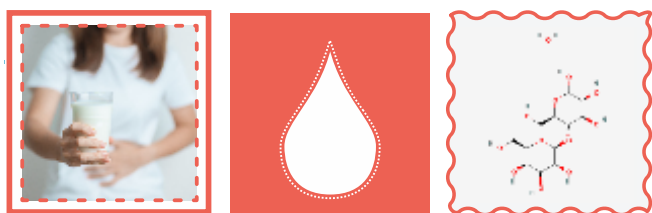




Dietary management of cow's milk allergy



Cow's milk allergy (CMA) is the most common food allergy in infancy and early childhood, affecting approximately 2–3% of infants. It includes a heterogeneous group of immune-mediated conditions with distinct clinical presentations, diagnostic challenges and management strategies. Dietary management is the cornerstone of treatment; however, misdiagnosis, prolonged avoidance and delayed reintroduction may adversely affect growth, nutritional status and quality of life. Recent international guidelines and position statements emphasise accurate phenotyping, nutritional adequacy and timely, structured reintroduction of cow's milk protein, including through the use of milk ladders. Extensively hydrolysed milk or hydrolysed rice formulas are suggested as the first line of treatment for cow's milk allergy. Amino acid formulas can be used in case of poor growth or more severe types of cow's milk allergies. Soya formula can be used in some cases, e.g. in case of cost issues of other formulas. Emerging evidence supports the safety and effectiveness of milk ladders in selected cases, with the potential to accelerate tolerance development and empower families. This review provides an in-depth and up-to-date summary of the evidence underpinning dietary management of CMA, with detailed discussion of guideline recommendations, nutritional risks, milk ladder implementation and safety, together with future research priorities.



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Cow's milk allergy (CMA) is typically the first food allergy encountered in early life and represents a significant clinical, nutritional and public health challenge. CMA usually presents within the first few months of life, coinciding with a period of rapid growth and neurodevelopment. During this time, milk formula is a main source of energy, high-quality protein, calcium, iodine, vitamin B12 and other essential micronutrients in infants who are not receiving any or sufficient human milk. As a result, inappropriate elimination diets, delayed diagnosis or prolonged avoidance of cow's milk protein can have far-reaching consequences for growth, nutritional adequacy and the family's quality of life. Individuals providing human milk and who are avoiding cow's milk owing to their child's allergy also need to take care to consume sufficient macro- and micronutrients.

Historically, CMA management focused primarily on strict avoidance of foods containing cow's milk until the allergy was naturally outgrown. While avoidance is necessary in the acute management of allergic reactions, this approach has increasingly been recognised as insufficient and, in some cases, harmful when applied for a prolonged period.¹ Advances in understanding immune tolerance, the impact of heating on allergenicity and the natural history of CMA have driven a paradigm shift towards proactive, individualised dietary strategies. These strategies emphasise accurate phenotyping, avoiding unnecessary restriction and rather focusing on overall nutritional intake, and structured reintroduction of cow's milk protein using evidence-based tools such as milk ladders.¹

This review summarises current evidence and international guidelines on the dietary management of CMA.^{1–3} Emphasis is placed on nutritional considerations, suitable milk alternatives if the infant is not receiving human milk, guidance for individuals providing human milk, the rationale and implementation of milk ladders, safety and effectiveness data, and emerging research directions that are reshaping clinical practice.

Phenotypes of cow's milk allergy

CMA is not a single disease entity but rather a spectrum of immune-mediated food allergy disorders with differing pathophysiology, clinical presentation and prognosis. Broadly, CMA is categorised into IgE-mediated and non-IgE-mediated phenotypes.⁴

IgE-mediated cow's milk allergy

IgE-mediated CMA is characterised by rapid-onset symptoms, which typically occur within minutes to two hours following ingestion of cow's milk protein (Table 1).¹ Clinical manifestations include cutaneous symptoms (urticaria, angioedema), gastrointestinal symptoms (vomiting, abdominal pain), respiratory symptoms (wheezing, coughing) and, in severe cases, anaphylaxis. Diagnosis is based on a clinical history supported by evidence of sensitisation, such as positive skin-prick testing or elevated serum IgE specific to cow's milk. Oral food challenges may be required to confirm diagnosis or assess tolerance, particularly in cases with equivocal histories.

