Development of food literacy in children and adolescents: implications for the design of strategies to promote healthier and more sustainable diets

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Narrative Review

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Food literacy has emerged as a key individual trait to promote the transformation of food systems toward healthy and sustainable diets. Childhood and adolescence are key periods for establishing the foundations of eating habits. Different food literacy competencies are acquired as children develop different cognitive abilities, skills, and experiences, contributing to the development of critical tools that allow them to navigate a complex food system. Thus, the design and implementation of programs to support the development of food literacy from early childhood can contribute to healthier and more sustainable eating habits. In this context, the aim of the present narrative review is to provide an in-depth description of how different food literacy competencies are developed in childhood and adolescence, integrating the extensive body of evidence on cognitive, social, and food-related development. Implications for the development of multisectoral strategies to target the multidimensional nature of food literacy and promote the development of the 3 types of competencies (relational, functional, and critical) are discussed.

Key words: *adolescence, childhood, food literacy, food skills, nutrition education.*

INTRODUCTION

Food systems have been identified as a major driver of malnutrition and climate change.[1–3] Current food systems are oriented toward the production of cheap, energy-dense products that maximize profit, failing to provide children and adolescents the healthy and sustainable foods they need to achieve optimal growth and development.[1,4] Children and adolescents worldwide do not consume enough micronutrient-rich foods, such as

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fruits, vegetables, pulses, and whole grains; conversely, they consume an excessive amount of energy-dense, ultraprocessed products with high content of sugar, fat, and/or sodium.[5,6] These eating patterns largely deviate from the scientific targets for healthy and sustainable diets, characterized by a diversity of plant-based foods, low quantities of animal foods, and ultraprocessed foods.[2]

The eating habits of children and adolescents are shaped by their interaction with the processes and conditions of the food systems, from production to consumption.[7] Food systems characterized by the wide availability and affordability of ultraprocessed products create social norms around processed, marketed foods, perpetuating poor food habits that are hard to break.[8] For this reason, introducing major transformations to the current food systems is paramount in guiding children and adolescents toward healthy and sustainable eating habits, as well as to achieve the United Nations' Sustainable Development Goals.[2,4,5] Two broad strategies have been proposed to achieve this objective: (1) introducing changes in the food environment and food supply chains to improve the availability, affordability, and desirability of healthy and sustainable foods; and (2) triggering society-led changes by equipping citizens with the capacity to take personal responsibility for their health and well-being.[1,2,9]

Food literacy is a key individual trait for the second strategy. Cullen et al defined food literacy as "the ability of an individual to understand food in a way that they develop a positive relationship with it, including food skills and practices across the lifespan to navigate, engage, and participate within a complex food system. It is the ability to make decisions to support the achievement of personal health and a sustainable food system considering environmental, social, economic, cultural, and political components."[10] Food literacy includes the competencies citizens need to relate to the food systems and to promote their transformation.[10–13]

Childhood and adolescence are important periods for the development of food literacy.[14,15] Different food literacy competencies are acquired as children develop different cognitive abilities, skills, and experiences.[16–18] Thus, the implementation of programs to support the development of food literacy from early childhood can largely contribute to healthy and more sustainable eating habits later in life.[19–24] Such programs can also contribute to the transformation of the food systems, because children are drivers of change, largely influencing their families' purchase decisions, and developing agency as they grow, navigating toward their own choices.[25]

One of the challenges faced by such programs is a lack of an in-depth understanding of how children and adolescents develop their food literacy and the specific competencies relevant to the different stages of these life periods.[26] Although several recent reviews have been published about food literacy,[10,13,27] the focus on children and adolescents is still scarce.

In this context, we intended the present narrative review to contribute to the literature by describing how food literacy is developed in children and adolescents and how it is linked to the ability to make informed and critical choices within a very complex food system. First, a conceptual framework for food literacy in childhood and adolescence is proposed. Then, an in-depth description of how different food literacy competencies are developed in childhood and adolescence is provided by integrating the extensive body of evidence on cognitive, social, and food-related development. Finally, implications for the design of public policies to promote healthier and more sustainable eating habits are presented, adapted to the particularities of the age group and the environment children and adolescents interact with. Promoting food literacy should be regarded as an important part of the puzzle, but only as 1 of the many actions needed to achieve healthy and sustainable eating habits in children and adolescents.

METHODS

Relevant literature on food literacy and its development during childhood and adolescence was searched in the Scopus and PubMed databases. Searches were performed with the generic term "food literacy," as well as with specific food literacy competencies (eg, "cooking skills," "persuasion knowledge"). Studies, narrative reviews, and systematic reviews published in English were considered. No limitations were considered on study design or publication date.

CONCEPTUAL FRAMEWORK OF FOOD LITERACY IN CHILDHOOD AND ADOLESCENCE

An adaptation of the concept of food literacy applied to children and adolescents is still lacking.[19] The development of an age-specific conceptualization of food literacy based on a food-systems approach could contribute to the development of strategies to promote healthier and more sustainable eating patterns.[13,23,28]

In the present work, food literacy is conceptualized as 1 of the individual characteristics that determine how children and adolescents interact with the food system.[29] It is defined as the abilities, knowledge, and skills children and adolescents need to interact with the components of the food system in a way that they can develop healthy and sustainable eating habits throughout their lifespan (Figure 1).

