Associations Between 10–14-year-old Children's Eating Competence, Dietary Patterns, and Dietary Quality

Master's Thesis
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Master's programme in
Human Nutrition and Food-Related Behavior,
Human Nutrition study track
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7.5.2025
Helsinki

Faculty: Faculty of Agriculture and Forestry
Degree programme: Human Nutrition and Food-Related Behavior
Study track: Human Nutrition
Author: Sonja Leivo
Title: Associations Between 10–14-year-old Children's Eating Competence, Dietary Patterns, and Dietary Quality
Level: Master's Degree
Month and year: May 2025
Number of pages: 50 (+11)
Keywords: eating competence, dietary quality, socioeconomic status, children
Supervisors: Reetta Lehto, Henna Vepsäläinen, Jenna Rahkola
Where deposited: HELDA – Digital Repository of the University of Helsinki
Abstract:
Examining the connections between eating competence (EC) and dietary quality helps to identify potential ways to promote healthy eating habits. The evidence on the relationship between children's EC and dietary quality is limited. This thesis examined the associations between 10–14-year-old children's EC, dietary patterns, and dietary quality. Additionally, it explored how caregivers' socioeconomic status (SES) is associated with the children's EC. This cross-sectional study used data from the DAGIS Next study. The sample consisted of 223 children and their families. EC was assessed with a 16-item Satter Eating Competence Inventory tool. Children's food consumption was assessed with a Food Frequency Questionnaire (FFQ), from which two dietary patterns were found through Principal Component Analysis. Dietary quality was assessed with a Healthy Food Intake Index (HFII), which was calculated based on 33 FFQ items. SES was measured with the highest family education level and relative household income. Linear regression, Kruskal-Wallis, and Chi-square tests were used to examine the associations between EC, diet, and family SES. Results showed that EC was positively associated with a Health-conscious dietary pattern (B=0.045, 95% CI 0.024, 0.064, p<0.001) and the HFII (B=0.120, 95% CI 0.074, 0.165, p<0.001), and inversely associated with a Meat-and-discretionary-foods dietary pattern (B=-0.033, 95% CI -0.055, -0.011, p=0.01). SES (parental education and relative household income) was not associated with the children's EC. In conclusion, higher EC was associated with a more healthful diet. Daycare centers and schools should more strongly incorporate EC into nutrition education and emphasize its significance in children's health promotion.

Tiedekunta: Maatalous-metsätieteellinen tiedekunta
Tutkinto-ohjelma: Ihmisen ravitsemuksen ja ruokakäyttäytymisen maisteriohjelma
Opintosuunta: Ihmisen ravitsemus
Tekijä: Sonja Leivo
Työn nimi: Yhteydet 10–14-vuotiaiden lasten syömisen taidon, ruokavaliotyylien ja ruokavalion laadun välillä
Työn laji: Maisterintutkielma
Aika: Toukokuu 2025
Sivumäärä: 50 (+11)
Avainsanat: syömisen taito, ruokavalion laatu, sosioekonominen asema, lapset
Ohjaajat: Reetta Lehto, Henna Vepsäläinen, Jenna Rahkola
Missä säilytetään: HELDA – Helsingin yliopiston digitaalinen arkisto
Tiivistelmä:
Syömisen taidon ja ruokavalion laadun välisten yhteyksien tarkastelu auttaa tunnistamaan mahdollisia keinoja terveellisten ruokailutottumusten edistämiseksi. Näyttö lasten syömisen taidon ja ruokavalion laadun välisistä yhteyksistä on rajallista. Tässä tutkielmassa tarkasteltiin 10–14-vuotiaiden lasten syömisen taidon, ruokavaliotyylien ja ruokavalion laadun välisiä yhteyksiä. Lisäksi tutkittiin, miten huoltajien sosioekonominen asema on yhteydessä lasten syömisen taitoon. Tässä poikkileikkaustutkimuksessa käytettiin aineistoa DAGIS Next tutkimuksesta. Otos koostui 223 lapsesta ja heidän perheistään. Syömisen taitoa arvioitiin 16-kohtaisella Satter Eating Competence Inventory -työkalulla. Lasten ruoankäyttöä arvioitiin ruoankäyttökyselyllä (Food Frequency Questionnaire, FFQ), josta pääkomponenttianalyysin avulla löydettiin kaksi ruokavaliotyyliä. Ruokavalion laatua arvioitiin Healthy Food Intake Index:llä (HFII), joka rakennettiin 33 FFQ-rivin avulla. Sosioekonomista asemaa mitattiin perheen korkeimman koulutustason ja suhteellisen kotitaloustulon avulla. Syömisen taidon, ruokavalion ja perheen sosioekonomisen aseman välisiä yhteyksiä tutkittiin lineaarisella regressioanalyysillä, Kruskal-Wallis-testillä ja Khiin neliö -testillä. Tulokset osoittivat, että syömisen taito oli positiivisesti yhteydessä terveystietoiseen (Health-conscious) ruokavaliotyyliin (B=0.045, 95 % LV 0.024, 0.064, p<0.001) ja HFII:iin (B=0.120, 95 % LV 0.074, 0.165, p<0.001) sekä käänteisesti yhteydessä lihaa ja satunnaisia herkkuja (Meat-and-discretionary-foods) painottavaan ruokavaliotyyliin (B=-0.033, 95 % LV -0.055, -0.011, p=0.01). Sosioekonominen asema (vanhempien koulutustaso ja suhteellinen kotitaloustulo) ei ollut yhteydessä lasten syömisen taitoon. Yhteenvetona voi todeta, että korkeampi syömisen taito oli yhteydessä terveellisempään ruokavalioon. Päiväkotien ja koulujen tulisi vahvemmin sisällyttää syömisen taito osaksi ravitsemuskasvatusta ja korostaa sen merkitystä lasten terveyden edistämisessä.