Importantly, IgE-mediated CMA is heterogeneous in severity and prognosis.⁵ A substantial proportion of children tolerate baked or extensively heated milk products, reflecting reduced allergenicity of whey or casein proteins following heating and the matrix effects of baked foods.⁶ This observation has important implications for dietary management and forms the

biological basis for milk ladder approaches in appropriately selected patients.⁷

Non-IgE-mediated cow's milk allergy

Non-IgE-mediated CMA (Table 2) includes several gastrointestinal phenotypes with delayed symptom onset, typically hours to days after ingestion.

These include allergic proctocolitis, enteropathy, gastroesophageal reflux disease, constipation and enterocolitis syndrome, all induced by food protein, as well as eosinophilic esophagitis.⁸

See Table 2 on the next page

Table 1: IgE-mediated cow’s milk allergy

Category	Details
Symptoms	Skin: urticaria, angioedema Gastrointestinal: throat swelling, crampy abdominal pain, immediate emesis, diarrhoea Respiratory: rhinorrhoea, sneezing, laryngospasm, cough, bronchospasm Cardiovascular: tachycardia, low blood pressure Generalised: anaphylaxis
Onset of symptoms after ingestion	Within minutes to 2 hours
Diagnosis	Detection of food-specific IgE by: • skin prick test • serologic tests • oral food challenge
Managment-acute symptoms	• Antihistamines • Epinephrine • Inhaled bronchodilator • Oxygen • Intravenous fluids
Management-dietary	• Dietary avoidance of cow’s milk • Majority tolerate cow’s milk in baked form
Natural history	• Generally outgrown before school age • Children reacting to baked milk or with peak milk-specific IgE >50 kUa/L tend to have a more prolonged course

Adapted from Venter et al.¹



Table 2: Non-IgE-mediated food protein-induced conditions associated with cow's milk allergy

Condition	Cardinal symptoms	Other symptoms	Age of onset	Method of diagnosis	Common culprit foods
Proctocolitis	Blood in stools	Mucus in stool, painful flatus, anal excoriation	<3 months	Avoidance and home introduction	Cow's milk (primary); sometimes soy, egg, wheat
Enteropathy	Faltering growth, diarrhoea	Mucus, abdominal pain, bloating, hypo-albuminaemia	<1 year	Avoidance and home introduction	Cow's milk (primary); sometimes soy, egg, wheat
Enterocolitis	Vomiting	Pallor, lethargy, diarrhoea, floppiness, hypotension	<1–2 years	Avoidance and observation or food challenge	Cow's milk, rice, fish, egg; less often: fruits, vegetables, meat
Eosinophilic oesophagitis	Dysphagia, feeding difficulties, faltering growth	Abdominal pain, vomiting	Any age (peak in middle age)	Avoidance and endoscopy; home introduction and endoscopy	Cow's milk, wheat, egg, legumes; sometimes fish, nuts, pulses
Gastroesophageal reflux	Intermittent painful vomiting	Feeding difficulties, faltering growth, back-arching	<6 months	Avoidance and observation or food challenge	Cow's milk (primary); sometimes soy, egg, wheat
Constipation	≥1 month with ≥2 Rome IV criteria	Painful straining, soft stools, perianal rash, fissures	>6 months	Avoidance and observation or food challenge	Cow's milk (primary); sometimes soy, egg, wheat

Adapted from Meyer et al.⁸

Clinical features can include rectal bleeding, chronic diarrhoea, vomiting, reflux-like symptoms, constipation, irritability and faltering growth. Diagnosis relies primarily on careful clinical assessment, symptom resolution following elimination of foods that contain cow's milk, and recurrence of symptoms upon reintroduction. Laboratory tests are typically unhelpful and overdiagnosis is common, particularly in infants with non-specific gastrointestinal symptoms. Consequently, guidelines emphasise the importance of time-limited elimination diets with clear plans for reintroduction to confirm the diagnosis and prevent unnecessary long-term restriction.