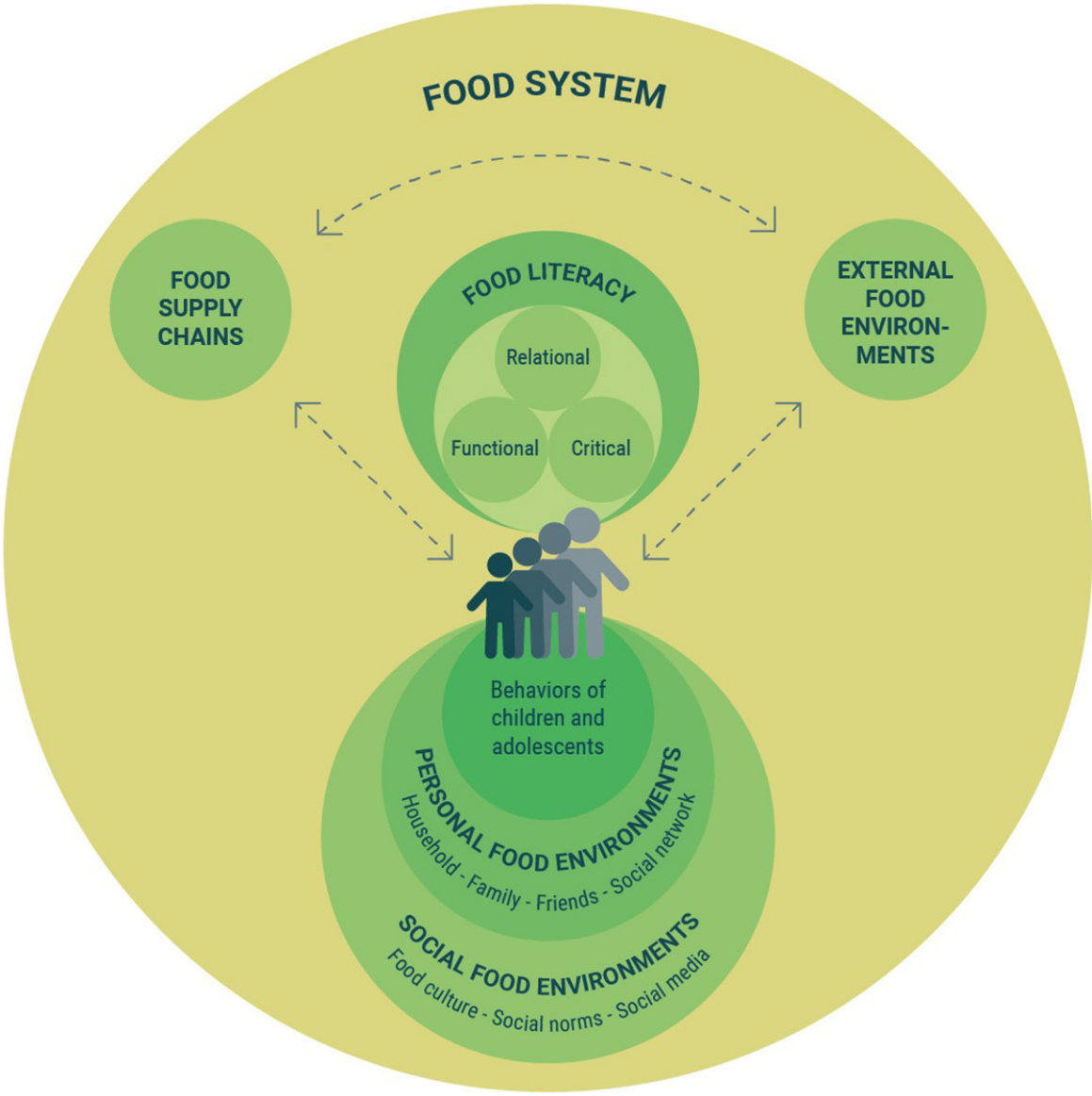

Figure 1 **Conceptual framework of food literacy based on a food systems approach.**

Following the models proposed by Nutbeam,[30] and Slater et al,[31] 3 main types of food literacy competencies are considered: relational, functional, and critical. Relational competencies refer to a series of practices, cultural competencies, and hedonic and emotional associations that enable children and adolescents to develop healthy and sustainable eating patterns.[31] Functional competencies include basic knowledge about food and nutrition, as well as food skills related to food planning, preparation, and disposal.[30,31] Finally, critical competencies include cognitive skills needed to critically analyze information and recognize social, economic, and environmental aspects of the food systems, and use the information to make healthy and sustainable food-related decisions.[32]

According to the proposed framework, food literacy has a bidirectional relationship with the components of the food system. First, the food literacy competencies needed to interact with the food system vary based on its typology, with notable differences between traditional and industrialized food systems.[33,34] Second, the characteristics of the personal and external food environments, as well as the characteristics of the food supply chain, are expected to largely influence how children and adolescents develop their food literacy. So far, an in-depth understanding of the effect of sociodemographic and contextual variables on children and adolescents' food literacy is lacking. A handful of studies have reported a negative association between educational attainment and household income,[35–38] in

agreement with socioeconomic inequities in health outcomes.[39–42] Several mechanisms may explain this association, including money and time investment in food, education, and healthcare, parental stress, and childcare practices.[40]

DEVELOPMENT OF FOOD LITERACY IN CHILDREN AND ADOLESCENTS

Food literacy undergoes major changes through childhood and adolescence, which encompass physiological, cognitive, and social development, as well as changes in eating behavior.[18,43,44] Different competencies are developed over time through different learning mechanisms.[45,46] Table 1 summarizes the main characteristics of cognitive development and eating behavior in the different periods of childhood and adolescence, as well as the periods when food literacy competencies are acquired. In the following sections, a detailed description of the development of each of the 3 types of food literacy competencies is provided.

