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Risk of Lactose Intolerance and Dairy Food Nutrition: A Review

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Abstract
Consumption of cow's milk and milk products is associated with overall diet quality and adequacy of intake of many essential nutrients including calcium, potassium, phosphorus, protein, vitamins A, D (if fortified), and B12, riboflavin, and niacin. Unfortunately, some individuals may avoid milk and milk products unnecessarily because of adverse reactions to these foods. Because of its **nutrient-rich** package, consumption of dairy foods can play a unique role in helping to promote health. People who avoid milk and milk products due to lactose intolerance miss many benefits, as dairy and its nutrients are associated with: Improved nutrient intake and diet quality. Cow's milk allergy is an immunologically mediated response to one or more of cow's milk proteins. Lactose intolerance, a no immunological reaction, is the occurrence of symptoms after persons with low levels of the enzyme lactase (lactose maldigesters) consume lactose (milk sugar) in amounts exceeding lactase's ability to digest it. Cow's milk protein allergy occurs primarily in infancy and early childhood. Moreover, the condition tends to be outgrown by 5 years of age. In contrast to cow's milk allergy, which occurs primarily in infancy and young childhood, lactose intolerance (symptoms) seldom occurs prior to preadolescence.
Keywords: Milk, lactose intolerance, Milk protein allergy, paediatric population

INTRODUCTION

Milk is the secretion of the mammary gland of female mammals (over 4000 species), and it is often the sole source of food for the very young mammal. The role of milk is to nourish and provide immunological protection. Milk in its natural state is a highly perishable material because it is susceptible to rapid spoilage by the action of naturally occurring enzymes and contaminating microorganisms. Many processes have been developed over the years, in particular, during the last century for preserving milk for long periods and to enhance its utilization and safety Miller GD, et al., 2007). Milk is converted into a wide variety of milk products using a range of advanced processing technologies. These include the traditional products, such as the variety of cheeses, yogurts, butters and spreads, ice cream, and dairy desserts, but also new dairy products containing reduced fat content and health-promoting components. Milk is also an excellent material for producing multifunctional ingredients that can be used in many food products (Robinson, 2002). Milk is one of the few foodstuffs consumed without further processing, and it is generally regarded as the most nearly perfect food. Nutritionists worldwide agree that it is of enormous value in promoting growth and development of children and young animals. Although it is important for infant and childhood feeding, milk and milk products continues to be important in our diets right throughout our adult life.

An ever-increasing variety of milk and other dairy products is available to meet the taste, nutrition, health, and convenience demands of consumers. For example, dairy products of varied fat content, of low or reduced-lactose content, fortified with nutrients such as vitamins A, D, and calcium, and processed to improve keeping quality are available Miller GD, et al.,2007). These products include milks (unflavored, flavored, evaporated, condensed, sweetened condensed, dry, nonfat dry), cultured or culture-containing dairy foods (yogurt, kefir, acidophilus milk, cultured buttermilk, sour cream), creams (heavy, light, whipping, half-and-half), butter, ice cream, and cheeses, among other products (American Academy of Pediatrics, 2005b). Milk can be processed and stored in some form (milk powder, condensed milk) in order to overcome perishable nature of milk in its natural state (Chandan, 2008).

Significance of the review

Nutritional milk supply energy (mainly from fats and sugar lactose), amino acids (from proteins), vitamins, and atomic elements (commonly but inaccurately referred to as minerals). In addition, several physiological functions are performed by milk constituents, including antimicrobial substances (immunoglobulins, lactoperoxidase, and lactotransferrin), enzymes and enzyme inhibitors, vitamin-binding carrier proteins, and cell growth and control factors. Because the nutritional and physiological requirements of each species are more or less unique, the composition of milk shows very marked interspecies differences (Wooten, WJ et al., 2005). Consumption of cow's milk and milk products is associated with overall diet quality and adequacy of intake of many essential nutrients including calcium, potassium, phosphorus, protein, vitamins A, D (if fortified), and B12, riboflavin, and niacin. Unfortunately, some individuals may avoid milk and milk products unnecessarily because

of adverse reactions to these foods. This article will review the appropriate consumption of milk and milk products with good managements of lactose intolerance and milk protein allergy.

Objective of the review

The objectives of this paper are to review:

- The intake of cow milk and its products
- Milk nutrients and their benefits
- Health aspects of milk consumption
- Adverse effect associated with milk such as lactose intolerance and protein allergy
- Lactose intolerance and its cause, types and treatments
- Milk protein allergy and its cause, types and treatments
- Milk alternatives for children and adults who have lactose intolerance and allergy

METHOD USED IN THE REVIEW

To achieve the objective of this paper different Literatures search and written material were reviewed and organized to provide, scientific information on milk nutrients and their benefits, health aspects of milk consumption, adverse effect associated with milk such as lactose intolerance and protein allergy, lactose intolerance and its cause, types and treatments, milk protein allergy and its cause, types and treatments and milk alternatives for children and adults who have lactose intolerance and allergy

RESULT AND DISCUSSION

Composition of milk

Milk can be considered as a heterogeneous material, composed of a complex mixture of lipids, proteins, carbohydrates and water. For example cow's milk consists of average of: 87% water and 13% total solids, of which ~9% solids-not-fat (SNF) and 3.7% fat (Figure 1) (Crittenden and Bennett 2005). More than 100 different components have been identified in cow's milk. Important nutritional contributions of milk and milk products are calcium, vitamin D (if fortified), protein, potassium, vitamin A, vitamin B12, riboflavin, niacin (or niacin equivalents), and phosphorus (American Academy of Pediatrics, 2004; Thong and Hourihane, 2004). As a result of new technologies in genetics, molecular biology, and analytical chemistry; a number of milk constituents with physiological benefits beyond milk's traditional package of nutrients are being recognized (Kosgey *et al.*, 2012).