Diagnostic and management challenges

Accurate diagnosis of CMA is difficult owing to symptom overlap with functional gastrointestinal disorders, gastroesophageal reflux, infant colic and infections. Both over- and underdiagnosis carry significant risks.⁹ Overdiagnosis may lead to unnecessary dietary restriction, increased financial burden, impaired growth, micronutrient deficiencies and increased parental anxiety. Conversely, underdiagnosis may result in persistent symptoms, poor growth or acute allergic reactions.^{10,11}

These challenges highlight the critical role of structured diagnostic pathways, multidisciplinary care and regular reassessment. Current guidelines and position statements stress the importance of avoiding a delayed diagnostic process by implementing planned elimination and reintroduction strategies, supported by dietetic expertise.

Guideline-based dietary management of cow's milk allergy

International guidelines and position statements over the past 20 years have substantially refined the dietary management of CMA. Major contributions include the World Allergy Organisation's guidance on Diagnosis and Rationale for Action against Cow's Milk Allergy (DRACMA),^{1,12} a position paper from the European Society for Paediatric Gastroenterology, Hepatology and Nutrition,² and guidance by the Global Allergy and Asthma European Network (GA2LEN).³ Consistent messages are that: CMA is often over diagnosed; elimination diets should be purposeful and time limited; and nutritional adequacy must remain central to all management decisions.

A key development has been advocating for proactive reassessment and structured reintroduction instead of prolonged avoidance.¹³ This shift is supported by improved understanding of CMA phenotypes, the natural history of both IgE- and non-IgE-mediated disease, and recognition of the adverse nutritional, developmental and psychosocial consequences of unnecessary dietary restriction. Guidelines now consistently recommend that cow's milk should be eliminated only upon clear clinical indication supported by an allergy-focused history, and that reintroduction plans should be discussed at the outset of management.¹⁴

- **IgE-mediated CMA:** Guidelines recommend elimination of foods that contain cow's milk together with administering emergency medication, such as adrenaline, when indicated. Dietary management should be individualised to consider the child's age, severity of

reactions, nutritional needs and family circumstances. Introducing milk using a milk ladder may be considered where appropriate.²

- **Non-IgE-mediated CMA:** Management typically involves short-term elimination of cow's milk protein, with symptom resolution expected within days to weeks. Timely reintroduction should be planned to confirm the diagnosis.¹⁵ After a period of avoidance, cow's milk can be reintroduced using a milk ladder to guide gradual exposure. In the case of enterocolitis syndrome, a more cautious approach is required, with delayed, and sometimes supervised, reintroduction depending on severity and clinical history.¹⁶ Ladders are used successfully in the case of allergic proctocolitis.¹⁷ The use of food ladders in other types of non-IgE-mediated CMA has not been described.

Nutritional considerations in cow's milk allergy

The nutritional implications of CMA are substantial, as cow's milk and dairy products are major contributors to energy, protein and micronutrient intake in infancy and early childhood. Over the past decade, nutritional research in CMA has broadened from focusing only on calcium and vitamin D to include a more holistic appreciation of dietary quality, micronutrient adequacy, feeding behaviours and long-term metabolic outcomes.^{10,11,18}

Growth and energy intake

Growth faltering has long been recognised as a potential consequence of CMA, particularly in infants with delayed diagnosis, ongoing gastrointestinal inflammation or poorly supervised elimination diets. Although many children with CMA grow along their centiles, approximately 10% have been reported to experience stunting. Importantly, recent studies indicate that impaired growth may persist even in children receiving dietetic input, suggesting that factors beyond only nutrient intake, such as chronic inflammation, cytokine activity and feeding difficulties, may contribute.^{11,19,20}

Conversely, more recent international survey data have highlighted an emerging burden of overweight and obesity in children with food allergies, including CMA.¹⁹ This shift mirrors global trends but also underscores the need for balanced dietary advice that avoids both under- and overcompensation following milk exclusion.