Relational competencies

Relational competencies are the first type of food literacy competency children acquire. These competencies include pleasure from eating healthy and sustainable foods, familiarity with diverse foods, enjoyment of trying new and diverse foods, positive emotional and hedonic associations with healthy and sustainable eating habits, enjoyment of shared meals, appreciation of food culture, as well as mindful eating practices and body image satisfaction.[31]

Pleasure from eating and food familiarity. The pleasure experienced from eating healthy and sustainable food is a key food literacy relational competency that starts developing even before children are born.[47–49] Pleasure is an innate indicator of the satisfaction of the child's physiological need to eat.[50] In the first 1000 days of life, children learn to associate the pleasure of eating with different foods through familiarization.[51] This learning process already starts during pregnancy and breastfeeding, when infants are exposed to flavors from their mother's diet.[47] Exposure to diverse foods during this period enhances familiarization and may ease the transition to the diversity of the infant's diet later on.[52,53] When complementary feeding is introduced and children transition to an adult omnivorous diet, children's exposure to a wide variety of flavors and textures stimulates the acceptance of diverse foods.[50]

Exposure to diverse foods from an early age increases food familiarity, which has been identified as a key influencer of children's willingness to experience new foods.[47] Familiarity with diverse foods and enjoyment of experiencing new and diverse foods can be regarded as relational competencies that contribute to the development of healthy eating habits[50] and also favors good coverage of nutritional needs. Repeated exposure to healthy and sustainable foods from an early age can contribute to increasing familiarity and reducing food neophobia (ie, children's rejection to try new and unfamiliar foods), which has been linked to reduced consumption of vegetables.[54]

The external food environment exerts a key effect on the development of children's and adolescents' ability to enjoy healthy and sustainable foods by influencing food availability and affordability.[55–57] Modern food environments are characterized by the wide availability of energy-dense and nutrient-poor foods.[1] This is particularly the case for products targeted at children, which are usually high in sugar and other nutrients associated with noncommunicable diseases.[8,58–61] Repeated exposure to these products may contribute to the development of preferences for foods with high sweetness and saltiness intensity, reducing children's ability to enjoy natural and healthy foods.[47,50,62]

Emotional and hedonic associations with foods. Children also learn to enjoy foods by observing others' eating behaviors, most often their parents.[63,64] Social interactions with others play an important role in the development of relational competencies; via social learning (ie, individual learning by observing and imitating behaviors of others[65]) and socialization (ie, the process of internalizing the norms and ideologies of society[66]). From infancy, children have a natural tendency to imitate (parents or peers), moderated by the emotional quality of the relationship between the observer and model,[15] with parents being highly influential role models. Social learning from adult models in the food context occurs from 14 months of age, with children being more likely to eat an unfamiliar food if they see an adult eating it,[67] even if they do not belong to their social group.[68] Peer modeling is effective for tasting new and nonpreferred foods from about 2–3 years of age, enhancing the reported liking of these,[69] even though adults/parents are still the most influential at this age.[70] In the preschool period, maternal modeling of healthy eating for 3-year-old children is positively correlated with children's interest in food and negatively with food fussiness at 4 years of age.[71] Peer modeling also has a positive effect on children's willingness to try novel foods; children's novel-food consumption increased after hearing a positive statement about the target food from their peers.[72,73] Studies have also shown that peers have more influence than adults on children's food selection.[74,75]

Table 1 **Summary of the main characteristics of cognitive development and eating behaviors in childhood and adolescence and the periods when food literacy competencies start to develop**

	Age range			
	Birth to 2 y	2–5 y	6–11 y	12–18 y
Characteristics of cognitive development	Sensory motor stage. Knowledge is acquired through the senses and actions. Preverbal stage	Preoperational stage. Symbolic thinking is developed. Objects are represented using words and images. Intuitive rather than logical thinking	Concrete operational stage. Logical thinking is developed. Time, space, and quantity are understood.	Formal operational stage. Abstract, logical, and counterfactual thinking is developed. Strategy and planning are possible.
Characteristics of eating behavior	Discovery phase. the sensory repertoire in relation to food expands quickly. Hand-to-mouth coordination and oral feeding skills strongly develop in relation to food experience (from milk to solid foods). Food representations start to emerge. Dislikes are not marked. The food environment is shaped by parents.	Food neophobia emerges by the end of the second year. Familiarity with foods strongly influences liking. Out-of-home socialization starts in the preschool context and children are sensitive to peer influence.	The developmental dimension of neophobia starts fading away. Children start developing cognition about foods (eg, the persuasive intent of food-related advertisements) but are still influenced by the affective content. Basic concepts about the effects of food on the body can be understood but emotional reactions to food still dominate.	Children tend to keep away from the parental food model. Peer influence becomes a major feature of adolescents' eating. Increasing awareness of food origin may alter food likes (eg, development of vegetarianism or veganism).
Food literacy competencies	Pleasure from eating healthy and sustainable food (R) Familiarity with diverse foods (R) Enjoyment of trying new and diverse foods (R) Positive emotional and hedonic associations with healthy and sustainable foods (R) Enjoyment of shared meals (R)	Mindful or internally regulated eating practices (R) Appreciating food culture (R) Enjoyment of food preparation (R) Body satisfaction (R) Human-nature bonds (R) Food categorization (F) Food-related knowledge (F) Numeracy skills (F)	Nutrition knowledge (F) Cooking skills (F) Food safety knowledge (F) Understanding of food labels (F) Budgeting and financial skills (F)	Ability to think critically about the food system (C) Persuasion knowledge (C) Media literacy (C)

Abbreviations: C, critical competencies; F, functional competencies; R, relational competencies.

From a young age, parents have a crucial impact on how children learn about food, as they shape the so-called home food environment.[76,77] This includes the food available at home and its accessibility, family food rules, parents' eating habits, their knowledge about food, and their feeding styles and practices. What, where, when, how much, and in which emotional and social context parents present foods to the child can have an immediate impact on children (eg, on their willingness to try certain foods), but also a longer-term impact in childhood and adulthood.