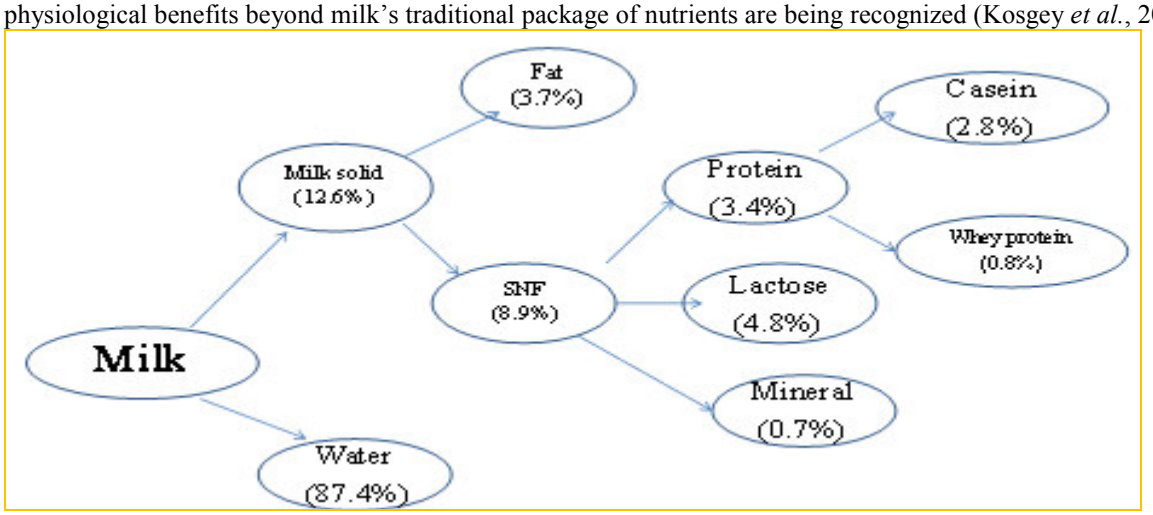

Figure 1 gross constituents of milk

Factors Affecting Composition of Milk

Milk composition is affected by numerous factors which can be classified into genetics and environment. Among the intrinsic genetic factors, the effects of breed has a dominate effect on milk constituents. Environmental factors such as: interval between milking, stage of lactation, age, disease, completeness of milking, season, farming system, herd management, milking frequency and feed affect milk composition. For example based on feed: milk fat of cows fed silages has a higher ratio of SFAs: UFAs; and a higher palmitic acid proportion, whereas the proportion of beneficial vaccenic and rumenic acids is lower (Duchacek, 2012).

Nutrients in Milk Products

Milk products contain up to 16 nutrients that are essential for health. Calcium, vitamin D and protein are some of the nutrients in milk products that keep the body functioning properly and could help reduce the risk of certain

diseases. Milk and milk products are the largest source of protein in pre-school children and the second largest contributor further to meat and meat products in all other age groups (Wooten, W. J. and Price, W., 2004). Cows‟ milk contains about 3.5% protein by weight, and of this total protein, 80% is casein and 20% whey. Casein is the dominant protein in milk and can be fractionated into four major components: alpha, beta, gamma and kappa-casein. Whey protein is composed predominantly of beta-lactoglobulin and alpha-lactalbumin, but other whey proteins include serum albumin, immunoglobulins (IgA, IgG, IgM), protease peptones, lactoferrin and transferrin (Hoelscher, D et al., 2002).

Nutritional benefit of Milk and Milk Products in the Diet

Milk is a fluid secreted by the female of all mammals, of which there are more than 4,000 species, for the primary function of meeting the complete nutritional requirements of the neonate of the species. It must supply energy (mainly from fats and sugar [lactose]), amino acids (from proteins), vitamins, and atomic elements (commonly but inaccurately referred to as minerals). In addition, several physiological functions are performed by milk constituents, including antimicrobial substances (immunoglobulins, lactoperoxidase, and lactotransferrin), enzymes and enzyme inhibitors, vitamin-binding carrier proteins, and cell growth and control factors. Because the nutritional and physiological requirements of each species are more or less unique, the composition of milk shows very marked interspecies differences(Weinberg, L. G., et al.,1998)

Physicochemically, milk is a very complex fluid. The constituents of milk occur in three phases. Most of the mass of milk is an aqueous solution of lactose, organic and inorganic salts. More than 100 different components have been identified in cow's milk. Important nutritional contributions of milk and milk products are calcium, vitamin D (if fortified), protein, potassium, vitamin A, vitamin B12, riboflavin, niacin (or niacin equivalents), and phosphorus. Research continues to identify positive ways that milk impacts health. In addition to building healthy bones, consuming milk, cheese and yogurt can boost immunity, lower blood pressure, reduce risk of diabetes, reduce risk for some cancers and help maintain your weight(Wooten, W, et al., 2004)