Acknowledgements and the student's contribution

This thesis was conducted as part of the DAGIS project, using data from the DAGIS Next follow-up study conducted in 2023. I was not involved in the data collection but received clean data with relevant variables and created additional variables necessary for the analyses. Based on the food frequency data, I constructed the Healthy Food Intake Index for the analyses. The two dietary patterns used in this thesis I received as ready variables, so I did not conduct the Principal Component Analysis myself. With guidance from my supervisors, I performed statistical analyses to answer my research questions. Additionally, I utilized artificial intelligence (ChatGPT) to help with statistical analyses, rephrasing, and improving the language and clarity of sentences. After using this tool, I have reviewed and edited the content as needed and I take full responsibility for the content of the whole thesis.

Finally, I wish to jointly express my greatest appreciation to my supervisors – Reetta Lehto, Henna Vepsäläinen, and Jenna Rahkola – for their invaluable support and guidance throughout this thesis project.

Abbreviations

CEBQ	Children's Eating Behavior Questionnaire
EC	Eating Competence
ecSatter	Satter Eating Competence Model
ecSI	ecSatter Inventory
FFQ	Food Frequency Questionnaire
HFII	Healthy Food Intake Index
SES	Socioeconomic status

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1 Introduction

Humans make hundreds of food choices daily, which are influenced by a range of personal, social, cultural, environmental, and economic factors (1). Eating behavior is comprised of these food choices, as well as feeding practices, dieting, and eating-related problems. People's food choices are influenced by more than just physiological needs and nutritional requirements, even though satisfying hunger and the need for satiety are the principal factors influencing people's eating behavior (2). Eating also has a strong emotional aspect since food is deeply connected to traditions, culture, and social environments. Additionally, emotional eating guides people to adjust their food choices based on their emotional state or temporary mood. The research on determinants of eating behavior largely focuses on the intraindividual factors, which include physiological processes, such as hunger, satiety, and innate preference for sweet foods, and psychological processes, such as learned food preferences, attitudes, personality traits, and self-regulation (1). In addition to the intraindividual factors, social, physical, and macro-level environments impact food choices and eating behavior. Eating behavior is a crucial aspect of life since the types and amounts of foods people eat considerably affect their health.

Eating competence is one framework that explains the connections between eating attitudes and behaviors, and it acknowledges the complexity of maintaining access to adequate amounts of various nutritious foods (3). The heart of eating competence is that if given proper attention, the internal cues of hunger, appetite, and satiety are trustworthy and can effectively guide food selection, support energy balance, and help regulate body weight. Eating competence has primarily been studied in adults, where higher eating competence has been associated with several health-promoting behaviors, such as higher consumption of fruits and vegetables, better adherence to the Mediterranean diet, higher physical activity levels, and better sleep quality (4). Eating competence has also been associated with positive feeding practices of parents when providing meals for their children. However, there remains a gap in research specifically measuring eating competence in children and adolescents.