Associative learning or conditioning occurs when an evaluation of a stimulus arises through its association with a second, already liked or disliked stimulus.[45] Children's conditioned associations with foods can also be regarded as a relevant food literacy competency, because they have the potential to shape food preferences and eating behaviors.[31,50] These associations are shaped early in childhood and are largely influenced by parental feeding practices. For example, pairing foods with rewards or positive adult attention can stimulate children's liking for these foods,[78,79] whereas parental pressure to eat can generate negative emotional associations and discourage children's consumption.[80] Parental use of coercive control feeding practices in early childhood (eg, restriction of certain foods, pressure to eat, the use of rewards and bribes) has mostly counterproductive effects on the child's eating (eg, more dislike of pressured foods, more food fussiness, less enjoyment of eating).[81] These effects can even be long-lasting: young adults reported retrospectively that the foods they disliked as adults were those they had been forced to eat as young children.[82] This exemplifies how parents can influence children's

relationship with food from early life and the acquisition of relational food literacy competencies like enjoying eating and enjoying experiencing new and diverse foods.

Enjoyment of shared meals, food preparation, and food culture. Cooking as a family and having family meals can also have an important impact on children's and adolescents' acquisition of relational food literacy competencies, particularly the ability to enjoy shared meals and food preparation. Family meal frequency has been associated with a higher intake of healthy food, child socialization, and decreased overweight and obesity risk in adulthood.[83–86] Children who enjoy the experience of shared family mealtimes are reported to be more positive about trying new foods in a nonmodeling context.[71,87,88] In addition, research found that young adults' present commensality is positively associated with their recalled frequencies of childhood family meals.[89] In the same study, recalling mothers' home cooking during childhood was also a significant predictor of young adults' cooking for themselves in the present day.[89] In addition, observing or participating in family cooking and family meals provides children the opportunity to familiarize themselves with and appreciate their food culture, which also contribute to cohesiveness and identity.[90]

Mindful or internally regulated eating practices. Mindful eating practices, also called internally regulated eating, can be regarded as another relational food literacy competency.[31] These practices can be regarded as a vast range of practices that rely on paying attention to body sensations, thoughts, and feelings about food.[91] They include paying attention to the sensory characteristics of foods while eating, paying attention to feelings of hunger and fullness, noticing cues that elicit eating or the urge to eat, taking nonjudgmental attitudes toward cravings and food-related thoughts, as well as viewing cravings as transient events that are separate from oneself.[92] Internally regulated eating practices have been associated with increased autoregulation, reduced frequency of binge-eating episodes, and reduced consumption of unhealthy foods by children, adolescents, and adults.[93,94] During childhood, adults can encourage children to engage in internally regulated eating patterns. Responsive feeding practices can promote mindful eating practices, whereas pressure to eat can have a deleterious effect.[71,95–98] In addition, interventions in school settings can positively contribute to the development of internally regulated eating practices.[94,99] A recent study reported that school lessons and activities related to mindful eating led to reduced frequency of food cravings and a significant increase in fruit intake among children 8–10 years old.[100] Activities focusing on sensory imagery, an underlying component of mindful eating, can also help children choose smaller portion sizes.[101]

Body satisfaction. Body satisfaction is another relevant relational competency, particularly during adolescence, because body dissatisfaction has been associated with eating disorders at that age.[102–104] Body image and eating patterns begin to develop early in life, and parents are highly influential agents of socialization in these domains by transmitting norms, beliefs, values, knowledge, attitudes, and behaviors related to food, body, and weight to their children.[105–107] Parental messages about food and weight can have an impact on children's relationship with their body image and body (dis)satisfaction, not only in preadolescent children[108] but also even those as young as preschoolers.[109] Peers and media also have an important influence on the body image of preadolescents.[110,111] However, the link between peers and the media and influence on body image is less evident in preschool children.[109] Recent work has stressed the importance of empowering children and families to fight against societal body-related pressures.[112] Moreover, they propose various strategies for parents to promote a positive body image and a healthy, positive relationship with food in their children,[112] with most of these strategies having the potential to be applied from early childhood.

Human-nature bonds. The adoption of sustainable eating habits requires the establishment of human-nature bonds.[25] Such bonds can be created through children's exposure to nature and interaction with nonhuman life (eg, plants and animals)[113] and environmental socialization (eg, children's interaction with adults who engage in pro-environmental behaviors).[25] Engaging with nature, for example, through food gardens, promotes mental well-being as well as a positive outlook and a sense of inclusion and belonging.[114] Gardening programs can also increase children's familiarity with and willingness to try fruits and vegetables, as well as their functional food literacy competencies through knowledge about the origin of vegetables.[87]

Functional competencies

Functional food-related competencies are the most well-defined components in the food literacy literature.[115] They refer to the basic knowledge of food and nutrition, as well as the skills necessary for food planning, preparation, and disposal.[30,31] In other words, functional competencies are the ability to obtain, understand, and use information on various food and

nutrition topics, as well as the practical skills to select foods and prepare a meal.[115] These competencies require symbolic, intuitive, and logical thinking and, as such, develop later than relational competencies.[31]

Food categorization. A key functional food competency is the ability to appropriately categorize food.[116,117] Food may be categorized in a myriad of ways, with different categories conducive to inferring different information.[118] For example, taxonomically categorizing foods (ie, fruits and vegetables) helps determine which foods will help meet the recommended daily intake levels.[119] Similarly, evaluatively categorizing food as healthy vs unhealthy helps guide both adults and children toward healthier eating habits.[120]

