of medications, it is recommended that infants be monitored every 4–8 weeks; by 1 year, most infants with mild to moderate reflux should be symptom-free and able to discontinue medications.[4] *[Level C Evidence]*

- Based on consensus (due to the absence of controlled studies) for infants with chronic GERD and inadequate weight gain, expert opinion suggests that nasogastric or nasojejunal feedings may be required to support weight gain if no other causes of failure to thrive are identified. For children over 1 year of age, anti-reflux surgery is considered for GERD when the child has persistent symptoms following medical management, is unable to be weaned from medication or is at risk for pulmonary aspiration.[4] *[Level C Evidence]*

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F.2 Thickened Formula

Overview

Some infants with gastroesophageal reflux (GER) who are formula fed develop additional complications. In these cases, a thickened formula is recommended.

Recommendations

a) Thickened infant formulas should only be given to a formula fed infant when recommended by a physician as spitting up is normal in infants.
b) If additional complications of GER develop (i.e. poor weight gain, excessive crying, feeding or respiratory problems) in formula fed infants, commercially pre-thickened infant formula with added rice starch or insoluble fibre may be recommended. Commercially available pre-thickened formula does not change the caloric density and can be given without an enlarged nipple hole.
c) Home-prepared thickened formula made by adding rice cereal to infant formula is not recommended.
d) If thickened formula is recommended by a physician, the choice of product can be determined by the parent/caregiver based on preference, cost and availability.

Evidence

- Some commercially available infant formulas have been slightly thickened with rice starch and are labelled as suitable for infants who spit up frequently. However, spitting up is normal for infants and rarely leads to failure to thrive or other health problems. Infants should be assessed by a physician if spitting up continues or becomes more severe.[1] Thickened formulas should only be given to infants when recommended by a physician.
- Thickened infant formula prepared at home by adding rice cereal to infant formula is not recommended as it will drastically increase the caloric density of the formula. This may lead to inappropriate weight gain. As well, the implications of early introduction of rice protein into an infant's diet are not known.[1]
- Thickened formulas have been shown to be moderately effective in reducing the clinical symptoms of GER (i.e. vomiting, regurgitation) in healthy infants, and to promote weight gain in infants with recurrent vomiting and poor weight gain. Side effects of thickened formulas include diarrhea and increased coughing. More research is needed to determine if there are possible nutritional risks with long-term use.[2] *[Level B Evidence]*
- Thickened formulas have not been shown to significantly reduce the frequency of symptoms in infants with severe reflux, such as gastroesophageal reflux disease.[1]

- As there is insufficient data demonstrating the effectiveness of one thickening agent or product over another, if a treatment using thickened formulas is recommended, the choice of product can be determined according to the parents' preference, cost and availability.[2] *[Level B Evidence]*
- Milk-thickening agents do not improve reflux index scores, however, they have been shown to decrease the number of vomiting episodes.[3] *[Level B Evidence]*

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F.3 Lactose Intolerance

Overview

Lactose intolerance is defined as a clinical syndrome of ≥1 symptoms after ingesting lactose, including abdominal pain, diarrhea, flatulence, bloating and nausea.[1] It is a result of an insufficient amount of the enzyme lactase, which is required to break down lactose in the body.[1]

There are 4 types of lactose intolerance:

1. Primary lactase deficiency is the most common, and is caused by a deficiency of the enzyme lactase. This type of lactase deficiency is uncommon in infants.[2] Onset of symptoms typically occurs in late adolescence and adulthood, but may occur in childhood.[1]
2. Secondary lactase deficiency is caused by injury to the digestive tract due to inflammation (e.g. bacterial or viral infection, food allergy). Damage to the cells that produce lactase results in a temporary reduction of the enzyme. This type of deficiency is more common in infants and children. Once the inflammation subsides, the level of lactase production is quickly re-established.[2]
3. Congenital lactase deficiency is an extremely rare and potentially life-threatening condition. Infants present with intractable diarrhea upon receiving breast milk or formula containing lactose. Infants must be fed lactose-free formula.
4. Developmental (neonatal) lactase deficiency is a deficiency of lactase in preterm infants (<34 weeks gestation).[1]

Among Hispanic, Asian and black children <5 years of age, approximately 20% have lactase deficiency. Caucasian children do not typically develop lactose intolerance until 4 or 5 years of age.[1]

Recommendations

a) If lactose intolerance is suspected in an infant or young child, encourage parents/caregivers to consult a physician regarding diagnosis through testing.
b) Breastfed infants should continue to be breastfed.
c) Formula fed infants can continue to be fed standard lactose-containing formulas. A trial of low-lactose or lactose-free formula may be suggested by a physician, but may not be necessary.
d) Older infants and young children diagnosed with lactose intolerance may consume lactose-free and lactose-reduced cow's milk. They may also be able to tolerate small amounts of cow's milk spaced throughout the day.
e) Complete avoidance of milk products is not recommended. Children may be able to consume small amounts of lactose in milk products spaced throughout the day and consumed with other foods without symptoms.

Evidence

- Lactase deficiency occurs when there are low concentrations of lactase in the small intestinal brush border relative to the concentrations observed in infants. Lactose malabsorption is a term that indicates a significant amount of lactose is not absorbed in the small bowel and is therefore delivered to the colon. Lactose malabsorption manifests as lactose intolerance, and is due to an imbalance between the amount of lactose ingested and the capacity for lactase to hydrolyze the lactose. The malabsorption is almost always a result of low levels of lactase.[3]
- Symptoms of lactose intolerance, including abdominal distention, flatulence, abdominal cramping, and (ultimately) diarrhea, are independent of the cause of lactose malabsorption. These symptoms are not necessarily correlated with the degree of intestinal lactase deficiency.[1]
- Symptoms of lactose intolerance that occur when milk products are ingested are generally transient and do not cause harm to the digestive tract, as opposed to celiac disease and allergic reactions that can lead to ongoing inflammation and mucosal damage.[1]
- Milk allergy and lactose intolerance may be difficult to differentiate based on symptoms alone as some are found in both conditions (i.e. abdominal pain, diarrhea, nausea, vomiting, gas, bloating). However, milk allergy often causes upper respiratory tract symptoms (i.e. stuffy or runny nose), pain, itching, fluid drainage from the ears, or skin reactions (i.e. eczema, hives), which lactose intolerance does not.[2]
- Milk allergy can sometimes result in lactase deficiency since secondary lactase deficiency is caused by inflammation in the digestive tract, so milk allergy and lactose intolerance can co-exist. Since milk is the only source of lactose in the diet, eliminating milk will cure both conditions, but will not distinguish which was the cause of the symptoms.[2]
- It is important to determine whether a milk allergy or lactose intolerance is causing symptoms as milk and milk products are a significant source of nutrients for infants and young children and should not be eliminated unless essential. Eliminating milk from the diet is also not easy as many foods contain milk. Avoiding them can make meal planning difficult.[2]
- A breastfed infant ingests lactose through breast milk. The lactose composition of breast milk remains constant, regardless of whether or not the mother consumes milk products.[2]
- If an infant has secondary lactose intolerance due to a gastrointestinal tract infection or other transient condition, continued breastfeeding is recommended as the diarrhea will gradually diminish as the underlying inflammation resolves.[2] Even with acute gastroenteritis, enough lactose digestion and absorption are preserved.[1]
- Some practitioners recommend placing a few drops of Lactaid liquid directly into a baby's mouth before breastfeeding, which may provide enough of the enzyme to break down the lactose in the breast milk and thus reduce digestive tract symptoms. Alternatively, the mother can pump her breast milk and treat the milk with Lactaid drops (4 drops per 250 mL milk), and allow the enzyme to act for 24 hours in the fridge. The baby can then be fed the lactose-

free milk the next day. This regimen should be continued until the diarrhea abates, at which point the infant can return to breastfeeding.[2]

- Perceived lactose intolerance in breastfed infants may actually be due to other factors such as over-supply of milk production and/or an imbalance in foremilk and hind milk. Further assessment in the breastfeeding mother/child pair is recommended, including assessment of breastfeeding practices and techniques, which could provide more assistance.[3]
- In developed countries, even when there is acute gastroenteritis, enough lactose digestion and absorption are preserved so that low-lactose and lactose-free infant formulas have no clinical advantages compared with standard lactose-containing formulas. The exception is severely undernourished children. No studies have shown any benefit to infant outcome measures such as colic, growth or development from using reduced or lactose-free formulas.[1]
- Depending on the degree of lactase deficiency and ethnicity, children with primary lactase deficiency may tolerate some lactose in the diet. The amount tolerated is influenced by the source of lactose, the amount consumed, and with what other foods the lactose is consumed. [4] *[Level C Evidence]*
- When managing lactose intolerance in infants and children, the American Academy of Pediatrics recommends including small amounts of milk products (125-250 mL) spaced throughout the day, as well as milk products containing partially digested lactose (yogurt, cheese, products containing *Lactobacillus acidophilus* and pretreated milk). This will help to ensure adequate calcium and vitamin D intake.[4] *[Level C Evidence]*
- Complete elimination of lactose may not be necessary or desirable, and may be associated with adverse skeletal outcomes. More research is needed in this area.[4] *[Level C Evidence]*
- Tests for lactose intolerance include:
  - The Breath Hydrogen Test (not appropriate for infants or toddlers) is the test of choice for assessing lactose intolerance in children and adults. No specific guidelines on lactose tolerance testing appear to have been published.
  - The Lactose Avoidance Test (appropriate for all ages, including infants and toddlers) involves dietary elimination of lactose followed by reintroduction and documentation of symptoms suggestive of lactose intolerance.
- Lactose maldigestion can be transitory. Repeat testing is encouraged.