This Master's thesis examines two key aspects related to children's eating competence. First, it examines the relationship between children's eating competence and their dietary habits. Proper nutrition during childhood, starting already from the first 1000

days of life, is crucial since it affects the child's growth and future development of diseases (5). Improper nutrition and inadequate physical activity can expose children to overweight, while genetics also play a role (6). In Finland, children's and adolescents' overweight and obesity is a problem. In 2023, the prevalence of overweight (ISO-BMI ≥ 25 kg/m^2) in 2–16-year-old Finnish boys and girls was 43 % (7). Children experience the same overweight-caused disorders as adults and overweight and obesity in childhood and adolescence often persist into adulthood, which is why it's important to treat children's overweight (6). Early dietary experiences can shape and influence the child's future nutritional preferences and affect consumption patterns throughout childhood (5).

As children approach adolescence, their independence increases, granting them more freedom and control over their food choices (8). During this period, eating patterns may shift for several reasons, for example, social pressure, media trends, animal rights concerns, and beliefs about the healthiness of certain food groups. Dietary patterns and food choices formed during childhood and adolescence often persist into adulthood (9). Given that and the significance of nutrition and eating habits in growth, development, and overall health, it is important to start learning healthy eating habits from childhood. However, good nutrition is not only about nutrient intake and "right" or "wrong" choices: developing a flexible relationship with food where eating is varied and doesn't cause shame or guilt is equally important (10,11).

Secondly, this thesis explores the relationship between eating competence and socioeconomic status (SES). In the literature, higher SES, reflected in factors such as education and income, has been associated with higher eating competence in adults (12). Similarly, children from higher socioeconomic backgrounds tend to engage in more health-promoting behaviors than those from lower socioeconomic backgrounds (13). This may be because children and adolescents with high parental SES have greater access to education, stable housing, nutritious food, clothing, and health and social services, all of which enhance self-confidence, self-esteem, and self-efficacy, ultimately supporting a healthier lifestyle. Based on these findings, it is reasonable to assume that children from higher parental socioeconomic backgrounds may also demonstrate higher eating competence compared to their peers from lower socioeconomic backgrounds.

2 Literature Review

2.1 Eating competence

Eating competence reflects a positive relationship with food and eating, including the ability to meet nutritional needs while maintaining flexibility and enjoyment (3). The following sections aim to provide a comprehensive overview of eating competence by exploring its background, assessment, and relations to other eating behavior concepts.

2.1.1 Background of the eating competence model

The Satter Eating Competence Model (ecSatter) is an evidence- and practice-based model but not based on one specific theoretical framework. However, there are some core foundations that lay the groundwork for the concept, one of them being biopsychosocial processes (3). The biopsychosocial model combines three aspects: biological, psychological, and social factors, which together help to understand mental and physical health (14). In the context of ecSatter, this means the tendency to maintain stable and preferred body weight, hunger and the drive for survival, as well as appetite and the desire for pleasurable experiences (3). These are more of the biological and psychological sides but are influenced and shaped by the social environment, such as social support and culture (14).

Even though one can change their eating attitudes and behaviors as an adult, the basis for eating competence is already created in childhood through structure and autonomy, a positive and varied food environment, and modeling behavior (3). Eating competence is rooted in the idea that eating is a learned behavior. Caregivers (and other adults) have a key role in shaping children's eating behaviors by providing structure, being responsible for selecting suitable foods, and offering them in a way that the child can easily handle while following the child's lead in regulating food intake and timing (15). Thus, as proposed by Satter, the parent is responsible for the *what*, *when*, and *where* of feeding, and the child is responsible for the *how much* and *whether* of eating (3). Slowly, in an ideal situation, with help from their parents and other adults, children start to develop attitudes toward eating, learn to enjoy available foods, regulate their food intake by listening to internal cues, and, as they grow older, navigate their eating environment independently.

Eating competence is composed of four dimensions – Eating Attitudes, Food Acceptance, Internal Regulation, and Contextual Skills – all of which contribute to how eating-competent an individual is (3). Figure 1 illustrates these dimensions and they are covered in this section.