Children's proneness to categorize foods, both in relation to sensory pleasure or nutrition, strongly develops with age and can be a predictor of healthy food choices.[121,122] Infants and toddlers initially show limited categorization abilities in the food domain. However, the ability to categorize foods rapidly improves during early childhood, both through explicit education and through daily experiences.[123] By ages 3–4 years, children can adequately categorize substances at a very basic level of knowing what is edible (food) or inedible.[124,125] More recent research demonstrates that by ages 3–5 years, children can discriminate at the superordinate level of vegetables and fruits,[126–128] and children as young as 4 years old can even categorize food as healthy or unhealthy.[120,129,130]

Food-related and nutrition knowledge. Functional food literacy competencies also entail general knowledge about food, including animal sources of food and how foods are grown and produced.[23] Such knowledge can be acquired through explicit teaching within the school setting, as well as through experience with food and food growing. Research has shown that knowledge about food appearance can be gained from early childhood by asking parents to read a picture book with pictures of foods and vegetables.[131] This type of knowledge contributes to relational food literacy competencies by increasing familiarity and willingness to taste fruit and vegetables.[132–134] In addition, knowledge about the sensory characteristics of foods can be gained through direct contact (ie, touching, smelling, playing with foods), which can also increase the willingness to try unfamiliar fruits and vegetables.[135–137]

Concerning nutritional knowledge, studies show that although 4-year-old children can categorize food as unhealthy, they are unable to comprehend the effects of food healthiness on the body nor use this ability to make informed food choices.[130] Studies have shown that formal operational thought is correlated with the ability to understand abstract concepts in science. Recent research on formal operations has shown that formal thought does not usually develop until late childhood or early adolescence and, moreover, only about half of the adult population comes to use formal reasoning consistently and reliably. Nutrition knowledge can be thought of as composed of 3 related accomplishments: (1) knowledge of a variety of relevant nutritional inputs and outputs; (2) knowledge that the inputs are functionally related to the outputs; and (3) knowledge of how inputs relate to outputs (ie, knowledge of nutritional relationships and processes).[138]

Raman[139] assessed the perceived impact of healthy and unhealthy foods on height and weight. In that study, preschoolers thought that both healthy and unhealthy foods would result in growing taller and more overweight. In another study, preschoolers and second graders were reported to think that psychobiological properties such as the "yuckiness" of food affected biological mechanisms such as growth (eg, height and weight), but they did not associate these psychobiological properties with illness.[139] For example, they thought that height would be more affected by a "yummy" healthy food than a "yucky" healthy food.[140]

Studies show that it is approximately at 5–7 years old that children begin to understand the effects of different food categories on the body and use such category knowledge to guide their food choices depending on the goals they have in mind (eg, selecting vegetables to promote their bodies' health).[141,142] However, children's perception of healthiness and nutritional value of food is also dependent on weight status, revealing the strong interdependency between functional competencies and self-image.[143]

Food preparation skills and food safety knowledge. Functional competencies also incorporate food preparation skills, which refer to the ability to perform tasks related to the preparation of food.[144] The definition of food preparation or cooking skills is complex because it involves a diverse set of mechanical, technical, conceptual, creative, and organizational skills.[144,145] Food preparation skills are acquired at home with family members, at schools, and in other formal learning environments, as well as through mass media.[145] Culinary interventions in the school setting have been associated with improvement in cooking skills, healthier eating habits, and positive changes in anthropometric measurements.[88,146] However, the optimal age to acquire and retain different types of food preparation skills is still unknown. [20]

Conceptual knowledge related to food preparation is acquired in early childhood. Emerging evidence by Pickard et al[118,147] shows that at ages 3–4 years, children

already have a good understanding of which utensils are required for the preparation of certain foods (eg, a sharp knife is needed to cut a watermelon, a cheese grater is needed to grate cheese). The same study also demonstrated that children of the same age had a good understanding of what foods are commonly served together in the same meal (eg, pasta with sauce). Children aged 3–4 years can also state whether foods were appropriate or inappropriate for a specific meal.[120,148] However, Pickard et al[147] noted that knowledge of the cultural appropriateness of meals and food events (eg, cereal at breakfast) was acquired later than knowledge of foods that go well together (eg, cereal and milk).

Although research has shown that children already possess knowledge of food categories and food scripts by 5 years old, mechanical and technical cooking skills are developed later because they require motor abilities.[20] Fine motor skills are the use of the small muscles of the extremities to manipulate and maneuver objects, whereas gross motor skills are the larger movements involving the limbs.[149] Food preparation requires both fine motor skills, for activities such as cutting and eating, and gross motor skills, such as stirring and carrying. Several factors influence children's fine and gross motor skills; of particular importance to food skills, age, experience, sex, and weight are variables of interest in culinary practice.[150] One study found that children with normal weight have better manual dexterity, motor precision, and gross motor skills than children with obesity.[151–153] Separate research indicates that boys' fine motor skills are worse than that of girls in the early years, but boys have better gross motor skills at an older age.[154] Socioeconomic status is also of importance when determining the skills of children in the kitchen. A study investigating a range of variables found that higher levels of education, having siblings, higher education level, and socioeconomic status of the parents were all predictive of greater development in fine motor skills.[155] In addition, emerging evidence suggests that baby-led weaning, a complementary feeding method that encourages the introduction of foods through self-feeding of age-appropriate pieces solid foods, can contribute to the development of fine motor skills.[156]

Food safety knowledge is also part of food preparation skills, as well as a functional food literacy competency.[31] Basic knowledge about food hygiene and safety can encourage safe food-handling behaviors and reduce the incidence of food-borne diseases.[157–159]