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F.4 – Constipation

Overview

The frequency, colour and consistency of bowel movements vary widely during infancy, depending on whether infants are breastfed or formula fed and whether they have been introduced to solids.[1] An infant has normal bowel function even if he/she appears to be in extreme discomfort, showing straining and reddening of the face. Constipation is rare. As long as the infant is growing normally and there are no signs of obstruction or enterocolitis, bowel function is within the normal range.[2]

Exclusively breastfed infants receiving adequate milk have a large variability in frequency of stools, ranging from daily to once every several days. The stool colour is predominantly yellow (rarely green or brown) and the consistency is soft (runny or pasty, rarely firm or hard). Formula fed infants generally have less frequent stools. The colour can be yellow, green, brown or black and there is a wide range of consistencies depending on the type of formula consumed. After solids are introduced, stools are usually brown and firmer. Occasionally, stool colour will reflect the colour of foods eaten. Bowel frequency decreases with age due to the maturing gut's ability to conserve water.[1]

Parents often express concerns about their infant or child's stools, and may label their child as constipated when their bowel habits do not match their conception of what is "normal". They may be unfamiliar with normal changes in stool patterns that occur with changes in age or diet.[1]

Constipation is "the subjective complaint of passage of abnormally delayed or infrequent passage of dry, hardened feces often accompanied by straining and/or pain."[3] There are 2 types of constipation: acute or chronic. Acute constipation lasts no more than 2 weeks, without the presence of a fecal mass, and can usually be addressed with dietary interventions. Chronic constipation lasts longer than 8 weeks and can be functional or organic (due to an underlying medical condition). Chronic constipation should be diagnosed by a physician.[3,4]

Recommendations

Infants <6 months of age

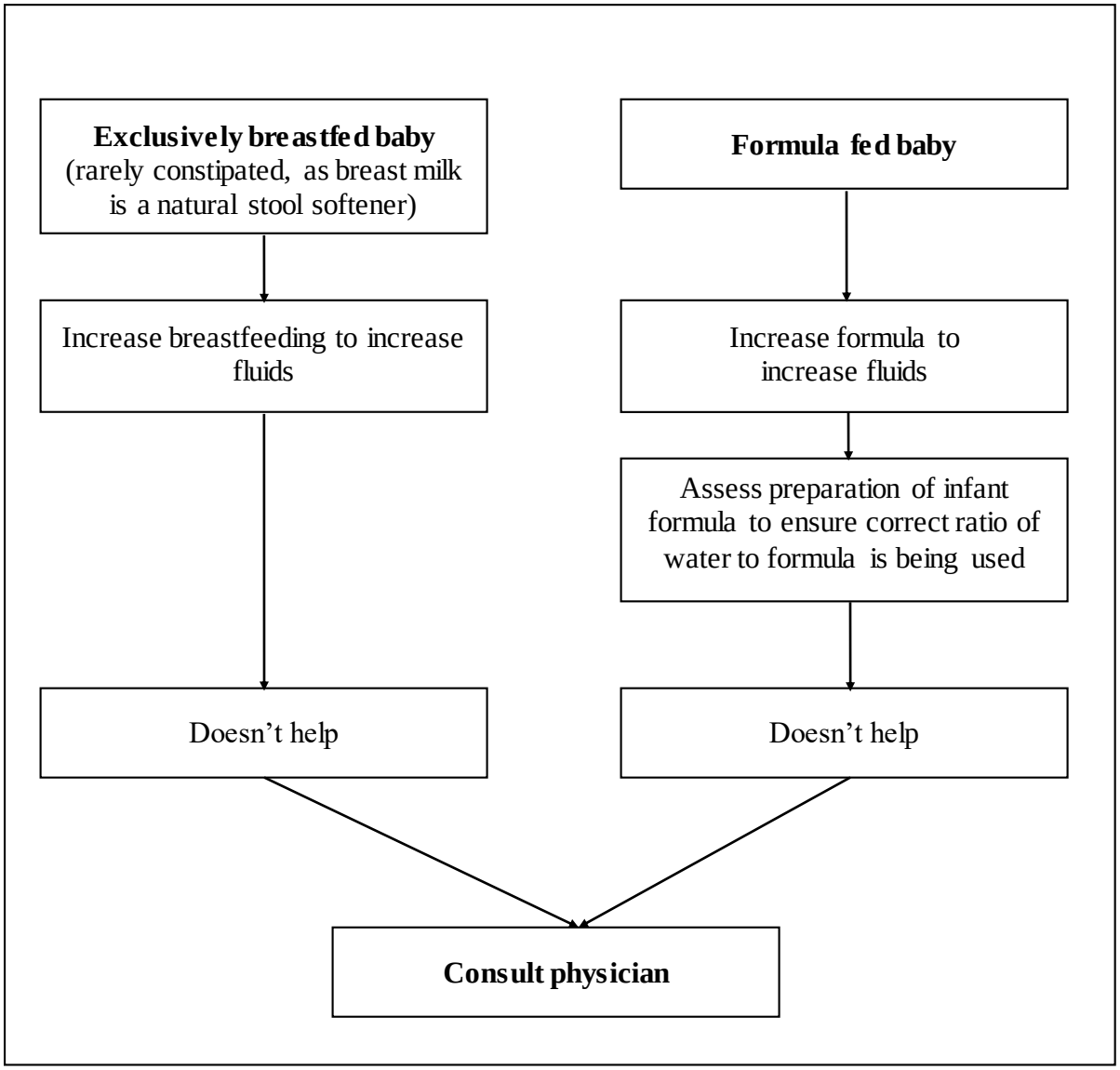
a) Increase breastfeeding or formula to ensure adequate fluid intake.
b) Public health practice often recommends baby massage (bicycling motion with legs, massaging the stomach) and warm baths.
c) Rectal probing is not recommended.
d) Juice is not recommended.
e) Water is not recommended.
f) Since some medications may cause constipation, any medications that an infant is taking should be noted to their physician.

g) There is limited evidence regarding the effects of probiotics on constipation in children, therefore no recommendation can be made at this time.
h) Chronic constipation may be a sign of allergy or intolerance to cow's milk, or may be due to organic causes (e.g. Hirschsprung disease).

Infants >6 months of age

i) Educate parents and caregivers regarding the wide variation in normal bowel patterns to avoid overtreatment, particularly once infants start eating solid foods.
j) Rectal probing is not recommended.
k) For acute constipation, the first-line treatment is to increase dietary fibre and fluids.
    - Increase breastfeeding or formula to ensure adequate fluid intake.
    - Increase intake of fibre-rich foods such as whole grain cereals and breads, fruits and vegetables, and cooked legumes.
    - Juices that naturally contain sorbitol such as prune, pear and apple, may be given within the context of a healthy diet.
l) For chronic constipation, the first-line treatment is medical with disimpaction and laxative therapy.
m) To prevent constipation, offer young children water and a variety of foods high in fibre each day, including whole grain breads and cereals, vegetables and fruit, and plant-based protein foods such as beans and lentils. Ensure that children are not filling up on juice, milk or other beverages which can displace foods that are sources of fibre.
n) Honey should be avoided in infants <1 year of age to prevent botulism; therefore, it should not be used to treat constipation.
o) A physician referral is warranted if constipation is accompanied by fever, abdominal distension, tight empty rectum with a palpable fecal mass, blood mixed with stool, or slow weight gain or weight loss.