ENERGY

The energy (calorie) content of milk and other dairy foods varies widely and depends mostly on the fat content of the milk, but also on the addition of non-fat milk solids, sweeteners, and other energyyielding components. For example, whole milk (3.25% milk fat) provides about 150 kcal per cup; reduced-fat (2%) milk provides 120 kcal per cup; low-fat (1%) milk provides 100 kcal per cup; and nonfat (skim) milk provides 80 kcal per cup. As mentioned above, milk is considered to be a food of high nutrient density, providing a high concentration of nutrients in relation to its energy content. Milk fat contributes unique characteristics to the appearance, texture, flavour and satiability of dairy foods. Dairy fat is a source of energy, essential fatty acids, fat-soluble vitamins, and several other components, such as conjugated linoleic acid (CLA) and sphingolipids (Story, M. and Alton, I.,1995).

About a quarter of the fat in milk is monounsaturated. The remainder is mostly saturated fat, although some polyunsaturated fats and other minor fatty acids are also present. Palmitic, stearic and myristic acids are the major saturated fats found in milk. Dairy fat is also comparatively rich in the short and medium chain saturated fats. Research continues to unravel the complexities associated with individual fatty acids and fats from different sources and it is becoming increasingly apparent that not all fatty acids, or saturated fatty acids, have the same biological effects. There are a variety of saturated fatty acids in milk and many of these have no effect on plasma cholesterol(Berkey, C. S. et al ,. 2005).

PROTEIN

Cow's milk is recognized as an excellent source of high-quality protein. In 2000, milk and other dairy foods (excluding butter) contributed 19% of the protein available in the nation's food supply. Cow's milk contains about 3.5% protein by weight, which accounts for about 38% of the total solids-not-fat content of milk, and contributes about 21% of the energy of whole milk. Milk also contains small amounts of various enzymes and traces of no protein nitrogenous materials. Of the total protein in cow's milk, about 80% is casein and 20% is whey protein. Casein, the dominant protein in cow's milk, can be fractionated electrophoretically into four major components: alpha-, beta-, gamma-, and kappa-casein. Casein is generally defined as the protein precipitated at pH 4.6, a property used in the manufacturing of cheese (Ranganathan R, et al., 2001)

Whey protein, which is more heterogeneous than casein, consists predominantly of beta-lactoglobulin and alpha-lactalbumin. Alpha-lactalbumin has a high content of the amino acid tryptophan, a precursor of niacin. Because of milk's tryptophan content, this food is an excellent source of niacin equivalents. One niacin equivalent is defined as 1 mg of niacin or 60 mg of tryptophan. Other whey proteins present in smaller amounts are serum albumin, immunoglobulins (e.g., IgA, IgG, IgM), protease peptones (Weinberg LG et al., 2004).

Nutritionally, cow's milk protein is considered to be high-quality or a "complete protein," because it contains, in varying amounts, all nine of the essential amino acids that human bodies cannot synthesize, and in

proportions resembling amino acid requirements. Because of its high quality, cow's milk protein is used as a standard reference protein to evaluate the nutritive value of food proteins. The quality of a protein is determined by any one of the several parameters indicated (Miller GD, et al., 2007).

Table 1 Protein faction of cow's milk

Protein and Protein Fraction	Concentration in Milk g/L
Total protein	36
Casein	29.5
α_{s1}-Casein	11.9
α_{s2}-Casein	3.1
β-Casein	9.8
κ-Casein	3.5
γ-Casein	1.2
Whey proteins	6.3
β-Lactoglobulin	3.2
α-Lactalbumin serum	1.2
Serum Albumin	0.4
Immunoglobulins	0.8
Proteose-Peptones	1.0

Source: From Jensen, R. G. Ed., *Handbook of Milk Composition*, Academic Press, New York, p. 465, 1995.

Calcium

Dietary Reference Intakes for calcium, aimed at Canadians and Americans, were published in 2010 by the Institute of Medicine. Those recommendations were established to promote calcium balance and good bone health in the majority of the population

VITAMINS

Almost all of the vitamins known to be essential to humans have been detected at some level in milk. Vitamins A, D, E, and K are associated with the fat component of milk. Vitamin A plays important roles in vision, gene expression, cellular differentiation, embryonic development, growth, reproduction, and immunocompetence [97]. Both vitamin A and its precursors, called carotenoids — principally beta-carotene — are present in variable amounts in milk fat (Rajeshwari, R. et al., 2005). About 11% to 50% of total vitamin A activity in milk is derived from carotenoids, the specific proportion depending on the breed and feed of the cow and season of year, among other factors

Vitamin D

Vitamin D is essential for overall health and may also play a key role in the prevention of certain types of cancer, multiple sclerosis, rheumatoid arthritis and type 1 diabetes. Vitamin D, a fat-soluble vitamin that enhances the intestinal absorption of calcium and phosphorus, is essential for the maintenance of a healthy skeleton throughout life (Dawson-Hughes and B, Harris SS, 2002).