Numeracy skills and understanding of food labels. To interact with the food environment, children need skills to interpret the information included on food labels and use such information to make healthy and sustainable food choices. Several educational programs and interventions for school-aged children and adolescents have been reported to be effective at improving the ability to interpret food labels.[160,161] In addition, children and adolescents require numeracy skills (ie, the ability to apply concepts of math in their everyday life) to interpret numerical nutrition information, but also to make food purchases, or modify recipes while cooking. Numeracy skills start developing early in life through everyday informal quantitative activities, such as counting objects, identifying written numbers, playing card games, or talking about money.[162] Formal mathematical skills are acquired later in life through explicit teaching at schools.[163] Numeracy skills in adults have been linked to health literacy and associated with preventive care behaviors and child health outcomes, which stress the importance of this functional competency.[164,165]

Budgetary and financial skills. Budgetary and financial skills are another functional food literacy competency children and adolescents need to navigate the modern food environment, which becomes increasingly important as they gain independence to make their food purchases.[166] These skills allow children to make food choices under budgetary restrictions. Recent research has suggested that financial skills promote rational decision-making and can reduce the likelihood of engaging in health-damaging behaviors, such as smoking and a lack of physical activity.[167,168]

Critical competencies

Developing critical competencies is crucial to navigating the modern, complex food environment and making healthy, sustainable food choices.[31] This is only possible by developing certain cognitive and social skills that are needed to question information and critically examine social, economic, and environmental aspects of food systems.[32] Critical thinking can be promoted from early childhood by providing opportunities for children to express themselves and to engage actively in food-related decisions.[169] However, only at the age of 8 years do children start to understand the persuasive messages of advertisements, yet they are mostly still unable to criticize them.[170] Even though children mostly understand the selling intent of marketers from the age of 8 years, the critical evaluation often does not reach the limit of desire for the advertised product. Broader critical food literacy competencies develop in adolescence when abstract, logical, and counterfactual thinking is developed. This type of competency is key to providing children and adolescents the ability to encourage major transformations in our current food

systems. With age, children develop stronger abilities to control their desires, making them more critical and their eating behavior less influenced by food marketing.[170] Studies indicate that by the ages of 12–14 years, children actually understand the persuasive intent of marketers.

Persuasion knowledge. Children form an interesting target group for companies because they are more receptive to advertising, due to their still-developing cognitive, communicative, and social skills, leading to less-critical reflections of advertisements.[170] At the same time, children already have a certain purchasing power. They are not only able to buy small products like candy with their own pocket money but also influence their parents' buying behavior and product choice.[170] By specifically being targeted by marketers, the development of the aforementioned critical competencies is crucial. Food marketing is omnipresent and children get exposed extensively to various types of it in their daily life, for example, in supermarkets (eg, via food packages), and via various media, including social media, and digital games.[171] This exposure can hinder the development of children's food literacy and negatively affect their health because it can create positive hedonic and emotional associations with unhealthy ultraprocessed products. This is done through the inclusion of cartoon characters, fun references, and other child-oriented elements.[171–173] In fact, various food marketing techniques have been shown to lead to an increased intake of the advertised foods and, further, to more positive attitudes regarding the advertised products.[171,174]

In more detail, acute exposure to food advertising was shown to increase food intake by children but not by adults.[174,175] This may be partly explainable by missing critical competencies and lacking the so-called persuasion knowledge. The latter refers to all theories and beliefs an individual holds about how marketers try to influence them and is the broad understanding of how, when, and why persuasion attempts are made.[176] Persuasion knowledge activates coping responses, which, in turn, lead to less favorable evaluations of persuasion attempts. Although studies on determining the specific age of this development are scarce, 5-year-old children are theoretically able to recognize advertising on television (TV).[17] Furthermore, at ages 8–12 years, they start being able to detect the intent of selling and persuasion of those ads.[177] However, it was shown that only a third of 10-year-olds, only a quarter of 8-year-olds, and none of the 6-year-olds included in another study noticed the persuasive intention of TV ads.[178] This is especially worrying because children ages 4–12 years watched TV for approximately 1.5 h/day and be exposed to unhealthy food products.[179] Hence, an important question in recent decades has been how children can be protected against the negative influences of food marketing, especially before having developed persuasion knowledge and critical competencies. This seems even more important regarding marketing use on the internet, which is the most commonly used media source for children and adolescents besides the TV.[179]

Social media opens a myriad of new options for marketers to use even stronger persuasion techniques. These techniques involve children and adolescents creating and sharing their experiences with food products and brands. The uniqueness of social media is that users themselves contribute to the marketing processes of companies (ie, user-generated marketing content). In addition to peers, influencers with whom children and young people can easily identify are used as a medium to distribute marketing messages. Influencers are close to the adolescent's environment, which makes advertising more fun but also blurs the line between online peer activity and advertising.[180,181] Research shows that children have difficulties recognizing those tactics and identifying the commercial motives of these messages, because of the involvement of feelings in the advertisements and the blurring line between advertising and entertainment.[182,183] Adolescents, in particular, may experience strong relationships with influencers and rather perceive them as friends. Recommendations from influencers, therefore, have greater credibility and authenticity than traditional forms of advertising. Influencer marketing is 1 of the more implicit marketing tactics that are omnipresent nowadays. This makes marketing efforts even harder to recognize for children and adolescents.[184] Besides influencer marketing, advergames (ie, advertising in video games) appear to have a stronger impact on the desire to purchase (or have it purchased by parents) than TV advertisements.[182] Because children and adolescents are of particular interest to companies and are specifically targeted in food campaigns, ways to support those individuals regarding food marketing must be found. Adolescents are an important target audience for food marketers because of their high social media use and greater purchasing power compared with younger children.[185]