Figure 1. Assessment and management of constipation in breastfed and formula fed infants <6 months of age



Evidence

- Normal bowel function occurs even when an infant appears to be in extreme discomfort. For the first 3–4 months of life, breastfed infants defecate approximately twice as frequently as formula fed infants. The frequency of bowel movements in infants varies; an infant who has soft, pain-free, but infrequent stools is not constipated and does not require further evaluation.[1]
- To prevent constipation, it is recommended that children eat a healthy balanced diet including fibre-rich foods such as whole grain cereals and breads, vegetables and fruit, and cooked legumes, along with adequate fluid intake according to Canada's Food Guide.[5,6] *[Level C Evidence]*

- Chronic organic constipation is rare and is caused by an underlying medical condition. It is diagnosed by a physician. Causes of organic constipation include anatomic (e.g. anorectal malformations), endocrinologic, metabolic (e.g. hypothroidism) or neurogenic factors (e.g. Hirschsprung disease).[3]
- Chronic functional constipation is constipation with no specific organic cause. There are many causes including pain, fever, dehydration, changes in diet or fluid intake, psychological issues, toilet training, medications and a family history of constipation.[4] The most common cause is painful defecation leading to voluntary holding of feces by a child who wants to avoid further unpleasant defecation.[3]
- Switching an infant to a low-iron formula is unnecessary. Ingestion of iron-fortified formula is not associated with an increased incidence of constipation.[5] *[Level B Evidence]*
- For acute constipation:
    - It is important to recognize and treat acute constipation early. If it is allowed to continue, it becomes chronic in one-third of patients.[7]
    - Based on expert opinion, dietary modifications to increase dietary fibre and fluid should be the first-line treatment for infants and young children.[5] *[Level C Evidence]*
    - Practice guidelines for the treatment of pediatric constipation recommend increasing intake of juices containing naturally occurring sorbitol such as apple, pear and prune, for infants under 1 year of age, within the context of a healthy diet. It is commonly recommended for older children; however there is no evidence available on the effective amounts, frequency or safe age of introduction. It is not recommended for infants under 6 months.[5] *[Level C Evidence]*
    - A balanced diet that includes fibre-rich foods helps prevent and treat acute constipation and may help prevent the development of chronic functional constipation.[5] *[Level C Evidence]*
- For chronic constipation:
    - The first-line treatment is medical, with disimpaction and laxative therapy.[7]
    - Increasing the volume of water or high osmolarity liquid intake in children with functional constipation has no effect on alleviating defecation difficulties, and should not be recommended unless history or clinical signs suggest abnormally low fluid intake for age and physical activity.[5] *[Level C Evidence]*
    - There is very little evidence that increasing fibre intake is helpful in the treatment of children with chronic functional constipation.[5] *[Level C Evidence]*
    - Once first-line treatment for children with chronic functional constipation has begun, consuming a balanced diet that contains fibre-rich foods is recommended to help prevent constipation from developing again.[5] *[Level C Evidence]*
- The safety of recommending wheat bran for constipation in infants and toddlers is controversial. Based on consensus, some guidelines recommend that unprocessed wheat bran not be given to children of any age due to the side effects of bloating and gas and the potential for decreased availability of micronutrients. However, evidence for this

recommendation is limited and conflicting. It is prudent not to offer unprocessed wheat bran to children younger than 2 years of age.[5] *[Level C Evidence]*

- There is inadequate evidence to support the effectiveness of probiotics in the treatment of chronic functional constipation in children or to recommend specific probiotics.[5] *[Level C Evidence]*
- For children with chronic constipation who do not respond to laxatives and/or dietary modifications, a trial of cow's milk elimination (under physician supervision) can be considered.[5] *[Level C Evidence]*
- No evidence was found to support the use of any of the following as an effective treatment of constipation in children: brown sugar, honey, corn syrup, fructo-oligosaccharides, omega-3 fish oils, excluding goat's milk.[5] *[Level D Evidence]*

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F.5 Diarrhea

Overview

Diarrhea is described as the sudden increase in the frequency and looseness of stools. For breastfed infants, diarrhea is defined as an abrupt increase in the number **and** looseness of stools and persisting for 3 or more stools. For formula fed infants, diarrhea is defined as an abrupt increase in number **or** looseness and persisting for 3 or more stools, becoming watery or very runny, containing mucous or blood or developing a new odour.[1] In Canada, acute gastroenteritis is usually a result of viral infections, such as rotavirus, which is the most common cause of severe gastroenteritis. Breastfeeding reduces the risk of gastrointestinal infections in infants.[2]

Recommendations

a) Appropriate management of an infant with acute diarrhea caused by gastroenteritis depends on the degree of dehydration.
b) For infants with minimal or no dehydration, oral rehydration solution (ORS) or free fluids should be provided to compensate for losses and cover maintenance needs. Nutrition should not be restricted.
c) For infants with mild to moderate dehydration, oral rehydration therapy (ORT) is the preferred treatment of fluid and electrolyte losses. Infants with severe dehydration should receive intravenous rehydration.
d) Early re-feeding with a normal diet as soon as dehydration is corrected is recommended to restore nutritional balance as soon as possible. Infants who have diarrhea and are not dehydrated should continue to be fed age-appropriate diets, without interruption.
e) Breastfed infants should continue to receive breast milk during the management of acute diarrhea.
f) Formula fed infants with mild to moderate dehydration, or whose dehydration has been treated, should continue to receive standard lactose-containing formula. In most cases of acute diarrhea, lactose-free formula is not necessary.
g) Infants and toddlers fed solid food should continue to receive their usual diet once rehydration occurs. The use of age-appropriate, nutrient-dense mixtures of common foods is recommended. Foods offered should be nutritious, easily digested and absorbed, culturally acceptable and should not have a deleterious effect on the illness.

Evidence

- Normal infant stool fluid losses are approximately 5 mL/kg/day. With acute diarrhea, these losses can increase to ≥200 mL/kg/day and quickly lead to dehydration.[3]
- The severity of fluid and electrolyte deficits, and the hemodynamic status of the child, dictate whether replacements must be administered intravenously or enterally.[3] *[Level A Evidence]*

- In developed countries, most children with gastroenteritis have mild symptoms with little or no dehydration, and can be managed with ORT.[3] *[Level A Evidence]*
- ORT is contraindicated in children with any of the following conditions: hemodynamic shock, stupor or coma, abdominal ileus, intestinal intussusceptions, or monosaccharide malabsorption.[3] *[Level A Evidence]*
- Enteral (oral or nasogastric) rehydration of infants and children has consistently been proven to be safer than, and as efficacious as, intravenous rehydration therapy (IVT).[3] *[Level A Evidence]*
- Some organizations recommend that caregivers keep a supply of ORS on hand at all times to be used as soon as diarrhea occurs, while others suggest that ORS is not necessary for the infant without dehydration, who can simply be encouraged to drink more than their usual amount of regular fluids while avoiding fluids high in simple sugars.[3] *[Level C Evidence]*
- For infants who are breastfed, breastfeeding should continue, even during the initial rehydration phase.[3] *[Level B Evidence]* Breastfeeding has been shown to reduce the severity and duration of diarrhea from rotavirus.[2]
- For formula fed infants, the routine use of lactose free formula during acute diarrhea is not justified in most cases. Lactose-free cow's milk protein-based formula has glucose polymers (usually from corn syrup solids). However, enough lactose digestion and absorption are preserved in acute gastroenteritis that low-lactose and lactose-free formulas have no clinical advantages over lactose-containing formulas. If dehydration has been treated, or if mild to moderate dehydration exists, lactose-free formulas are not indicated.[3] *[Level B Evidence]*
- The use of age-appropriate, nutrient-dense mixtures of common foods is recommended for feeding infants and toddlers once rehydration occurs.[3] *[Level A Evidence]*
- Early feeding is associated with better outcomes, including reduced stool output, duration of illness, increased weight gain and improvement in nutritional status.[3] *[Level A Evidence]*
- Unrestricted diets do not worsen the course or symptoms of mild diarrhea and can decrease stool output compared with ORT or IVT alone.[3] *[Level A Evidence]*
- Early re-feeding promotes gut nutrition by reducing abnormal increases in intestinal permeability and enhancing gut repair.[3] *[Level A Evidence]*
- Although nutrient malabsorption occurs, 80% to 95% of carbohydrates, 70% of fat and 75% of nitrogen are absorbed from mixed diets during acute diarrhea.[3] *[Level A Evidence]*
- The osmotic load of foods and fluids high in simple sugars (e.g. juice, sports drinks, soft drinks, flavoured gelatin, sugary desserts) may worsen diarrhea and should be avoided.[3] *[Level A Evidence]*
- Restricted diets, such as the once-favoured BRAT (bananas, rice, applesauce, tea or toast) diet contain low energy, protein and fat content. Additionally, prolonged gut rest or clear fluids can result in severe malnutrition.[3] *[Level A Evidence]*

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F.6 Colic

Overview

Infants with colic cry excessively, but are otherwise healthy and growing well. They may cry for hours each day for no obvious reason and generally do not respond to efforts to soothe them. Colic usually starts between the 3rd and 6th week after birth and subsides by age 3-4 months in 60-90% of infants.[1] The most common definition of colic is an infant who has periods of crying that last 3 or more hours per day for 3 or more days per week, for a minimum of 3 weeks.[2] Colic occurs in up to 40% of all infants.[1]