In addition to the essential fat-soluble vitamins, milk and other dairy foods also contain all of the water-soluble vitamins in varying amounts required by humans. Significant amounts of thiamine (vitamin B1), which acts as a coenzyme for many reactions in carbohydrate metabolism, are found in milk (0.04 mg/100 g or 0.11 mg/cup). Milk is also an excellent source of riboflavin, or vitamin B2. This vitamin functions as a precursor for certain essential coenzymes important in the oxidation of glucose, fatty acids, amino acids, and purines (Wooten, W. J. and Price, W., 2004).

MINERALS

Milk and other dairy foods are important sources of major minerals, particularly calcium, phosphorus, magnesium, potassium, and trace elements such as zinc. The mineral content of cow's milk is influenced by several factors, including the stage of lactation, environmental influences, and genetics. For this reason, there may be wide variation in the content of specific minerals in milk. Milk (whole, low-fat, fat-free, flavored) and other dairy products (yogurt, cheese) are an excellent source of readily bioavailable calcium, providing approximately 300 mg per serving. About 99% of the body's calcium is found in bone and teeth, with the remaining one percent in body fluids, nerves, heart, and muscle (Huth PJ, et al., 2008). Throughout life, calcium is continually being removed from bones and replaced with more calcium. Consequently, the need for an adequate supply of dietary calcium is important throughout life, not only during the years of skeletal

development. In addition to calcium's beneficial role in bone health, this mineral fulfils several other important physiological functions in human metabolism, as evidenced by its role in blood coagulation, myocardial function, muscle contractility, and integrity of intracellular cement substances and various membranes

Milk and Lactose Intolerance

Lactose intolerance is a no allergic food sensitivity, and comes from a lack of production of the enzyme lactase, required to digest the predominant sugar in milk. Adverse effects of lactose intolerance generally occur after much higher levels of milk consumption than do adverse effects of milk allergy. Milk allergy is a food allergy, an adverse immune reaction to a food protein that is normally harmless to the no allergic individual. Lactose intolerance is considered the normal state for most adults on a worldwide scale and is not typically considered to be a disease condition National Library of Medicine, 2014).

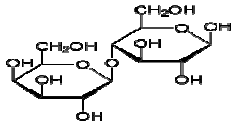

Figure 2 Lactose

Ingested lactose is hydrolysed by lactase, an enzyme of the microvillus membrane of the enterocytes, into its components, glucose and galactose, which are absorbed. If lactase activity is low or absent, undigested lactose may induce the symptoms of lactose intolerance. Intolerance to lactose is normally dependent on the activity of lactase and, therefore, also dependent on the acute dose and the frequency of consumption as well as the total daily amount of lactose ingested. Problems with lactose digestion result in bloating, abdominal cramps, flatulence, and loose stools. Many people consider these symptoms to reflect intolerance to lactose, but there are several concepts surrounding lactose intolerance that need to be clarified. Lactose is a sugar that is unique to milk and requires the enzyme lactase (ß-galactosidase) for digestion (Savaiano DA, et al.,2006). All humans, with a very small number of exceptions, are born with the ability to generate adequate amounts of the enzyme lactase in their digestive system. Milk is the only food newborns receive so their bodies must be able to digest lactose in order to obtain the energy required for growth and development. As humans age, the ability to produce the enzyme lactase decreases, a condition called*lactase no persistence*. Most people, even into adulthood, maintain some lactase activity in their gut. People that experience the symptoms described above after eating dairy products typically have exceeded the activity of the lactase available in their system and this is called *lactose mal-absorption*. The term *lactose intolerance* is used to describe the above symptoms in *response to a defined amount of lactose consumed, usually tested in a clinical setting* . (Suchy FJ, et al.,2010)