Media literacy. To protect children and adolescents, several interventions have been tested in research. Interventions aimed at increasing media literacy may be good tools to reduce the effect of food marketing on children's and adolescents' eating behavior. Although there are several definitions, media literacy is often described as having the skills to critically engage with

and evaluate media messages.[186] Hence, increasing media literacy could lead to greater persuasion knowledge, especially in children from the age of 12 years, although concerns have been expressed that regulation will have greater effects than education. A recent study indicated that a media literacy intervention may lead to an increased understanding of the purpose of advertisements and being more critical of unhealthy food marketing as self-reported by children ages 7–12 years.[187]

IMPLICATIONS FOR THE DEVELOPMENT OF PUBLIC POLICIES TO PROMOTE HEALTHY AND SUSTAINABLE EATING HABITS

Food literacy has emerged as a key individual trait to promote the transformation of food systems toward healthy and sustainable diets.[9,10,12] Considering that childhood and adolescence are key periods for establishing the foundations of eating habits, strategies to support the development of food literacy competencies are a momentous policy challenge.

To date, most interventions to promote the development of food literacy in children and adolescents have oversimplified the concept by only focusing on a limited set of competencies.[24,188–190] For decades, efforts to promote healthy and sustainable eating habits among children and adolescents have mainly focused on nutritional knowledge and specific functional food literacy competency.[191–193] These strategies have a limited impact on children's eating behavior and can even have a counterproductive effect, encouraging children to reject healthy foods.[50] This emphasizes the need to broaden the focus of strategies to promote changes in the eating habits of children and adolescents to encompass the diverse set of competencies needed to interact with all the components of the food system. A key starting point for policymaking is the adoption of a comprehensive view of food literacy that captures the 3 types of competencies: relational, functional, and critical. This is consistent with recommendations for the promotion of health literacy.[194]

A comprehensive range of multisectoral and multicomponent strategies is needed to target the multidimensional nature of food literacy. These strategies should be adapted to the regional context with consideration of the typology of the local food system, as well as the developmental level of children, because these influence the development of food literacy. In addition, strategies should consider the different environments children and adolescents interact with (eg, home, school, in the school canteen, food stores), because these exert a large influence on the policy options and the factors that influence their effectiveness. Table 2 provides a summary of the key characteristics of public policies aimed at promoting healthy and sustainable eating habits in childhood and adolescence in different environments, according to the stage of development and context of eating.

Relational competencies should be the main focus of strategies targeting infants and preschoolers. The ability to derive pleasure from eating is the first relational competency to develop and plays a key role in the definition of the eating habits of children and adolescents. Emphasis should be placed on the ability to derive pleasure from eating healthy and sustainable foods, as well as on increasing familiarity with diverse foods. Repeated exposure is a key strategy for learning to develop pleasure from eating healthy and sustainable foods.[47,64]

Despite its importance, pleasure has been underused thus far in public health communication campaigns and interventions.[50,195] More frequent inclusion of messages related to hedonic, interpersonal, and psychosocial dimensions of eating can contribute to changing parents' social representations of eating during the first years of life, which usually reflect a strong medical and nutritional view.[196,197] Pleasure-oriented messages have been reported recently to be effective at triggering changes in food choices, particularly among people with lower diet quality.[198]

During infancy, most feeding decisions are made by parents and caregivers, who should be the target of public policies through the delivery of targeted messages.[199,200] Efforts should be placed on building a healthy food environment and promoting responsive feeding practices to favor the discovery of healthy foods in a responsive way.[76] Parents and caregivers can easily promote familiarity with diverse foods and enjoyment of trying new foods through repeated exposure, social learning, and socialization.[47,50,62] These practices can be promoted through behavior-change communication campaigns and nutrition counseling.[199,201–203]

For preschoolers (ages 2–5 years), the focus should be kept on the development of relational competencies. During this stage, parents and caregivers are still mostly responsible for children's food intake. Apart from shaping the home food environment, they can start promoting other relational competencies through experiential learning, including mindful eating practices, enjoyment of food preparation, and human-nature bonds. Examples of effective strategies to promote relational competencies include sharing family mealtimes, taste lessons, and vegetable gardens.[71,87,88,204,205]

During this development period, simple strategies to promote functional food literacy competencies (eg, food categorization, food-related knowledge, and numeracy skills) can be implemented. This can be easily achieved at home by everyday activities, such as

Table 2 **Summary of the characteristics of public health policies aimed at promoting healthy and sustainable eating habits, according to the stage of development and context of eating**

Stage	Context	Implications
Infants	Home	Targeted to parents Focus on building a healthy food environment and responsive feeding practices
Preschoolers	Home	Targeted at parents Focus on a healthy food environment and the development of relational competencies Functional competencies, such as food-related knowledge and numeracy skills, can be developed.
Preschoolers	Schools	Focus on relational competencies such as food enjoyment, noncontingent sensory discoveries, mindful eating practices, and human-nature bonds Functional competencies, such as food categorization, food-related knowledge, and numeracy skills can be promoted.
School-age children	Home	Opportunity to engage children in cooking activities and meal planning
School-age children, preadolescents	Schools	Development of age-appropriate children's functional competencies through educational programs Contribution to the creation of social norms through rules to establish healthy and sustainable menus
Preadolescents, adolescents	Home	Opportunity to engage (pre)adolescents in cooking activities and meal planning, including shopping and meal preparation Promotion of critical food literacy skills
School-age children, preadolescents	Schools	Contribution to the creation of social norms through rules to establish healthy and sustainable menus Development of age-appropriate children's functional and critical competencies through educational programs
Adolescents	Schools	Opportunities to further develop functional and critical competencies through educational programs about food labeling, food marketing, food composition, food prices, food production, and food systems in general
All	External food environments	Marketing restrictions and food reformulation strategies are needed to promote relational food literacy (ie, positive hedonic and emotional associations with healthy and sustainable foods). Improving physical access to healthy and sustainable foods
All	Personal food environments	Improving availability and accessibility of formal and nonformal education Improving economic access to healthy and sustainable foods through social assistance programs

exposure and direct contact with foods,[135–137] engagement with food preparation at home and school,[88,146] reading books,[131] playing card games, or talking about money to purchase foods.[162]