Regular growth monitoring using World Health Organization growth standards is essential, alongside assessment of energy and protein intake.^{9,10,21}

Micronutrient deficiencies

Children with CMA are at increased risk of nutritional compromise owing to a major food group being eliminated from their diet during a critical period of growth. Nutritional risk increases when multiple foods are excluded or when alternative milks are nutritionally inadequate.¹⁸

Beyond calcium and vitamin D deficiencies, children with CMA may have insufficient intakes of iodine, vitamin B12, riboflavin, iron, zinc and vitamin A (Table 3). Iodine deficiency has emerged as a particularly important concern,²² especially in predominantly breastfed infants and young children following dairy exclusion, given the critical role of iodine in neurodevelopment. This has prompted increased emphasis on dietary iodine assessment and the fortification profile of milk alternatives.^{11,18}

Table 3: Key nutritional risks in children with cow's milk allergy

Nutrient	Reason for risk	Clinical implications	Management strategies
Calcium	Dairy elimination	Impaired bone mineralisation	Fortified alternatives; supplements
Vitamin D	Reduced intake	Rickets; poor bone health	Routine supplementation
Iodine	Loss of dairy source	Thyroid dysfunction; neuro-developmental risk	Monitor intake; fortified foods or supplements
Protein	Milk exclusion in infancy	Poor growth, reduced lean mass	Adequate formula and solid food intake
Vitamin B12	Dairy avoidance	Anaemia; neuro-developmental effects	Monitoring and supplementation

Adapted from Venter et al.¹⁸

Choosing a milk alternative

Milk formulas

Current guidelines (Table 4) recommend extensively hydrolysed formula (eHF) milk or hydrolysed rice formulas as a first-line option for the management of CMA.¹⁻³ Amino acid formulas are noted to be appropriate when eHF is not tolerated or in the case of more severe disease, and the use of a temporary lactose-free formula (2–4 weeks) may be preferred in infants with severe diarrhoea or malnutrition.³ Partially hydrolysed formulas are either not recommended¹⁻³ or not addressed² in current guidance.

None of the guideline documents recommend soy formula as a first choice,¹⁻³ and it is specifically advised against for feeding infants younger than 6 months by the GALEN guidelines.³ The use of soy formula is, however, noted as being acceptable in selected cases for economic, cultural or palatability reasons,³ or as a last resort when other options have been exhausted.² None of the guidelines specifically advise for or against the use of pre-, pro- or synbiotics.

- Guidelines by the World Allergy Organization² note that growth outcomes appear to be broadly similar with the use of eHF, rice hydrolysate and soy, although amino acid formula may be associated with

better growth than eHF in infants. Specific recommendations¹⁻³ regarding formula use to support growth include the following:

- In both **IgE-mediated and non-IgE mediated CMA**, infants fed amino acid formula may experience better growth than with eHF.
- Overall, growth outcomes are broadly similar with the use of eHF, rice hydrolysate and soy, with potential advantages of amino acid formula in specific groups.⁸



Table 4: Recommendations regarding suitable milk alternatives¹⁻³

	DRACMA	GA ² LEN	ESGPHAN
Extensively hydrolysed formula (eHF) and amino acid formula	1 Extensively hydrolysed (milk) formula or a hydrolysed infant rice formula. 2 An amino acid formula can be a second option.	1 Use a documented hypoallergenic extensively hydrolysed cow's milk formula, OR an amino acid formula if better tolerated or more appropriate.	1 Extensively hydrolysed cow's milk formula or rice hydrolysate. 2 Amino acid formula should be reserved for severe cases or infants with an absent or partial response to eHF. In patients with CMA and severe diarrhoea or malnutrition, the transient use of a formula without lactose for 2–4 weeks may be preferred.
Partially hydrolysed cow's milk formula	NA	Not recommended	Not recommended
Soy formula	3 Soy formula would be regarded as the last choice.	Use of soy-based formula in infants under 6 months not advised.	Soy infant formula should not be used as the first choice for the diagnostic elimination diet, but can be considered in some cases for economic, cultural and palatability reasons.
Pre-/pro-/synbiotics	Formulas with or without can be used for infants with either IgE- or non-IgE-mediated CMA	No recommendation for or against use of prebiotics, probiotics or synbiotics	Insufficient evidence for pro-, pre- or synbiotics