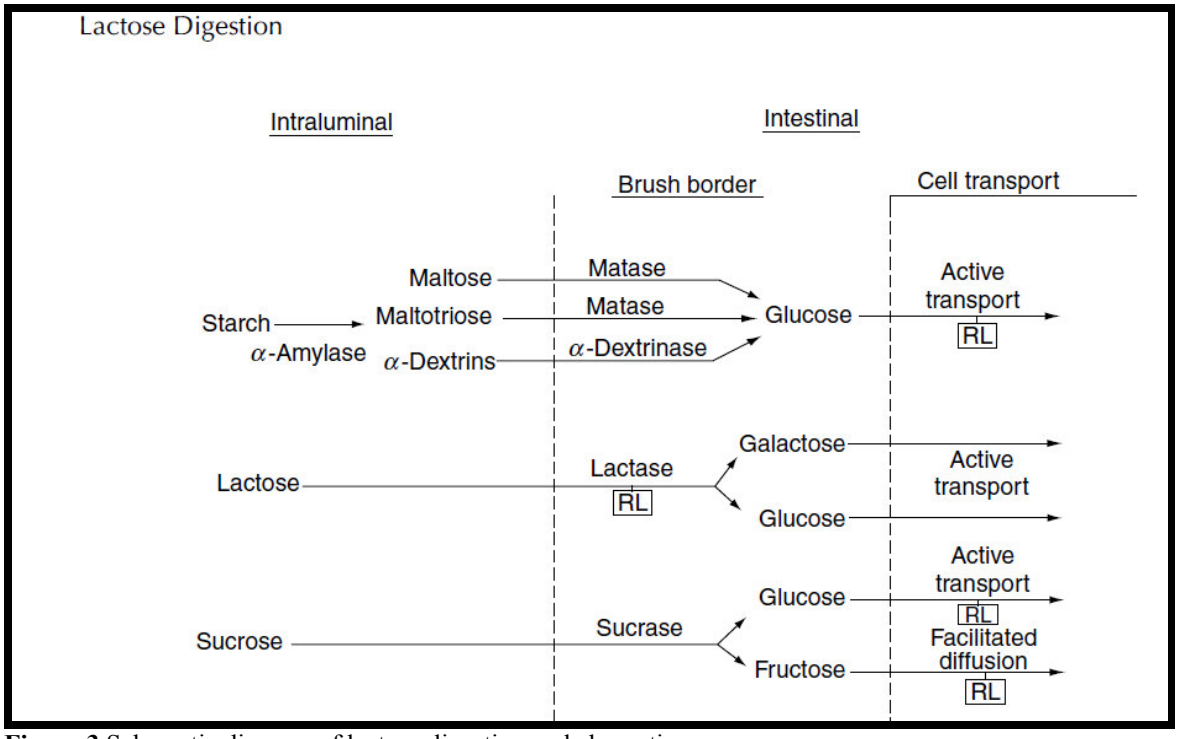

Figure 3 Schematic diagram of lactose digestion and absorption

Another clarification that needs to be made is that fresh milk does not contain lactase. Lactase may be present in dairy products, but it comes from lactic acid bacteria that are either added specifically to milk for fermentation or through airborne or other contamination. It also should be noted that pasteurization does not affect lactose, and pasteurized milk is neither more nor less digestible, nor has different lactose content than raw milk (Keith JN, et al., 2011).

Individuals vary in their ability to digest lactose, the severity of their symptoms, and their perception of their symptoms. Considerable research has been conducted on these topics. There is a greater incidence of lactose mal-absorption in adults from countries that traditionally do not have a strong dairy industry. The prevalence of lactose mal-absorption is very high (almost 100%) in Asian countries, above 50% in South America and Africa, and is approximately 53% among Mexican Americans and 80% among African American (Vesa et al., 2000).

The issue of lactose intolerance and mal-digestion is a very emotional one. Although many people consider themselves to be lactose intolerant, they are often able to digest a limited quantity of lactose. Some people are more sensitive to the discomfort experienced with bloating and abdominal cramps and may perceive the symptoms to be more severe. Symptoms incorrectly attributed to poor digestion of dairy products may be caused by other bowel disorders. Many people may consider themselves lactose intolerant and therefore avoid dairy products, when in fact they could include dairy products in their diets. Long term avoidance of dairy products, due to perceived lactose mal-absorption, can result in decreased consumption of calcium, potassium, magnesium and other minerals and vitamins that can lead to problems with bone health, hypertension and other disorders (Lactose intolerance and African Americans, 2009).

There are several strategies available for people with lactose mal-digestion to allow them to enjoy dairy products with minimal discomfort. Consuming small quantities of dairy at a time will help to keep the lactose load manageable for the enzymes available. Consuming dairy products with a meal helps because the other foods in the meal will prolong gastric emptying, which means the stomach empties slower and therefore the amount of lactose reaching the small intestine is spread out over a longer period of time, thereby not overloading the lactase enzymes (Lactose Intolerance and Health, 2010).

Continued consumption of small quantities of dairy will not increase lactase activity, but the environment of the digestion system will begin to adapt to the presence of lactose and reduce unpleasant symptoms. Fermented dairy foods contain lactic acid bacteria that have lactase present, providing additional active enzymes to assist with human digestion. Fermented dairy products usually have less lactose present because the lactose has been partially used by the bacteria to produce the desirable flavors and textures of products like yogurt and cheese. There are also lactose-reduced dairy products on the market (Høst A.1994). Lactase enzyme can also be taken in pill form prior to consuming dairy products to ease digestion. nLactose intolerance results from an inability to metabolize lactose due to an absence or an insufficient amount of lactase in the intestinal mucosa. Undigested lactose passes through the small intestine into the large bowel where it is fermented by the hosts' indigenious gut microflora into short chain fatty acids, carbon dioxide and hydrogen (Kuitunen P, et al., 1995).

Causes of Lactose intolerance

Lactose intolerance is gastrointestinal upset due to the inability to digest significant quantities of lactose. Lactose is a sugar found in milk and other dairy products. Lactose intolerance is caused by a reduction in the digestive enzyme lactase. Lactase breaks down the sugar lactose into sugars that can be more easily absorbed. When not fully broken down, lactose ferments in the colon and causes symptoms. Lactose intolerance is the clinical syndrome that occurs, when the inability to digest lactose results in gastrointestinal symptoms. It is estimated that around 70% of the world's population are deficient in lactase. However not all lactase deficiency results in lactose intolerance and it is likely that its prevalence is over estimated (Nicklas T, et al.,2009).