Recommendations

a) Mothers who breastfeed should be encouraged to continue breastfeeding if their baby develops colic. Breastfeeding may not be protective against colic, but it is not detrimental.
b) There is insufficient evidence to conclude that maternal diet contributes to infant colic. However, limited evidence suggests that excluding potentially allergenic foods from the mother's diet when breastfeeding (i.e. cow's milk, eggs, fish, soy, nuts, wheat) may help to reduce colic symptoms in infants ≤6 weeks of age. It is important to ensure that the mother's diet is nutritionally adequate. Dietary restrictions should be discontinued after 2 weeks if no benefit is seen.
c) Simethicone (found in such products as Ovol and Infacol) is not recommended as it has not been shown to be effective.
d) Gripe water is not recommended as a treatment for infant colic. Parents/caregivers who choose to use gripe water should be advised to use one that does not contain alcohol or sucrose.
e) Herbal tea is not recommended in the treatment of colic.
f) The use of low-lactose formulas to reduce the duration or severity of colic is not recommended in the majority of infants.
g) Probiotics is an option for families, but there is not enough evidence to support a standard recommendation in the treatment of colic and does not need to be promoted to all caregivers of infants with colic. Emerging evidence suggests that probiotic supplementation with 5 drops of *L. reuteri* daily may provide some benefits in infants that are exclusively breastfed where the mother is also following a dairy-free diet (i.e. avoiding all food products containing milk derivatives).
h) Probiotic-supplemented formulas are not recommended as a treatment for colic in formula fed infants as there is not enough evidence to suggest a benefit to their use.

Evidence

- The prevalence and amount of crying associated with infant colic are similar in breastfed and formula fed infants.[4] *[Level B Evidence]*

- Breastfeeding does not have a protective effect on the development of colic.[3] *[Level B Evidence]*
- There is conflicting evidence as to whether maternal diet contributes to infant colic. Limited evidence suggests that excluding potentially allergenic foods from the mother's diet when breastfeeding (i.e. cow's milk protein, eggs, nuts, wheat, soy and fish) may help to reduce colic symptoms in very young infants (≤6 weeks of age), and in cases where an allergy to cow's milk protein is suspected.[4] *[Level C Evidence]*
- If an elimination diet is attempted by the mother, it is important to ensure a nutritionally adequate diet is maintained, including sufficient protein, calories, calcium and vitamin D. Dietary restrictions should be discontinued after 2 weeks if no benefit is seen.[4] *[Level C Evidence]*
- Simethicone has not been shown to be more effective than placebo in treating infant colic.[5] *[Level B Evidence]*
- No randomized controlled trials evaluating the effect of gripe water on infants with colic have been undertaken; therefore it cannot be recommended as a treatment for colic.[6,7] Some brands of gripe water contain sugar and alcohol, which are not necessary and can be harmful to infants.[3]
- Herbal tea is not recommended in the treatment of colic.[3] *[Level B Evidence]* Herbal teas are not recommended for infants as they may have potentially harmful side effects, there is a lack of standardized strength and dosage and there are a multitude of products available. The amount of herbal tea that may need to be consumed could displace milk intake and result in an inadequate intake of nutrients.[3]
- The Canadian Pediatric Society (CPS) indicates that nutrition interventions in formula fed infants should be avoided in the majority of infants. However, among infants with severe colic, if there is a concern of a cow's milk protein allergy, a 2-week trial of extensively hydrolyzed formula could be considered.[4] *[Level C Evidence]*
- A small number of studies investigating the effect of probiotic supplements on colic have been conducted in recent years. The results from these studies have been mixed, but some promising studies are emerging.
- Supplementation with BioGaia (currently the only probiotic available for infants) is an option for families should they have the financial ability to purchase the product, but due to lack of evidence, this treatment does not need to be promoted to all caregivers of infants with colic.
- Results from a randomized study suggested that the use of *Lactobacillus reuteri* probiotic drops may be of some benefit in decreasing symptoms of colic in breastfed infants. However, more research is required before they can be recommended routinely. While probiotics have a good safety profile and there are generally no adverse side effects from their use, CPS states that there is insufficient evidence to recommend for or against the use of probiotics or prebiotics in the management of infant colic.[4] *[Level C Evidence]*.

- A study of 83 breastfed infants under 3 months of age concluded *L. reuteri* has a potential role as a therapeutic approach to infantile colic. For 28 days, 41 infants were randomized to receive *L. reuteri* and 42 were randomized to receive simethicone. All mothers were also asked to follow a cow's milk-free diet. At the end of the study, median crying time was less in the probiotic group (51 minutes/day) than the simethicone group (145 minutes/day) and the researchers found that 95% of the patients in the probiotic group responded to the treatment, versus only 7% of the patients in the simethicone group.[9]
- A systematic review and meta-analysis, involving a total of 1825 infants in 12 trials, examined the outcome of infant crying in infants 3 months or younger, randomized to receive either oral probiotics versus placebo or no treatment or standard treatment. These 12 eligible trials intervened with 3 different probiotic strains: *L. rhamnosus LGG*, *Bifidobacterium spp*, and *L. reuteri*. Seven of the reviewed trials were prevention trials, and 5 were management trials. Of the 12 trials, 6 suggested probiotics reduced crying and 6 did not. Three of the 5 management trials concluded probiotics effectively treat colic in breastfed infants. Meta-analysis of the 3 trials using *L. reuteri* as the intervention found that in breastfed infants with colic, crying time was reduced (65 minutes less per day) after 21 days of treatment, but noted that all 3 studies had potential biases. This systematic review and meta-analysis concluded that the use of *L. reuteri* in breastfed term infants with colic is promising, but there is still insufficient evidence to support the general use of probiotics in all infants with colic and in the prevention of colic in healthy term infants.[10]
- A randomized clinical trial involving 589 infants was completed prophylactically, where infants received *L. reuteri* or a placebo within the first week of life, and for 90 days afterwards. At 3 months of age, the mean duration of crying time was significantly different between the *L. reuteri* and placebo groups (38 vs. 71 minutes, respectively). The authors concluded that prophylactic use of *L. reuteri* during the first 3 months of life reduced the onset of colic, and other functional gastrointestinal disorders, and reduced private and public cost for the management of this condition.[11]
- Live microorganisms may be added to infant formula if the microorganism has been assessed as safe for infant use. The addition of live microorganisms to infant formula is intended to mimic the effects of breast milk on the infant's gastrointestinal system. However more evidence is needed to substantiate clinical benefits from infant formula supplemented with live microorganisms.[8]

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F.7 Probiotics

Overview

Probiotics are live micro-organisms, which when administered in a sufficient quantity, alter the microflora of the host and have the potential for beneficial health effects. Probiotics can be ingested through oral supplements or food products. For a certain bacterial strain to be called probiotic, it must meet 5 criteria. The bacteria must:

1. be of human origin (meaning that it will survive in a human body)
2. have a demonstrated safety profile
3. will survive transit through the gastrointestinal tract (will not be killed or digested by stomach acid or digestive enzymes)
4. will colonize in the large intestine upon its arrival, and
5. will provide a research-proven health benefit to the host.

Recommendations

a) The consumption of probiotics is safe for infants who are in good general health. Caution should be exercised when using probiotic therapy in immunocompromised or critically ill individuals.

b) The Lactobacillius and Bifidobacterium species used in the food industry and in clinical trials are safe for pediatric populations.

c) There is insufficient data to recommend the use of probiotic supplemented infant formula at this time. Due to the lack of adverse effects, caregivers may choose probiotic supplemented infant formulas if desired.

d) There is not enough evidence to support a standard recommendation for probiotic use with regards to colic. Emerging evidence suggests that probiotic supplementation with 5 drops of *L. reuteri* daily may provide some benefits in infants that are exclusively breastfed where the mother is also following a dairy-free diet (defined as the avoidance of all food products that contain milk derivatives). Supplementation with BioGaia is an option for families should they have the financial ability to purchase the product. But due to a lack of evidence, this treatment does not need to be promoted to all caregivers of infants with colic.

e) There is not enough evidence available to support that probiotics are effective in treating chronic functional constipation in children, or to recommend specific probiotics.

f) There is insufficient evidence to recommend perinatal probiotic supplementation to prevent the symptoms of atopic disease.

g) Administration of certain strains of probiotics to modify intestinal flora has been shown to be safe and to shorten the recovery period from acute diarrhea managed by oral rehydration therapy and early re-feeding.

h) Individuals with food allergies must ensure that the probiotic is free from their specific allergen. Cow's milk proteins are a common growth substrate and minute quantities may be present in some probiotic supplements. Individuals who are allergic to cow's milk should not consume products containing cow's milk proteins. *[Level C Evidence]*