Mammalian milks and plant-based beverages

The use of other mammalian milks is not recommended for the management of CMA owing to a high level of cross-reactivity and nutritional concerns. The greatest level of cross-reaction is seen between cow's milk and that of sheep and goats. Less similarity is seen between these milks and that from pigs, horses and donkeys, and camels and dromedaries. However, none of these mammalian milks are recommended for the management of CMA. The calcium content of milk from mares and donkeys is lower than that of cow's milk, as are the folate and vitamin B12 levels in milk from buffalo, sheep and goats (the folate and vitamin B12 content of other mammalian milks is not known).²³

Plant-based beverages can be used in children older than 1 year if they are eating well (also see criteria for the use of plant-based beverages in Figure 1).¹

Breastfeeding and maternal diet

Breastfeeding (feeding human milk) should be actively supported in infants with CMA. Maternal elimination of cow's milk protein is rarely required, but may be considered for a limited diagnostic trial of 2–4 weeks if infants are symptomatic on exclusive breastfeeding.

Is at least one year of age

Eats a varied solid food variety from each food group

Gets at least two-thirds of their energy from the varied solid food diet

Consumes no more than 2 servings per day (1 serving = 240 ml of milk substitute day or yoghurt substitute)

Eats age-appropriate textures

Gets enough protein and fat and micronutrients in the diet from the solid foods and available milk substitute

Has no feeding difficulties that may reduce food variety

Has no known micronutrient deficiencies;

AND

Has no religious/cultural requirements that reduce the variety of foods consumed

Figure 1: Factors that may indicate a toddler is ready to transition to a plant-based beverage

Crucially, reintroduction of cow's milk in the mother's diet should follow to confirm symptom recurrence and avoid unnecessary prolonged restriction.²⁴ The World Allergy Organization recommends that maternal elimination trials can be considered if:²

- IgE-mediated food allergy is suspected owing to the infant being symptomatic on breastfeeding alone
- non-IgE-mediated symptoms are experienced and the medical history or a clinical examination strongly suggests a food allergy
- an infant presents with moderate to severe eczema/atopic dermatitis that is unresponsive to topical steroids and is sensitised to the food protein.

The effect of processing on milk protein: Rationale for the use of milk ladders

Cow's milk contains multiple allergenic proteins, including whey proteins (α -lactalbumin, β -lactoglobulin) and caseins. Processing can alter exposure or the structure of proteins and therefore the associated allergenicity. For example, heating and baking substantially reduce the allergenicity of whey proteins and, to a lesser extent, caseins, whereas homogenisation may increase allergen exposure. Fermentation modifies protein structure and digestibility and reduces the allergenicity. These principles underpin the rationale for graded reintroduction strategies using milk ladders.²⁵

Milk ladders provide a structured, stepwise approach to reintroduce cow's milk protein, progressing from foods with the lowest allergenic potential to those with higher allergenicity. Typically, ladders begin with extensively baked milk products, followed by lightly baked items, fermented dairy products, and finally fresh liquid milk (Figure 2).⁶

Milk ladders aim to support immune tolerance, reduce dietary monotony, empower families and minimise unnecessary prolonged avoidance. However, variability in ladder design across regions has prompted calls for greater standardisation.⁷ Biochemical analysis has been used in this regard to determine the total milk protein content of different products (with reference to casein and whey content).²⁶⁻²⁸

Evidence in support of the use of milk ladders

Growing evidence supports the safety and effectiveness of milk ladders in selected cases of CMA (Table 5). For example, observational studies from the UK demonstrate high completion rates of home-based milk ladders in children with IgE-mediated CMA.²⁹ Results showed that although allergic reactions were fairly common, they were typically mild and no cases of anaphylaxis requiring adrenaline were reported during ladder progression.