Most lactase deficiency is genetically determined. In general, people of Northern European descent have lower rates of lactase deficiency (2-30%) and people of Mediterranean, South American, African and Asian descent have higher rates (60- 100%). Both males and females are affected equally. There have been two studies in New Zealand, reported in the 1980s, which suggest that people of Mäori and Pacific origin have a higher prevalence of lactase deficiency than New Zealand Europeans.[5,6] A literature search did not reveal any recent follow-up studies to confirm these results (Heine RG,2008).

Lactose intolerance is a disease mainly of individuals over the age of five. Milk intolerance occurs as a result of the decrease or absence of an enzyme, called lactase, in the gastrointestinal tract that is required to metabolise the milk sugar lactose. The production of lactase is genetically programmed. Children are born with the lactase enzyme functioning correctly. At the age of around 5 years, for reasons unknown, black children partially or completely lose this enzyme. Children below the age of five who have a severe bout of diarrhoea or another severe illness may also develop temporary or permanent lactose intolerance. Because the level of lactase

deficiency varies between individuals, some will be able to drink more milk before symptoms occur than others. Primary lactase deficiency, also referred to as lactase-non-persistence (LNP) is genetically determined and a normal, developmental phenomenon characterised by the down-regulation of lactase activity, which occurs soon after weaning in most ethnic groups. LNP prevalence and the age of manifestation vary considerably amongst different ethnic populations (Lactose Intolerance and Health,2010)

Types of Lactose Intolerance

Primary lactose intolerance results from an inability to manufacture any lactase. This form of lactose intolerance tends to affect those of African and Asian decent and has a very low prevalence in Northern Europeans (2-5%). Additionally Primary lactose intolerance is also known as Lactose non persistence (LNP). LNP is a genetically inherited condition and tends to develop after them age of 5 years4 as a result of the physiological down-regulation of lactase production Crittenden, R. G. and Bennett, L. E, 2005).

Secondary lactose intolerance results from a temporary insufficiency of lactose production. It is usually caused by an underlying patho-physiological condition such as illness, injury, medication or intestinal surgery resulting in damage to the villi in the intestinal mucosa (the site of lactase manufacture). Causal factors include coeliac disease, gastroenteritis; acute rotavirus infection, Crohn's disease and protracted use of antibiotics.4 Secondary intolerance can occur in infants however it is a transient condition with symptoms often resolving after a short period of reduced lactose exposure, allowing adequate time for gut recovery.

Types of lactase deficiency

Primary lactase deficiency: autosomal recessive and also known as adult-type hypolactasia, lactase nonpersistence, or hereditary lactase deficiency. Deficiency of lactase develops at various ages (American Academy of Pediatrics,1992).

Secondary lactase deficiency: follows damage to the intestinal mucosa - eg, acute viral or bacterial gastroenteritis, uncontrolled coeliac disease or inflammatory bowel disease or chemotherapy. This resolves when the disease process is over and the intestinal mucosa heals. It is more common in children and especially in the developing world.

Congenital lactase deficiency: an extremely rare autosomal recessive disorder and associated with minimal or complete absence of, lactase activity. It becomes apparent once milk is introduced, usually with intractable diarrhoea once milk or lactose formula has been introduced. **Developmental lactase deficiency**: occurs in premature babies (<34 weeks of gestation) and improves once the intestine matures.

Table 2types of lactase deficiency

Lactase Deficiency	
Type	**Pathogenesis**
Congenial	Enzyme activity absent from birth
Primary	Genetically predetermined reduction of enzyme activity during childhood or adolescence
Secondary	Reduced to enzyme activity in response to diffuse intestinal insult — giardiasis rotavirus, topical sprue, celiac disease, bacterial overgrowth, Crohn's disease, intestinal resection

Source: From Rusynyk, A. R. and Still, C. D., *JAOA*, 101 (4), S10–S12, 2001. With permission.

Management of Lactose intolerance

Lactose intolerance is easily managed by:

- Regular consumption of milk that adapts the colon bacteria and facilitates digestion of lactose,
- Consumption of yogurts and cheeses and other dairy foods low in lactose,
- Consumption of dairy foods with meals to slow transit and maximize digestion, and
- Use of lactose digestive aids.

Symptoms of lactose intolerance

Symptoms of lactose intolerance generally begin within two hours of consuming milk or other dairy products. The severity of symptoms depends on how much lactase your body produces and how much lactose you eat. The common symptoms of lactose intolerance are nausea, vomiting, abdominal distension, abdominal cramps, and

the passing of flatus (air). The degree of symptoms depends on the amount of milk taken in (more specifically, the amount of lactose) and the degree to which the body is deficient in lactase enzyme.

Factors that prone to lactose intolerance

I. **Increasing age.** Lactose intolerance becomes more common as you age the condition is uncommon in babies and young children.
II. **Ethnicity** Lactose intolerance is most common in black, Asian, Hispanic and American Indian people.
III. **Premature birth.** Infants born prematurely may have reduced levels of lactase because this enzyme increases in the foetus late in the third trimester.
IV. **Diseases affecting the small intestine.** Small intestine problems that can cause lactose intolerance include bacterial overgrowth, celiac disease and Crohn's disease.
V. **Certain cancer treatments.** If you have received radiation therapy for cancer in your abdomen or have intestinal complications from chemotherapy, you have an increased risk of lactose intolerance.