Evidence

- The consumption of probiotics is safe for infants who are in good general health. However, each genera contains many different species and strains, and only the species and strains that have been studied or have a long history of traditional use can be considered safe at this time. Caution should be exercised when using probiotic therapy in immunocompromised or critically ill individuals.[1] *[Level B Evidence]*
- Evidence suggests that each probiotic strain stimulates the immune system in a different way. Probiotic strains that have not been thoroughly tested in infants should not be recommended. It is not known how probiotics affect the developing immune system.[2]
- The majority of scientific studies completed to date have described a good tolerance to probiotic preparations and the absence of significant adverse effects.[3] Most commercially available probiotic strains are considered to be safe; however, the safety of one strain cannot be extrapolated to another. All known cases of bacteremia and fungemia related to administration of probiotics have occurred in individuals who were critically ill or severely immunocompromised.[4] No reports of sepsis have occurred in healthy individuals.
- It has been suggested that transfer of antibiotic resistance through translocation and infection by probiotic strains is a safety issue[5]; however, registration of strains in Canada requires that probiotic organisms possess no genes of antibiotic resistance, virulence factors or enterotoxins.
- Live microorganisms may be added to infant formula if the microorganism has been assessed as safe for infant use. The addition of live microorganisms to infant formula is intended to mimic the effects of breast milk on the infant's gastrointestinal system. However more evidence is needed to substantiate clinical benefits from infant formula supplemented with live microorganisms.[6]
- Results from a randomized study suggested that the use of *Lactobacillus reuteri* probiotic drops may be of some benefit in decreasing symptoms of colic in breastfed infants. However, more research is required before they can be recommended routinely. While probiotics have a good safety profile and there are generally no adverse side effects from their use, the Canadian Pediatric Society states that there is insufficient evidence to recommend for or against the use of probiotics or prebiotics in the management of infant colic.[2] *[Level C Evidence]*

- A study of 83 breastfed infants under 3 months of age concluded *L. reuteri* has a potential role as a therapeutic approach to infantile colic. For 28 days, 41 infants were randomized to receive *L. reuteri* and 42 were randomized to receive simethicone. All mothers were also asked to follow a cow's milk-free diet. At the end of the study, median crying time was less in the probiotic group (51 minutes/day) than the simethicone group (145 minutes/day) and the researchers found that 95% of the patients in the probiotic group responded to the treatment, versus only 7% of the patients in the simethicone group.[7]
- A systematic review and meta-analysis, involving a total of 1825 infants in 12 trials, examined the outcome of infant crying in infants 3 months or younger, randomized to receive either oral probiotics versus placebo or no treatment or standard treatment. These 12 eligible trials intervened with 3 different probiotic strains: *L. rhamnosus LGG*, *Bifidobacterium spp*, and *L. reuteri*. Seven of the reviewed trials were prevention trials, and 5 were management trials. Of the 12 trials, 6 suggested probiotics reduced crying and 6 did not. Three of the 5 management trials concluded probiotics effectively treat colic in breastfed infants. Meta-analysis of the 3 trials using *L. reuteri* as the intervention found that in breastfed infants with colic crying time was reduced (65 minutes less per day) after 21 days of treatment, but noted that all 3 studies had potential biases. This systematic review and meta-analysis concluded that the use of *L. reuteri* in breastfed term infants with colic is promising, but there is still insufficient evidence to support the general use of probiotics in all infants with colic and in the prevention of colic in healthy term infants.[8]
- A randomized clinical trial involving 589 infants was completed prophylactically, where infants received *L. reuteri* or a placebo within the first week of life, and for 90 days afterwards. At 3 months of age, the mean duration of crying time was significantly different between the *L. reuteri* and placebo groups (38 vs. 71 minutes, respectively). The authors concluded that prophylactic use of *L. reuteri* during the first 3 months of life reduced the onset of colic, and other functional gastrointestinal disorders, and reduced private and public cost for the management of this condition.[9]
- Limited evidence was available looking at the results and recommendations of probiotic supplementation as a treatment for chronic functional constipation. Two studies were identified. In a study of 44 infants over the age of 6 months, diagnosed with chronic constipation, 22 received supplementation with *L. reuteri* for 8 weeks. At the end of the study period, the authors concluded that the infants receiving *L. reuteri* had statistically significant increased bowel frequency when compared to the control group, but no improvement in stool consistency and episodes of inconsolable crying. The second study investigated whether oral supplementation with *L. reuteri* can reduce the onset of constipation (among other indicators) in infants younger than 3 months. Two hundred and thirty-eight infants were randomized to receive the intervention. After 1 month of intervention and at the end of the 3-month intervention, infants receiving *L. reuteri* displayed a significantly increased evacuation frequency when compared to the control group.[9]

- Probiotics have been shown to have modest clinical benefit in the treatment of atopic dermatitis. Further research is required to determine which subjects would benefit.[2]
- Probiotics are a useful adjunct therapy for the treatment of acute infectious diarrhea in children. Beneficial effects include reduced duration of diarrhea, reduced stool frequency and reduced risk of diarrhea lasting 3 or more days. Adverse effects are minimal. The effect is seen particularly in young children and when the probiotic is administered early in the course of the illness and at a dose of at least 10^{10} CFU/day. *Sacharomyces boulardii* has been shown to be effective in reducing the duration of diarrhea in children.[10]
- The substrate medium that is used to support the growth of the bacteria used for probiotic supplements often contains cow's milk proteins. Minute quantities of cow's milk proteins may be present in some probiotic supplements.[5]

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F.8 Prebiotics

Overview

Prebiotics are a non-digestible food ingredient that triggers the growth of healthy bacteria in the intestinal flora. This can provide health benefits to the host. Breast milk contains prebiotics. Infant formulas supplemented with galacto-oligosacchardies (GOS), a type of prebiotic, are available in Canada.

Recommendations

a) More research is required to investigate the safety of prebiotics in infant formula.
b) There is currently insufficient evidence to recommend prebiotics for the management of atopic dermatitis.

Evidence

- Three studies have evaluated the impact of oligosaccharide supplementation of infant formula on growth. Two studies found no significant difference in growth, but the sample size and duration (birth to 1 month of age) were small. The third study had an adequate sample size, but other nutrient differences between the test and control formulas existed; thus, the impact of oligosaccharides are difficult to assess from this study.[1]
- Loose watery stools, borborygmi, abdominal pain and excess flatus are potential side effects, particularly with larger doses. Caution must be exercised in young infants due to a higher risk of dehydration.[1,2]
- Infants with an atopic family history who consumed a partially hydrolyzed formula with fructo-oligosaccharides (FOS)/GOS (test formula; dosage not provided) (n=8) from at least 2 months of age had more fecal bifidobacteria and less atopic dermatitis at 12 months of age compared with infants consuming a standard cow's milk formula (n=8). No infants in the test formula group had atopic dermatitis compared with 5/8 infants in the standard cow's milk formula group. This difference cannot be directly attributed to the prebiotics as the protein in the test formula was partially hydrolyzed, which may have resulted in the reduced atopic dermatitis.[3]
- Infants with atopic dermatitis were found to have different species of bifidobacteria than healthy controls. Atopic infants had significantly more *Bifidobacterium adolescentis* than non-atopic infants. The non-atopic infants harboured more *Bifidobacterium bifidum*. Therefore, the effect of prebiotic intake must be conducted at the species level to allow evaluation of the potential benefit in atopic disease.[4] *[Level C Evidence]*
- Prebiotic supplementation of infant formula may reduce the presentation of atopic dermatitis. Although there is ongoing research regarding the benefit of prebiotic supplementation for the management of atopy, there is currently insufficient evidence to recommend prebiotics.[4] *[Level C Evidence]*

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F.9 Vegetarian and Vegan Diets

Overview

Vegetarian diets typically exclude animal and fish products. Some vegetarian diets include milk and milk products and eggs. Vegan diets exclude animal products such as meats, fish, poultry, dairy and eggs or products containing these foods. The vegan diet is based on grains, legumes, seeds, and nuts. Key nutrients of concern for both vegetarian and vegan diets include: energy, protein, omega-3 fats, iron, calcium, vitamins B_{12} and D.

Well-planned vegetarian and vegan diets can support the normal growth and development of infants up to 1 year of age.

Recommendations

For breastfeeding infants of vegetarian and vegan mothers:

a) Soy and rice beverages and homemade formula should not be used to replace breast milk or commercial infant formula during the first 2 years of life.

b) Macrobiotic, raw, and fruitarian diets in infants are not recommended, as they have been associated with impaired growth and failure to thrive.

c) Consider ways to increase eicosapentaenoic acid (EPA) and docosahexaenoic (DHA) intake in vegetarians, as North American vegetarian diets typically contain low amounts of these nutrients. Sources include:
   - DHA supplements in caplet form;
   - EPA in sea vegetables;
   - DHA in omega-3-enriched eggs; and food sources of alpha-linolenic acid (ALA).

d) Additional strategies to increase EPA and DHA in the vegetarian diet include optimizing the conversion of ALA to EPA and DHA by:
   - avoiding trans fats and saturated fats;
   - limiting oils that are high in omega-6 fatty acids;
   - obtaining omega-6 fatty acids primarily from whole plant foods;
   - obtaining omega-3 fatty acids from flaxseed, flaxseed oil, walnuts and other good sources; and
   - using DHA supplements, rather than ALA supplements, to increase DHA body stores in vegetarians and vegans.