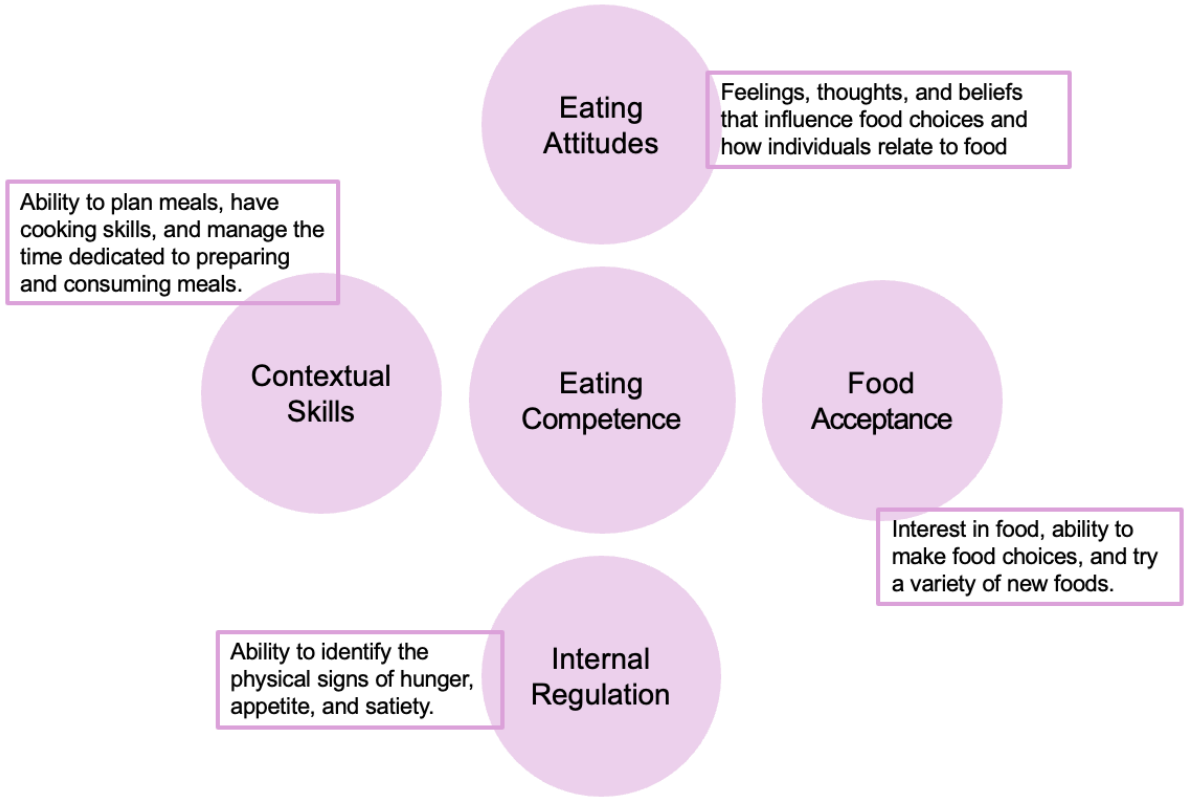

Figure 1. The four components of eating competence (revised from (4)).

Eating Attitudes are about having positive, relaxed, comfortable, and flexible attitudes towards eating, which supports nutritional health and allows awareness of both outer and inner eating experiences (3). Emotions influence eating behavior, typically by increasing or decreasing food intake (16). Since eating is deeply tied to the earliest experiences and the social and emotional responses they create, eating with self-awareness can be emotionally powerful and even upsetting (3). Emotional responses to food and eating experiences influence what attitudes individuals have about eating. Eating Attitudes also include being trusting of feelings: accepting and enjoying the pleasure of eating and the experience of satiety. Eating is powerfully rewarding because it relieves the pain of hunger. However, for some, this might cause feelings of shame and worry instead of being something to celebrate.

Eating competence aims at avoiding nutritional criticism and restrictive behaviors: all foods are accepted, even the ones considered “unhealthy” (17). Food Acceptance is

about being calm and comfortable around food, including unfamiliar or disliked ones, and being open to trying new foods and learning to like them (3). When thinking about how eating competence possibly affects food consumption and, therefore, dietary quality, one good example is from the study by Aittola and colleagues (18). The study was an intervention aiming to enhance eating competence among adults with a heightened risk for type 2 diabetes. The authors observed that improvement in the total eating competence score increased the consumption of fruits and vegetables, fish and meat, as well as snacks and treats. The fact that the consumption of all of these different food groups, considered both healthy and unhealthy, increased, could indicate a change in food acceptance towards a more permissive and relaxed way of eating.

The biological side of eating competence is highlighted, especially in paying attention to and responding to the internal cues of hunger, appetite, and satiety, which ecSatter refers to as Internal Regulation (3). Listening to the body's cues also helps individuals maintain a body weight that is naturally suitable for them and supports optimal health.