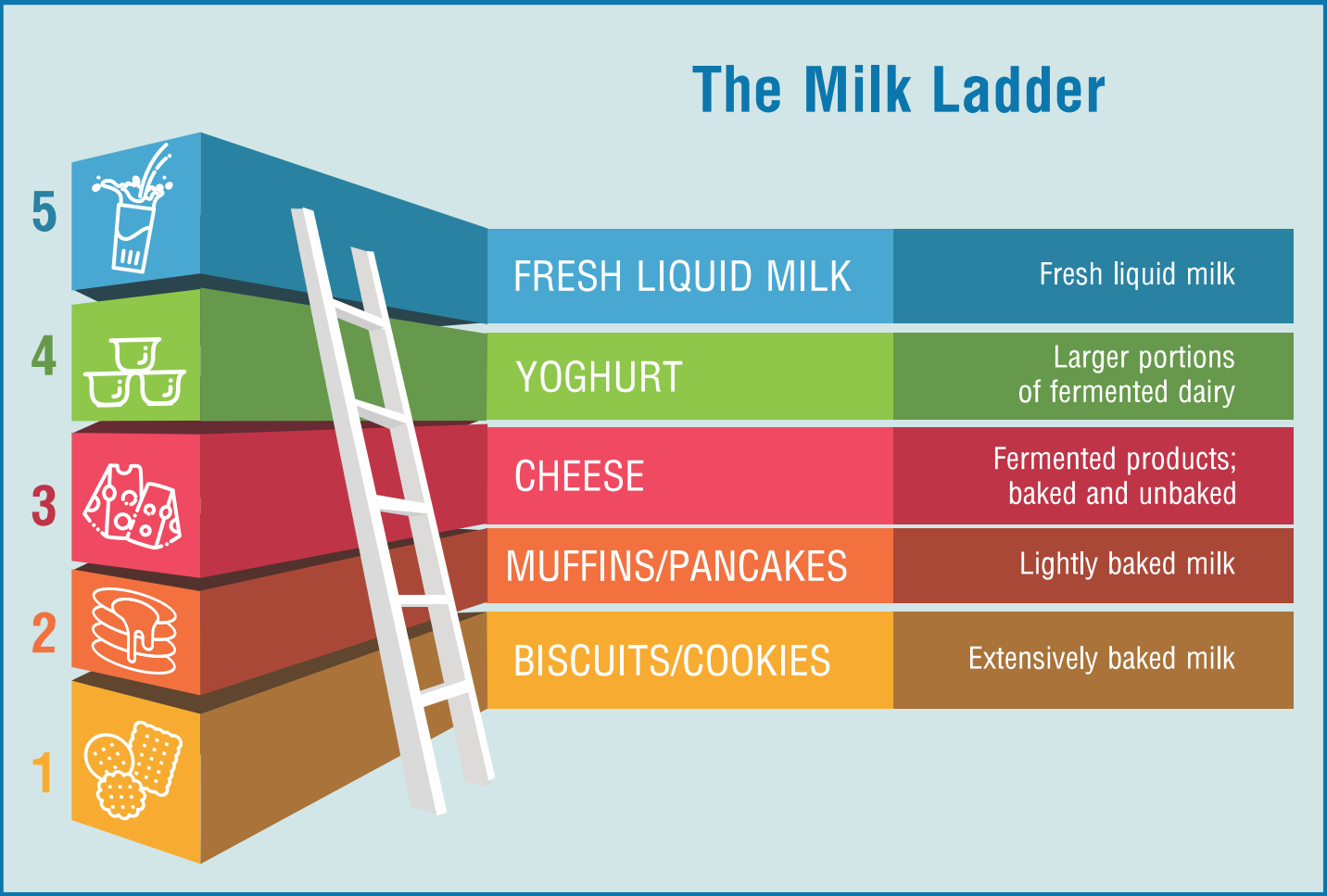


Figure 2: Schematic representation of a milk ladder

Table 5: Currently available milk ladders

Steps	Foods/step	Recipes included	Dose escalation	Starting/ending dose		Measured protein content	Nutritional soundness	Culturally appropriate	Other comments
BSACI ³⁰ – Mild IgE- and non-IgE-mediated CMA									
4	Multiple	No	Starts small but quickly escalated cow's milk protein			No	No	For British population	Foods in a single step are dissimilar in allergenicity; many foods per step; portion sizes not specified
MAP ³¹ – Mild to moderate non-IgE-mediated CMA									
12	1–2	Yes	Moderate jump in steps (some steps subdivided into multiple steps)	23 mg per ¼ cookie; 47.5 mg per ½ cookie 95 mg per cookie	7.2 g	No	No	UK diet specific	Complex recipes
iMAP ³² – Mild to moderate non-IgE-mediated CMA									
6	1	Yes	Large jumps in steps (some steps divided into multiple steps)	9 mg per ¼ cookie; 17.5 mg mg per ½ cookie; 35 mg per cookie	6.9 g	No	Yes	International	Simple recipes
Mediterranean milk ladder ²⁷ – Not specified									
7	1–3	Yes	Moderate – large jump in steps	70 mg per cookie	3.2 g	Yes – total protein, casein and beta-lactoglobulin	No	Mediterranean	Calculated and measured cow's milk protein not always similar
Indian milk ladder ²⁸ – non-IgE-mediated CMA									
6	1–4	Yes	Moderate to large jumps in steps	20–25 mg per ½ cookie	8.68 g	Yes – total protein	High in sugar and fat, although recipes were adjusted to reduce sugar and fat content where possible	Culturally relevant to India	Calculated and measured cow's milk protein not always similar
Canadian milk ladder ³³ – IgE-mediated CMA; children of preschool age with a history of only mild IgE-mediated reactions									
4	2–4	No	Large jumps between steps and within steps	Not listed		No	No	Canadian foods	Foods in a single step are dissimilar in allergenicity
German milk ladder ³⁴ – Mild to moderate non-IgE- and IgE-mediated CMA; children of preschool age or younger who meet set criteria									