For breastfeeding infants of vegan mothers:

e) Supplement infants from birth with the adequate intake (AI) of vitamin B_{12} if their vegan mother does not consume sufficient quantities of vitamin B_{12}.

f) Infants do not require a supplement if their vegan mother meets the recommended daily allowance (RDA) for vitamin B_{12}. They will receive sufficient vitamin B_{12} from breast milk.

g) Introduce vitamin B_{12}-fortified foods and beverages or supplementary vitamin B_{12} into an infant's diet as their intake of breast milk decreases.
h) Infants born to mothers with a long history of veganism do not require a vitamin B_{12} supplement if the mother takes a B_{12} supplement while pregnant and lactating.
i) Vegan infants who are not breastfed or weaned before 1 year of age should be fed with a commercial fortified soy-based formula during the first 2 years of life.

Table 1. Vitamin B_{12} food sources

Cheese	Poultry
Eggs	Red Star T-6635+ Yeast (Vegetarian Support Formula)
Fish	Rice beverages*
Meat	Shellfish
Milk	Soy beverages*
Milk products	Soy-based meat substitutes*

**Not all products are fortified with vitamin B_{12}, check the Nutrition Facts table on the food label.*

For introducing a solid vegetarian or vegan diet to infants:

a) At 6 months of age, whether they are breastfed or formula fed, infants require extra nutrients from solid foods. Key nutrients of concern include energy, iron, omega-3 fats, protein, calcium, vitamins D and B_{12}.
b) Breastfed infants of mothers who follow a vegetarian or vegan diet require vitamin D supplementation.
c) Infants fed a vegan diet may require zinc supplementation.
d) The solid foods typically introduced first include vegetarian foods (cereals, vegetables, fruits). Tofu, pureed legumes and tempeh may also be introduced at this stage. Meat analogues, which tend to be combinations of ingredients such as soy and gluten, may be introduced after lack of allergic reaction to individual ingredients has been established.
e) Dietary sources of vitamin B_{12} for inclusion in vegan diets include fortified soy beverage (250 mL provides 50% of the recommended daily intake) and meat analogues. Nutritional yeast (Red Star T-6635+) is also marketed as a source of vitamin B_{12}.

Evidence

- The breast milk of vegetarian mothers is nutritionally adequate, with lower levels of environmental contaminants and a similar quantity of fat to that of omnivore women. Fat composition differs, with breast milk of vegetarians lower in saturated fat, EPA and DHA and higher in linoleic and linolenic acid than that of the general population.[1] The content of vitamins D and B_{12} in breast milk depends to some extent on maternal intake rather than stores; reliable sources are essential (Table 1).[1]

- Breastfed infants of vegetarian and vegan mothers thrive and exhibit normal growth patterns during the first 6 months.[1] A slightly slower, though normal, rate of growth during the first year reflects the fact that a higher proportion of vegetarian mothers breastfeed, compared with non-vegetarian women.[1]
- Infants fed soy formula grow and develop normally, as do infants on cow's milk formula.[1]
- Soy and rice beverages and homemade formula should not be used to replace breast milk or commercial infant formula during the first year of life, as these foods do not contain the proper ratio of macronutrients, nor do they have appropriate micronutrient levels for young infants.[2]
- Macrobiotic, raw, and fruitarian diets have been associated with impaired growth and failure to thrive and are not recommended for infants.[1,3,4] Some parents following these diets have erroneous beliefs regarding what constitutes a proper diet, are opposed to the use of supplements and fortified foods, or are opposed to the use of commercial formula if an infant is not breastfed.[1] As a result of these beliefs, their infants may receive insufficient amounts of some nutrients, including calories, protein, vitamin B_{12}, vitamin D, calcium, iron and riboflavin.[1,3,4]
- Infants born to mothers with a long history of veganism, and who are not supplemented with vitamin B_{12}, may be at risk for vitamin B_{12} deficiency due to the combined effect of low stores at birth and low vitamin B_{12} content of breast milk.[1,2]
- A recent pooled analysis of case reports of vitamin B_{12}-deficient infants identified that all cases were due to maternal vitamin B_{12} deficiency secondary to a strict vegan diet or untreated pernicious anemia.[3] Symptoms typically occurred between 4 and 10 months of age, and included megaloblastic anemia, hypotonia, irritability, refusal of solid food and declining growth rate. The pooled analysis also showed that rapid recovery occurred in all infants within days of treatment with vitamin B_{12} (usually 1 mg intramuscular for 4 days, sometimes followed by large oral doses to replenish stores); however, about half of these children had long-term developmental impairment. The review also reported that infants born to vitamin B_{12}-replete mothers have about 25 µg vitamin B_{12} stores at birth that are generally sufficient to last during the first year of life, but endogenous stores may be lower if maternal intake of vitamin B_{12} during pregnancy is low. During the first 6 months, infants consume an average of 0.25 µg/day of vitamin B_{12} from breast milk. Vitamin B_{12} levels in breast milk match maternal serum levels; the vitamin B_{12} concentration of breast milk from mothers with poor intake (i.e. vegans) or poor absorption has been reported to be 5–85 ng/L, compared with the normal range of 180–300 ng/L.[3]
- The adequate intake for vitamin B_{12} is 0.4 µg/d from birth to 6 months of age and 0.5 µg/d from 7–12 months; the RDA for vitamin B_{12} is 2.6 µg/day during pregnancy and 2.8 µg/day during lactation.[4]
- Vegan infants who are not exclusively breastfed should be fed with a commercial fortified soy-based formula during the first 2 years of life.[1,2]

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F.10 Vitamin/Mineral Supplementation: Fluoride

Recommendations

a) The Canadian Pediatric Society recommends no supplemental fluoride until an infant is >6 months of age.
b) For infants and young children from 6 months of age to 3 years old who are living in areas where the household water supply contains <0.3 ppm fluoride, daily supplementation with 0.25 ppm fluoride is recommended if:
    - The child does not brush his/her teeth (or have them brushed by a parent or caregiver) at least twice a day, and
    - A dental health professional deems the child susceptible to high caries activity (i.e. family history, caries trends and patterns in communities or geographic areas).
c) Where water contains >0.3 ppm, no supplementation is needed (the level of fluoride in Winnipeg water is 0.72–0.95 ppm, with a target of 0.85 ppm).

Evidence

- Fluoridation of the water supply is an effective means of preventing dental caries.[1] The Daily Reference Intakes set the adequate intake for fluoride to be 0.01 mg per day for infants from birth to 6 months of age and 0.5 mg/d for infants from 7–12 months of age. The upper limit for fluoride for infants 7–12 months of age is 0.9 mg per day. The ingestion of more than the recommended daily dose of fluoride is associated with an increased risk of dental fluorosis.[2-4]
- A position statement from the Nutrition Committee of the Canadian Paediatric Society outlines the following fluoride recommendations for infants and children: [3]
    - Fluoride should continue to be added to municipal water supplies where natural concentrations are <0.3 ppm. A suitable trade-off between dental caries and fluorosis occurs around 0.7 ppm.
    - Children should use only a pea-sized amount of toothpaste, and be encouraged not to swallow the excess.
    - Because the action of fluoride is topical, no fluoride should be given before teeth have erupted.
    - Supplemental fluoride should be administered only from the age of 6 months (at a dose of 0.25 mg/day for children aged 6 months to 3 years), and only if the following conditions exist:
        - the concentration of fluoride in drinking water is <0.3 ppm;
        - the child does not brush his or her teeth at least twice per day; and
        - if, in the judgement of a dentist or other healthcare professional, the child is susceptible to high caries activity.
    - Supplemental fluoride should be given in preparations that maximize the topical effect, such as mouthwashes or lozenges. Drops, if used, should be diluted with water and squirted on the teeth.

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F.11 Vitamin and Mineral Supplementation: Vitamin D

Recommendations

a) For infants 0-12 months old, Table 1 outlines the recommended vitamin D supplementation per day.

b) For children 12-24 months old, a vitamin D supplement of 400 IU per day is recommended if:[1]
   - the child is breastfed or receiving breast milk, or
   - the child is not consuming cow's milk[2]

c) Some parents/caregivers may choose to give their infant a multivitamin supplement such as Enfamil® Tri-Vi-Sol®, which contains vitamins A, C and D. However, the extra vitamins A and C are not required by a healthy term infant.