Meals are important since they give structure and reassurance that you will be fed (17). Family meals, especially, are emphasized in eating competence and are part of the fourth dimension, Contextual Skills. While eating competence stresses family meals, it also acknowledges the importance of structure for singles and adults with no children. Regular meals not only ensure consistent food intake but also create chances to connect with other people and offer an opportunity to tune in on oneself. Family meals are important for children and adolescents to connect with their family, but also considering dietary habits. Higher family meal frequency has been associated with healthier dietary patterns, such as higher consumption of fruits and vegetables and lower consumption of fried foods, soda, and other sweetened beverages in 6–14-year-old children and adolescents (19,20). In addition to family meals, Contextual Skills cover the skills and resources to obtain and provide satisfying food at regular times, paying attention to food and oneself during meals, and being able to manage the time and priorities to create space for eating (3).

2.1.2 Assessment of eating competence

The Eating Competence Satter Inventory (ecSI) is a tool used to assess the four components of eating competence through 16 statements (Table 1) (17). The respondent denotes a level of agreement for each statement as always, often,

sometimes, rarely, or never, which are scored with 3, 2, 1, 0, and 0 points, respectively, and summed up so that the total score ranges from 0 to 48 points (21). The scoring follows the rationale of Garner (22). Respondents with a score of 32 points or higher are considered eating-competent. The cutoff value is based on clinical expertise (21).

Table 1. Statements in the Eating Competence Satter Inventory (ecSI) (21).

Eating competence component	Statement
Eating Attitudes	I am relaxed about eating.
	I am comfortable about eating enough.
	I enjoy food and eating.
	I am comfortable with my enjoyment of food and eating.
	I feel it is okay to eat food that I like.
Food Acceptance	I experiment with new food and learn to like it.
	If the situation demands, I can “make do” by eating food I don’t much care for.
	I eat a wide variety of food.
Internal Regulation	I assume I will get enough to eat.
	I eat as much as I am hungry for.
	I eat until I feel satisfied.
Contextual Skills	I tune in to food and pay attention to myself when I eat.
	I make time to eat.
	I have regular meals.
	I think about nutrition when I choose what I eat.
	I generally plan for feeding myself. I don’t just grab food when I get hungry

The ecSI has been developed in English, translated into several languages, and its validity has been examined (12,21,23–26). Construct validity refers to the extent to which a test accurately measures the concept it was designed to measure (27). The construct validity of the ecSI was assessed in a study by Lohse and colleagues (21), in which the responses from ecSI were compared with several other validated instruments, such as the Three-Factor Eating Questionnaire (28), the Eating Disorders Inventory-2 (22), a Food Preference Survey (29), a fruit and vegetable Stage of Change algorithm (30), and Expanded Food and Nutrition Education Program questions (31). Additionally, self-reported weight and height and questions about food preparation practices, physical activity, and demographics were asked (21). All of the questionnaires were administered simultaneously as a survey booklet, placing the ecSI

either first or last to control for an order effect of completion. In total, 863 adults (men and women) completed the survey online or as a paper survey. The results showed that eating-competent individuals had less restrained eating, hunger, food dislikes, weight dissatisfaction, and drive for thinness, and, on the other hand, higher physical activity and stage of change for fruit and vegetable consumption, and increased food preparation. Thus, the authors concluded that the construct validity of the ecSI seems acceptable.

One measure to assess the reliability of a tool is test-retest reliability (32). It measures the consistency of the results when the same test on the same sample is repeated at different time points. Stotts and Lohse assessed the test-retest reliability of the ecSI in their study, where 259 adults in the United States completed the ecSI questionnaire two times so that the time between the first and second questionnaire was two to six weeks (33). With the ecSI, demographic information, food security, self-reported height and weight, as well as measures of dietary behavior were also collected. Test-retest reliability was assessed with Spearman's rank correlation coefficient (rho, r_s), and coefficients approaching 0.70 were considered acceptable. The results showed that test-retest reliability was evident for the total ecSI scale (r_s=0.68) and the three subscales: Eating Attitudes (r_s=0.70), Food Acceptance (r_s=0.65), and Contextual Skills (r_s=0.70), but the reliability for the Internal Regulation subscale was low (r_s=0.52). However, the findings were sufficient to state that ecSI was a reliable tool in the study sample, and with revision of some of the ecSI items, it could be used to assess nutrition education aimed at enhancing eating competence.