6	1–3	Yes	Moderate jump in steps (each step is subdivided into multiple steps)	8 mg per wheat rusk or cookie	7 g	No	No (some recipes adapted to contain less sugar)	German	Each step with progressive serving increases of the same food
Spanish milk ladder ³⁵ – IgE-mediated CMA									
4	2–8	Yes (not published currently)	Moderate to large jumps in some steps (each step is subdivided into multiple steps)	95 mg	6.2 g	No	Yes	Spanish	Foods within each substep have same estimated protein content
Ukrainian milk ladder ³⁶ – Mild to moderate non-IgE-mediated CMA and mild IgE-mediated CMA									
5	2–7	No	Starts with a grain-sized amount; gradually increased to a portion that the child can eat daily	300 mg	Not specified	No	No	Ukrainian	Portion sizes not specified; foods in a single step are dissimilar in allergenicity
Leicester milk ladder ²⁹ – IgE-mediated CMA with set criteria: <3 years, skin or gastrointestinal symptoms only, and skin prick test <8 mm									
4	Multiple	No	Starts small but quickly escalated cow's milk protein	350 mg	Not specified	No	No	British	Long time spent on each step; foods in a single step are dissimilar in allergenicity
Belgian milk ladder ³⁷ – Mild to moderate non-IgE-mediated CMA (excluding food protein-induced enterocolitis syndrome and eosinophilic esophagitis: patients aged 1–3 years									
6	1–4	No	Large jump when moving from hard cheese to soft cheese	Not listed		No	No	Belgium	Ladder only progresses to growing-up milk and does not include fresh milk
French milk ladder ³⁸ – Mild to moderate non-IgE- and IgE-mediated CMA									
22	1	Some foods	Overlap with OIT*. Starting dose dependent on reactogenic dose at OFC*. Dose escalation focuses on quantity of milk per serving.	Not listed		No	No	French	Ladder differs for older and younger children - For older children, the ladder ends with cheese and not milk - For younger children, ladder ends with growing-up milk