Cow's milk allergy

Cow's milk allergy and lactose intolerance are often confused with each other, but they are not the same. Find out in this section what the difference is – this will help you to discuss your baby's health with your doctor who can then decide how best to provide a solution to the problem. Cow's milk is made up of lots of different components, for example proteins (such as casein and whey), milk sugar (called lactose) and fat (Crittenden, R. et al., 2005).

The allergic reaction happens because the immune system mistakes the proteins in cow's milk to be a threat, when in fact they should be harmless. It then releases chemicals such as histamines and others – it's these chemicals that trigger the signs and symptoms of an allergic reaction . (Zeiger RS.1990).

Lactose intolerance is triggered by the lactose sugar in cow's milk. In people with lactose intolerance, the digestive system can't fully digest this milk sugar, because it doesn't make enough of the lactase enzyme. So instead of being digested and absorbed, the lactose stays in the gut and feeds the gut bacteria, which release acids and gases that cause the symptoms of lactose intolerance (Tiainen JM, et al., 1995)

In some cases, people can develop lactose intolerance when their gut becomes damaged through illness, surgery or certain medications (this is called secondary lactase deficiency). In these cases, the lactose intolerance can be temporary or permanent. It can sometimes develop after an episode of gastroenteritis. Only in very rare cases does lactose intolerance affect babies from birth (called congenital lactase deficiency). In this case, the person remains lactose intolerant for life. Since cow's milk allergy and lactose intolerance are caused by two different problems, there are slightly different ways of managing the conditions (Savilahti E and Kuitunen M, 2002)

Management of Cow's milk allergy

Cow's milk allergy is managed by completely eliminating cow's mil protein from your baby's diet, as even a small amount of cow's milk protein could potentially trigger an allergic reaction. Initially, lactose intolerance may be managed by completely eliminating cow's milk protein from the diet too. However, an entirely dairy-free diet is rarely needed in the long term. Most people with lactose intolerance are able to digest some lactose, as they still have a low level of the enzyme, lactase. This means that some dairy products can be carefully reintroduced into the diet – how much depends on the individual, so it's important to follow the guidance of a dietitian when doing this. Some babies will benefit from having a lactose-free infant formula (Host A, et al.,2002).