Children' socialization in preschool offers additional opportunities to promote a healthy food environment and to foster the development of many relational and functional food literacy competencies. School activities that promote familiarity with foods and the acquisition of food-related knowledge should be prioritized, including exposure to diverse foods, sensory games with foods, and gardening programs.[87,135,204,206] In addition, the time available for eating is another characteristic of the school food environment that can influence children and adolescents' ability to engage in mindful eating practices: time constraints can discourage mindful eating and promote the consumption of unhealthy foods.[207,208]

Emphasis on functional food literacy competencies should start once children develop logical thinking, around 6 years of age (Table 1). Such competencies provide children with the knowledge and skills needed for completing different food-related competencies and further contribute to the development of relational competencies.[31] Schools are the ideal setting to foster the development of functional food literacy competencies through formal education. However, it should be stressed that school nutrition education programs should go beyond nutrition knowledge and include practical skills related to food planning, purchase, preparation, and disposal. Research has shown that nutrition education programs delivered at schools are more effective at promoting healthy eating behavior if they address different food literacy competencies instead of focusing on just knowledge transfer.[209,210] Home economics programs have been identified as privileged settings for the promotion of functional food literacy.[31,32,211] Schools can also shape relational competencies in children by shaping social norms around foods by enforcing rules to establish healthy and sustainable menus. This includes restrictions on the sale of foods with unfavorable nutritional profiles in school

canteens, because they should be regarded as an integral part of the school system instead of being oriented toward obtaining economic profit.[212–214] Regarding the home environment, public health messages should encourage parents to create opportunities to involve school-age children in cooking activities and meal planning at home, because these activities can contribute to the development of both functional and relational food literacy competencies.

The onset of adolescence provides the opportunity to support the development of critical food literacy competencies both at home and in schools. Adolescents should be provided the tools to have a critical view of the food system, which may protect them against the deleterious effect of food marketing and encourage them to act as drivers of change toward healthier and more sustainable food systems. For this purpose, educational workshops and interventions aimed at neutralizing the positive associations raised by marketing of unhealthy foods have been shown to be promising approaches.[187,215]

Regardless of the stage of development, the influence of the food environment on food literacy development cannot be disregarded. Public policies should shape external food environments to promote food literacy in children and adolescents and to enable them to have a positive relationship with healthy and sustainable food. This requires the introduction of strict nutritional guidelines and marketing regulations to protect infants, children, and adolescents from exposure to nutritionally inadequate foods that may hinder the development of relational food literacy competencies.[173,216] Governmental action to encourage the food industry in food reformulation strategies can also contribute to the development of relational competencies by reducing the availability of nutrient-poor, energy-dense foods with excessive content of sugar, fats, and sodium.[217–221] This is particularly relevant for commercial products targeted at children, because these products usually are less healthy than those targeted at adults.[222,223]

Public policies to promote food literacy in children and adolescent should also address socioeconomic determinants of food literacy. This includes improving the availability and accessibility of formal and nonformal education, which has been identified as a key determinant of child health and well-being.[39,40,42] Policies to secure access to food for the most vulnerable populations should also be an integral part of promoting the food literacy of children and adolescents, particularly in low- and middle-income countries. These include school meal programs,[224] cash transfers, and food provision.[225,226] Food literacy shares a dual relationship with food insecurity.[227] The latter reduces children's and adolescents' ability to experience a wide range of healthy foods and may limit their ability to use a diverse set of skills to navigate the food environment.[228] In addition, food literacy can reduce the negative effects of food insecurity on diet and health through knowledge and skills to optimize food selection under budgetary restrictions.[229]

In closing, the need to conduct more research on children's and adolescents' food literacy needs to be highlighted. This includes assessing the level of food literacy in children and adolescents globally, identifying the sociodemographic correlates of low food literacy, and evaluating the impact of interventions within the broad framework of national nutritional policies. One of the priorities for future research should be the revision of existing tools to measure food literacy and to put further emphasis on the pleasure-related competencies of children and adolescents. Pleasure from eating does not yet have a salient role in measurement instruments assessing food and nutrition literacy in children and adolescents,[19] despite the fact that the ability to derive pleasure from eating is the first relational competency to develop. Having reliable and consistent measurement tools will contribute to advance research on the topic to inform the development of effective policies to improve food literacy in children and adolescents.

Finally, it should be noted that the implementation of strategies to promote food literacy should only be regarded as part of the multifaceted set of actions needed to achieve healthy and sustainable eating habits in children and adolescents.[1,4] Changes in the food supply chains and external food environments should be introduced to achieve child-centered food systems that make healthy and sustainable diets available, affordable, appealing, and aspirational.[4]

CONCLUSION

Major transformations in food literacy experience during childhood and adolescence, encompassing changes in eating behavior, as well as physiological, cognitive, and social development, are key periods for establishing the foundations of eating habits. A broad range of multisectoral strategies is necessary to promote the development of the 3 types of competencies (relational, functional, and critical) in childhood and adolescence. Such strategies should be adapted to the stage of development and the regional context.

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