Table 1. Recommended vitamin D supplementation per day for infants 0-12 months

Population	Amount per day
Breastfed infants	400-800 IU
Combination fed infants (breast milk and formula)	400 IU
Formula fed infants	400 IU

Evidence

- Vitamin D is a fat-soluble vitamin that is essential for the absorption and utilization of calcium and phosphorus. It is required for proper growth and development of bones and teeth. A lack of vitamin D can cause rickets, a condition characterized by softening and deformation of bones.[3] Rickets remains a concern in some parts of Canada.[4]
- Vitamin D is needed to protect against the future development of diseases such as osteoporosis. Current research indicates that vitamin D may provide a role in non-bone chronic disease prevention as well.[5,6,7,8,9]
- Cases of vitamin D deficiency still occur in Canada among infants who are not supplemented. Without supplementation, infant vitamin D stores are quickly depleted, particularly if the mother's stores are low.[10]

- The following are the Dietary Reference Intakes for vitamin D per day recommended by Health Canada and the Institute of Medicine:[11]

Age Group	Adequate Intake (AI) /Recommended Dietary Allowance (RDA) per day	Tolerable Upper Intake Level (UL) per day
Infants 0-6 months	400 IU (AI)	1000 IU
Infants 7-12 months	400 IU (AI)	1500 IU
Children 1-3 years	600 IU (RDA)	2500 IU

Tolerable Upper Intake Level (UL): The highest level of continuing daily nutrient intake that is likely to pose no risk of adverse health effects in almost all individuals in the life-stage group for which it has been designed. Long-term intakes above the UL increase the risk of adverse health effects.

- The vitamin D content of breast milk ranges from 4–40 IU/L.[12,13] Breast milk does not meet the needs for vitamin D for infants.
- Most infant formula contains 400 IU/L of formula.[14]
- Sunlight is the main source of vitamin D for humans, which is made in the body when bare skin is exposed to sunlight. The amount produced depends on many factors such as skin pigmentation, the use of sunscreen, geographic location, the season, and environmental factors such as the time of day, amount of cloud and the presence of smog.[11]
- Dark-skinned infants require increased sunlight exposure (10-20 fold) to produce the same amount of vitamin D3 compared to light-skinned infants, making them particularly vulnerable to developing rickets.[15]
- Clothing and sunscreen also interfere with the body's production of vitamin D. No vitamin D is made by the skin when sitting indoors by a window, as clear glass blocks 97% of ultraviolet B rays.[16]
- In addition, infants <1 year of age should be kept out of direct sunlight due to the risk of skin cancer. Sunscreen should not be applied to infants <6 months of age, but is recommended for infants >6 months of age.[17]
- The geographic latitude of Canada, and Winnipeg (49°N) and Churchill (58°N) in particular, results in inadequate ultraviolet exposure to stimulate formation of vitamin D in the skin for a large portion of the year during the winter months.[15] The Canadian Pediatric Society (CPS) recommends infants between the 40th and 55th parallel with risk factors for vitamin D deficiency receive 800 IU/day between October and April, and all infants north of the 55th parallel receive 800 IU/day between October and April. CPS' risk factors for vitamin D deficiency include living in Northern latitudes, First Nations and Inuit peoples, those who wear clothing covering most of their bodies due to cultural or religious reasons and those with highly pigmented skin.[14]

- After 9–12 months of age, fortified whole cow's milk becomes the most common food source of vitamin D in the diet. One cup of milk contains 103-105 IU of vitamin D.[18] Infants who are old enough to eat solid foods should not consume >750 mL of milk per day since milk is low in iron. Large amounts of milk in the infant's diet can lead to iron deficiency anemia.[1]
- In Canada, cow's milk and margarine must be fortified with vitamin D. Fortified plant-based beverages (e.g. fortified soy beverage), calcium-fortified orange juice and goat's milk may be fortified with vitamin D. Cheese and yogurt may be made with vitamin D-fortified milk, but it does not contain as much vitamin D as fluid milk. The only natural sources of vitamin D are fatty fish and egg yolks.[11]
- The most appropriate supplement is a single vitamin D supplement. Liquid supplements are recommended for children <24 months of age and should be given directly into the mouth.[19]

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Client Resources

- *How to give a baby a Vitamin D drop every day*. 2015. Winnipeg, MB: Healthy Start for Mom and Me, Winnipeg Regional Health Authority. Available at:
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  French - https://www.hsmm.ca/wp-content/uploads/HSMM_VitD_FR_NTL.pdf

F.12 Vitamin and Mineral Supplementation: Iron

Recommendations

a) Iron supplements are not routinely recommended for the general healthy term infant population.
b) If a parent/caregiver suspects an infant may be at risk for or have iron deficiency he/she should consult a physician.
c) Infants will meet their iron needs with exclusive breastfeeding for the first 6 months of life. Infants who are exclusively breastfed require the addition of iron-rich solid foods at 6 months of age, with continued breastfeeding to 2 years and beyond.
d) Infants who are not breastfed or are partially breastfed require infant formula with iron from birth, with the addition of iron-rich solid foods at 6 months. Infant formula is required until 9–12 months of age, at which time whole cow's milk can be introduced if the infant is consuming a variety of iron-rich foods.
e) At 6 months of age, iron-rich solid foods – including meats, poultry, fish, cooked egg yolk, meat alternatives (e.g. legumes such as chickpeas and lentils, tofu), iron-fortified infant cereals – are required to meet infants' iron needs. There are 2 types of iron found in food. Heme iron is available in animal products and is better absorbed than non-heme iron, which is found in plant sources. Consuming foods that are rich in vitamin C (e.g. oranges, tomatoes) can help to increase absorption of non-heme iron.

Evidence

- Iron deficiency anemia may have irreversible cognitive effects; thus, prevention of anemia is crucial.[1,2]
- An infant will meet his/her iron needs with breast milk for the first 6 months of life. Infants who are not breastfed should be given infant formula with iron from birth, as parents/caregivers may forget to switch from a non-iron-fortified infant formula to an infant formula with iron at age 4–6 months.[2]
- At 6 months of age infants require the addition of iron-rich foods, including meats, poultry, fish, cooked egg yolk, meat alternatives (e.g. legumes such as chickpeas and lentils, tofu), and iron-fortified infant cereals.[2]
- As per the Dietary Reference Intakes, infants from age birth to 6 months require 11 mg iron per day, and infants ages 7–12 months require 7 mg iron per day.[3]

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F.13 Oral Health

Overview

Early childhood caries (ECC) is a preventable, chronic infectious disease that affects disproportionate numbers of children from low income families and some ethnic groups.[1] It can lead to serious infection, eating difficulties, certain vitamin and mineral deficiencies and other dental and social problems.[2-6] Practicing good oral care in the early years can help to prevent ECC and help children establish healthy oral hygiene habits.

Recommendations

To decrease the risk of developing ECC, advise parents and caregivers to:

a) Consume a healthy diet during pregnancy. Vitamin D and calcium are essential building blocks for strong teeth.

b) Ensure regular dental care for both parents and/or caregivers. This may reduce the transmission of cavity-causing bacteria to the infant.

c) Starting from birth, wipe an infant's gums twice a day with a clean, damp washcloth.[7] This helps them become comfortable with daily mouth care routines.

d) Wipe an infant's lips, gums and teeth after breastfeeding or formula feeding, especially when the infant falls asleep during feeding.

e) Begin brushing teeth twice a day with a soft, age-appropriate-sized toothbrush as soon as the first primary tooth erupts (approximately 6 months of age).[8,9] A parent or caregiver should help children brush their teeth until they are 8 years old.

f) For children *less than 3 years of age*, consult a dental professional to determine if the child is at risk for developing tooth decay.
   - If the child is at risk, use a small amount (size of a grain of rice – see Figure 1) of fluoride toothpaste.
   - If the child is not at risk, use only water to brush their teeth.