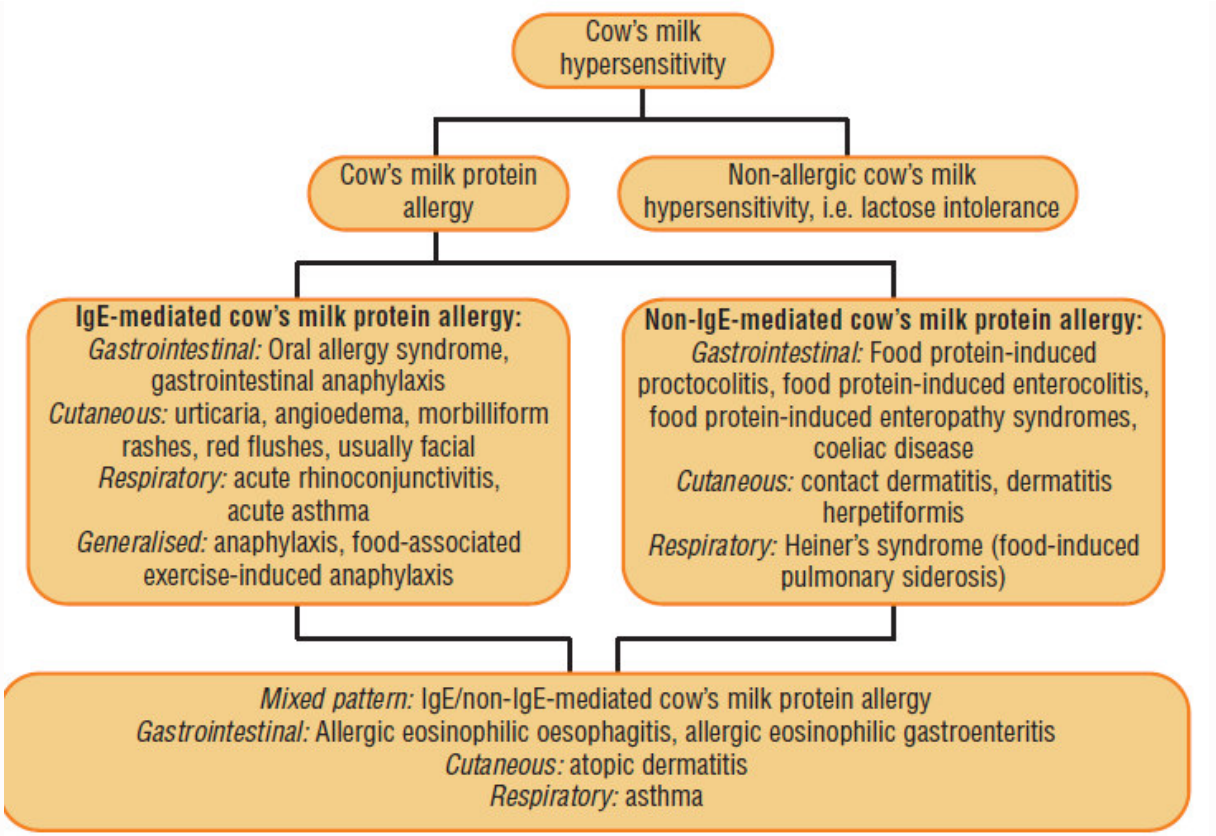

Figure 4 Schematic diagram of cow's milk allergy and lactose intolerance

In many European countries a trend to eliminate milk and dairy products from everyday diet may be observed with increasing frequency. This problem becomes of particular importance when the rejection of dairy products concerns healthy children and adolescents, with no allergy to milk or lactose intolerance. There may be numerous causes to this phenomenon, such as e.g. imitation of inappropriate eating habits of adults, willingness to reduce fat content or socio-economic situation. Sometimes children and adolescents are forced to accept such a situation when parents do not purchase milk and dairy products when doing shopping. Elimination of milk and dairy products from the diet is connected with a reduced supply of calcium required for normal growth and development in children and adolescents [Black et al. 2002, Du et al. 2002, Kalkwarf et al. 2003]. Calcium is necessary to ensure adequate bone mineralisation [Ilich and Kerstetter 2000, Dodiuk-Gad et al. 2005].

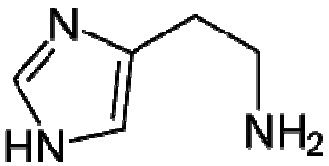

Figure 5 histamine,

The structure shown is what causes a person to feel itchy during an allergic reaction. A common medication to stop this is an antihistamine, which fights the histamines in the person's system.

The protein in the food is the most common allergic component. These kinds of allergies occur when the body's immune system mistakenly identifies a protein as harmful. Some proteins or fragments of proteins are resistant to digestion and those that are not broken down in the digestive process are tagged by the Immunoglobulin E (IgE). These tags fool the immune system into thinking that the protein is an invader. The immune system, thinking the organism (the individual) is under attack, sends white blood cells to attack, and that triggers an allergic reaction (Fiocchi A, et al.,2010). An allergy is an overreaction of the immune system to a substance that's harmless to most people. But in someone with an allergy, the body's immune system treats the substance (called an **allergen**) as an invader and overreacts, causing symptoms that can range from annoying to serious or life threatening. In an attempt to protect the body, the immune system of the allergic person produces antibodies called immunoglobulin E (IgE).

Difference between Lactose intolerance and milk allergy

Lactose is a sugar found in milk. It cannot become absorbed by the body unless is gets changed into more simple sugars called glucose and galactose. This change happens when the lactose passes through the stomach into the upper part of the gut (small intestine) and comes into contact with a chemical called lactase (Brill H,2008). Lactase is made by cells that line the upper part of the small intestine. If there is not enough lactase in the small intestine, lactose cannot be broken down and cannot get absorbed. This leads to lactose intolerance. Some people confuse lactose intolerance with allergy to cow's milk. With milk *allergy*, your immune system reacts to proteins found in milk which can cause symptoms. Lactose *intolerance* is not an allergy. Symptoms are caused by the undigested lactose in the gut (Høst A,2002).

Table 3 comparison and contrast of cow's milk allergy and lactose intolerance

	Milk Allergy	Lactose Intolerance
Cause	Abnormal immune response to ingestion of cow's milk protein	Low intestinal levels of the lactase enzyme that digests lactose (milk sugar)
Age of Onset Symptoms	Usually in infancy; abdominal pain, vomiting, diarrhea, nasal congestion, skin rash	Early/late childhood; abdominal gas, bloating, cramps, diarrhea
Diagnosis	Food elimination and challenge; RAST blood test	Breath hydrogen test
Dairy Food Use/Avoidance	Eliminate cow's milk protein from the diet for a time	No need to eliminate dairy foods; experiment with varying amounts/types of dairy foods to improve tolerance

Terms and definitions associated with allergy

- **Food hypersensitivity** is the umbrella term used to describe both a food allergy and a food intolerance..
- **True food allergy** involves the inappropriate activation of the immune system to one or more proteins present in foods.
- **Alternatively food intolerance** is a reproducible adverse reaction to a food that does not illicit an immune response.
- **Food toxicity:** Toxins and poison may naturally occur in food such as glyco-alkaloids (in potato), cyanogenic glycosides (in beans) and bacterial contaminants. Free histamine resulting from bacterial degradation of the flesh in scombroid fish results in scrombotoxicity – a pseudo allergic reaction typified by intense itching, rapid pulse and skin flushing. This reaction is due to the direct toxic effect of the spoiled food and is called food toxicity.
- **Food aversion:** Finally, some people are psychologically convinced that certain foods disagree with them, however, but when tested fail to react to that food. This occurs quite commonly and is referred to as food aversion.

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Table:4 Lactose contents of different dairy products

Dairy product	Serving size	Lactose content	Percentage
Milk, regular	250 ml	12 g	4.80%
Milk, reduced fat	250 ml	13 g	5.20%
Yogurt, plain, regular	200 g	9 g	4.50%
Yogurt, plain, low-fat	200 g	12 g	6.00%
Cheddar cheese	30 g	0.02 g	0.07%
Cottage cheese	30 g	0.1 g	0.33%
Butter	1 tsp (5.9ml)	0.03 g	0.51%
Ice cream	50 g	3 g	6.00%

Source : National Library of Medicine, 2014)

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