*(OIT) Oral Immunotherapy *(OFC) Oral Food Challenge

Randomised and observational studies from Ireland¹³ and Spain^{13,39} show that children managed with milk ladders are significantly more likely to achieve successful milk introduction compared with those managed by strict avoidance. Importantly, anaphylaxis occurred more frequently in avoidance groups owing to accidental exposures, highlighting potential protective effects of structured reintroduction.⁴⁰

Milk ladders may be seen as a low-intensity form of oral immunotherapy in infancy. Comparative studies suggest similar effectiveness and safety,⁴¹ with improved acceptance and dietary diversity. However, existing studies are limited by retrospective design, small sample sizes and a lack of standardised diagnostic confirmation, underscoring the need for high-quality randomised trials.⁴¹

In non-IgE-mediated CMA, particularly in the case of allergic proctocolitis, milk ladders facilitate early and successful reintroduction of cow's milk to the diet. Most infants achieve tolerance within the first two years of life (often before 12 months), supporting guideline recommendations for timely reintroduction rather than prolonged avoidance.¹⁷ Results from a worldwide survey indicate that milk ladders are frequently used in all types of non-IgE-mediated CMA.⁴²

Key research priorities include standardisation of milk ladder protocols, identification of biomarkers predicting success, evaluation of long-term nutritional and psychosocial outcomes, and comparative effectiveness trials versus formal oral immunotherapy.

Patient selection, education and safety

Not all children with CMA are suitable candidates for the use of milk ladders. Favourable factors include mild to moderate symptoms, absence of recent anaphylaxis, lower levels of sensitisation, and strong family engagement. Education, shared decision-making and use of safety checklists are essential to minimise risk and optimise outcomes.⁷ Favourable factors for the use of milk ladders in non-IgE-mediated CMA with severe symptoms, such as in the case of enterocolitis syndrome, are currently unclear.



Conclusion

Over the past decade, the approach to the management of CMA has shifted from prolonged avoidance to proactive, evidence-based strategies that prioritise nutritional adequacy, developmental needs and timely reintroduction of cow's milk protein. This shift reflects improved understanding of CMA phenotypes, immune tolerance mechanisms and the unintended harms associated with unnecessary dietary restriction during critical periods of growth and neurodevelopment.

International guidelines now consistently emphasise that eliminating cow's milk should be done purposefully, for only a limited time and be regularly reviewed. Accurate phenotyping, structured diagnostic pathways and early dietetic involvement are central to avoiding both over- and underdiagnosis. Nutritional considerations extend beyond calcium and vitamin D intakes, and now also include iodine and vitamin B12 levels, as well as protein quality, energy balance, feeding behaviours and long-term growth trajectories.

The use of milk ladders can offer a practical, family-centred method for graded reintroduction of cow's milk protein that aligns with the natural history of allergy resolution. Evidence from observational and comparative studies suggests that milk ladders are safe, acceptable and effective in accelerating tolerance acquisition while potentially reducing the risk of accidental reactions associated with strict avoidance. However, they are not universally applicable and must be implemented within a framework of shared decision-making, education and safety planning. Future research should focus on standardising protocols, refining patient selection through clinical and immunological biomarkers, and evaluating long-term nutritional, immunological, and psychosocial outcomes.

In summary, contemporary dietary management of CMA should balance safety with proactive tolerance development. Milk ladders, embedded within guideline-based care and supported by dietetic expertise, represent a key tool in achieving this balance, improving nutritional outcomes, empowering families and optimising quality of life for children with CMA.

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