   For children *3-6 years of age*, use a green pea-sized amount (see Figure 1) of toothpaste.[10]

g) Begin to floss an infant's teeth as soon as two teeth are touching.

h) Use a cold, wet cloth or teething ring instead of teething biscuits.[7]

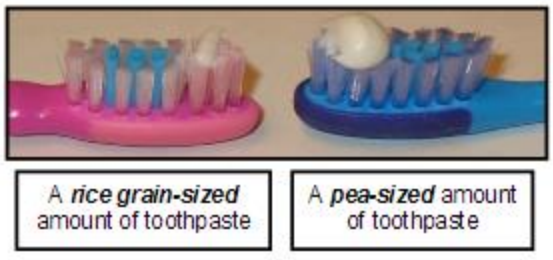
i) Refrain from giving infants bottles containing naturally occurring or added sugar (e.g. breast milk, formula, juice) when they are put to sleep. Do not prop an infant's bottle.[8,9]

j) Encourage infants to drink from an open cup. Begin to offer it at 6 months of age with assistance, allowing infants to develop this skill as they approach 1 year of age. Drinking from an open cup can help to reduce constant consumption of sugar-containing liquids, reducing the risk of dental decay.[2]

k) Wean infants from bottle drinking by 12-18 months of age.[8] From this age onwards, avoid giving an infant any liquid containing naturally occurring or added sugar (e.g. juice, pop, other sweet drinks) in a bottle or no-spill sippy training cup.[8] Use an open cup.[2,10]

l) Avoid saliva-sharing activities (i.e. sharing utensils, testing food temperatures, cleaning pacifiers or bottle nipples in one's mouth, using a parent's toothbrush for an infant) to prevent passing on cavity-causing bacteria to the infant.[8]
m) Refrain from giving children fluoride supplements (drops or tablets) or fluoridated mouthwash or mouth rinses unless advised by a dental professional, due to the risk of fluorosis. Fluoride supplementation is not recommended for infants less than 6 months of age.[1]
n) Check the infant or child's teeth at least once a month for signs of tooth decay. Lift the top lip and look along the gum line. Also check behind the top front teeth using a dental mirror. Decay presents as white, brown or discoloured areas on the teeth, often along the gum line.[7]
o) Take the infant to see a dentist by the time he/she is 12 months old.[7]

Figure 1. Recommended amount of toothpaste for children 0-3 years old at risk of tooth decay (rice grain-sized) and children 3-6 years old (pea-sized).



Source: Tooth Care (& Mouth Care) Starts at Birth Newborn to 6 years. Healthy Smile Happy Child Manitoba 2014. http://www.wrha.mb.ca/healthinfo/preventill/files/ECTD_Newborn-6_E.pdf

Evidence

- Non-dietary population and individual risk factors exist that may increase the risk of dental caries. Population factors are socio-economic status, ethnicity, maternal education, not seeking regular dental care and no access to dental insurance or dental service. Individual factors include active dental caries, a history of caries in older siblings or caregivers, high levels of infection with cariogenic bacteria (e.g. *Streptococcus mutans*), one malnutrition episode during pregnancy (which increases the risk for enamel defects, which are more prone to developing cavities), premature birth (also increases the risk for enamel defects), pacifier sucking (non-nutritive sucking) and oral hygiene. Risk increases when combined with dietary practices that are conducive to dental caries.[1,11] *[Level A Evidence]*
- Breast milk is not an independent risk factor for the development of ECC. There is evidence showing that particular feeding practices such as feeding at night, weaning after 12 months, and breastfeeding without proper oral hygiene can lead to the development of ECC.[12] *[Level B Evidence]* The evidence for the protective effect of breastfeeding on the development of ECC is still mixed.[12] *[Level C Evidence]*

- The role of breastfeeding in the development of ECC remains controversial. It is well accepted that ECC occurs in some populations of breastfed infants.[1] The most recent data indicates that breast milk is not an independent risk factor for ECC.[11, 13]
- Nighttime bottle feeding may increase the risk for the development of ECC; however, bottle use alone may not be a risk factor for decay.[8,14] *[Level B Evidence]*
- Propping the bottle on a pillow can lead to early childhood tooth decay. Infants may not swallow their last mouthful of formula or other nourishment. It can pool around the teeth and eventually cause decay.[15]
- Extended and repetitive breast or bottle feeding should be followed by wiping the infant's teeth and gums.[16]
- An adult should brush the teeth and gums of children from birth to age 3. An adult should assist children from age 3 to 8 years of age in brushing their teeth.[10]
- The use of fluoridated toothpaste from birth to 3 years of age is determined by the level of risk for ECC. The level of risk should be assessed by a dental professional. A child may be at risk if one or more of the following conditions are present:[10]
    - Lives in an area with a non-fluoridated water supply and low (<0.3 ppm) natural fluoride levels
    - A visible defect, notch, cavity or white chalky area is present on a baby tooth in the front of the mouth
    - The child regularly consumers sugar (including natural sugars) between meals. This includes liquids other than water in a bottle or sippy cup.
    - The child has special needs that limit his or her cooperative abilities, making it difficult for a parent/caregiver to brush the child's teeth
    - The child's teeth are brushed less often than once a day
    - The child was born prematurely with a very low birth weight (<1500 g or 3 lb)
    - The parent/caregiver has tooth decay
    - The child has visible plaque, such as white or yellow deposits, on the teeth
- Prolonged exposure of primary teeth to sugar (primarily sucrose, but also glucose and fructose) is a contributing factor in the development of ECC. The sugar(s) may be in the form of sweets (candies and other sweetened foods) or sweetened beverages (e.g. pop, fruit drinks, punches, sports drinks).[8] Juice also has a high sugar content. Unsweetened homogenized (3.25% M.F.) milk is recommended over sweetened milk.[2] The frequency, timing and amount of sugar consumed are all factors significantly associated with ECC.[8] *[Level B Evidence]*
- The World Health Organization recommends children (and adults) reduce their intake of free sugars to less than 10% of total energy. Free sugars are all forms of sugar added to foods and beverages by manufacturers, cooks and consumers, as well as sugars that are naturally present in honey, syrups, fruit juices and fruit juice concentrates. Reducing the risk of dental caries in childhood is important to reduce the cumulative negative health effects of dental caries later in life.[17]

- Drinking from an open cup can help to decrease constant consumption and over exposure of the teeth to sugar-containing liquids. Decreasing this exposure may help reduce the risk of dental decay.[2]
- One of the most common bacteria associated with ECC is *Streptococci mutans*. The earlier age at which these bacteria are acquired by the infant is a significant indicator of ECC risk.[1,18,19,20] The bacteria metabolize carbohydrates and produce acid which demineralizes tooth enamel during decay.[1] *Streptococci mutans* is transmitted to the infant via saliva, usually by the mother.[8,21,22]
- Fluoride supplements (drops or tablets) or fluoridated mouthwash/rinse should not be given to children <6 years of age, as they may swallow it. This recommendation is consistent with recommendations made by Health Canada's First Nations and Inuit Health Branch and the Canadian Association of Public Health Dentistry. If children <6 years of age ingest high levels of fluoride during the period of tooth formation, they can develop dental fluorosis, a condition in which white areas or brown stains appear on the surface of teeth, affecting their appearance but not their function. However, excessive intake of fluoride can damage tooth enamel, causing tooth pain and difficulty chewing.[23]

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Client Resources

- *Tooth Care (& Mouth Care) Starts at Birth: Newborn to 6 Years*. 2014. Winnipeg, MB: Healthy Smile Happy Child Project; Manitoba Collaborative Project for the Prevention of Early Childhood Tooth Decay. Available at: https://wrha.mb.ca/wp-content/site-documents/healthinfo/preventill/files/ECTD_Newborn-6_E.pdf. (Also available in French and Cree: https://wrha.mb.ca/oral-health/early-childhood-tooth-decay/)
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- *Making Connections: Your First Two Years with Baby*. Winnipeg, MB: Healthy Child Manitoba, 2009. Available at: http://www.gov.mb.ca/healthychild/healthybaby/hb_makingconnections.pdf.

Appendix. Grading the Evidence of Research Articles

Level	Criteria	Explanation for Grading
Level A	Conclusion is supported by good evidence	• The evidence consists of results from studies of strong design for answering the question addressed. • Results are both clinically important and consistent with minor exceptions at most. • Results are free of significant doubts about generalizability, bias, and flaws in the research design. • Studies with negative results have sufficiently large samples to have adequate statistical power.
Level B	Conclusion is supported by fair evidence	• The evidence consists of results from studies of strong design for answering the question addressed, but there is some uncertainty attached to the conclusion because of inconsistencies among the results from the studies or because of minor doubts about generalizability, bias, research design flaws, or adequacy of sample size. • Alternatively, the evidence consists solely of results from weaker designs for the question addressed, but the results have been confirmed in separate studies and are consistent, with minor exceptions at most.
Level C	Conclusion is supported by limited evidence or expert opinion	• The evidence consists of results from studies of strong design for answering the question addressed, but there is substantial uncertainty attached to the conclusion because of inconsistencies among the results from different studies or because of serious doubts about the generalizability, bias, research design flaws, or adequacy of sample size. • Alternatively, the evidence consists solely of results from a limited number of studies of weak design for answering the question addressed. • Finally, the support for a particular opinion may consist of statement of informed, respected authorities based on their experiences, descriptive studies or reports of expert panels.
Level D	A conclusion is either not possible or extremely limited because evidence is unavailable and/or of poor quality and/or is contradictory.	• No evidence from clinical studies or authoritative sources was found.

Adapted from: *Dietitians of Canada, Practice-based Evidence in Nutrition, 2009*