The eating competence assessment tool has evolved through the years (Appendix 1). Even though validity has been found acceptable in one population, the tool may not work as expected in a different type of population, which is why the applicability of the original ecSI was tested in a small sample of low-income women (18–49-year-olds, N=25) through two rounds of cognitive interviews (34). During the first interview round, four of the 16 statements of the original ecSI were misinterpreted due to reasons such as clarity and wording. The misinterpreted statements were revised and combined with the 12 original, unaltered statements, and tested again. In the second interview round, the alternate versions of the four items provided a better fit between participant comprehension and the intended item meaning. The modified instrument was named ecSI for Low-Income (ecSI/LI) and its validity was assessed in a bigger

sample of low-income females (18–45-year-olds, N=507) (35). The authors found the construct validity of the ecSI/LI acceptable and showed that eating competence was positively associated with physical activity, fruit and vegetable intake, and meal planning and negatively associated with body mass index, dissatisfaction with body weight, and attributes related to disordered eating

Later, Lohse examined whether the ecSI/LI could also be used in persons not identified as low-income and could thus replace the original ecSI (36). Both ecSI and ecSI/LI were filled out by 21–53-year-old adults. The analyses showed that the scores on both versions of the instrument highly correlated with each other, suggesting that ecSI/LI can be used as a measure to assess eating competence also in persons of higher socioeconomic positions. Thus, ecSI/LI evolved to the Satter Eating Competence Inventory 2.0 (ecSI 2.0). Finally, Godleski and colleagues further assessed the structural validity of the ecSI 2.0 in a demographically heterogeneous sample (37). Based on a confirmatory factor analysis, the statement *I trust myself to eat enough for me* was moved from the Internal Regulation subscale to the Eating Attitudes subscale in ecSI 2.0. The current, most recently updated instrument, ecSI 2.0™, still consists of 16 statements and four subcomponents, but the place of one statement and the wording of several statements have changed throughout the different versions of the ecSI.

The target group of this thesis is children, but the amount of data on eating competence in children and adolescents is limited. Tilles-Tirkkonen and colleagues were the first to examine eating competence in adolescents (25). In addition to looking at the associations between eating competence and food selection, meal patterns, and psychobehavioral factors in 10–17-year-old Finnish adolescents, they examined the utility of a preliminary Finnish translation of the ecSI 2.0 as well as its construct validity. Confirmatory factor analysis indicated an acceptable model fit and showed that all four components correlated with each other and had high internal consistency. This suggests acceptable construct validity for the Finnish translation of the ecSI 2.0 among Finnish adolescents. Additionally, a study conducted by Claes and colleagues in Belgium examined the construct validity (in relation to eating disorder measures) and reliability of the Dutch translation of the ecSI 2.0™ in adolescents (13–16-year-olds) and emerging adults (17–21-year-olds) (26). Again, confirmatory factor analysis indicated a good model fit and intercorrelation. The reliability of the total scale, Eating Attitudes, Food Acceptance, Internal Regulation, and Contextual Skills subscales was

acceptable to excellent (Cronbach's α coefficients 0.91, 0.91, 0.69, and 0.80, respectively). Finally, all of the subscales and the total eating competence score showed large negative correlations with eating disorder symptoms, such as drive for thinness, bulimia, and body dissatisfaction. These two studies conducted in adolescent samples used the same cutoff value (score of 32 points) for eating-competent/not-eating-competent individuals, which has been used in adult populations, to allow comparison with other studies on eating competence (25,26). However, Tilles-Tirkkonen and colleagues pointed out that future studies should determine whether the cutoff value is suitable for adolescents (25).

Tilles-Tirkkonen and colleagues, as well as Claes and colleagues, found associations between adolescents' eating competence and health-promoting eating patterns, body mass index, eating disorder symptoms, and identity confusion (25,26). The findings of these two studies indicate that the ecSI tool could be appropriate and useful also in the adolescent age group.

2.1.3 Relations to other eating behavior concepts

Eating behaviors similar to eating competence are intuitive and mindful eating. Intuitive eating has three central characteristics: unconditional permission to eat whenever hungry and whatever food is desired, eating for physical reasons rather than emotional ones, and relying on internal hunger and fullness cues to decide when and how much to eat (38). Mindful eating refers to being non-judgmentally aware of both physical and emotional sensations while eating or being in a food-related environment (39). All of these three concepts are fairly overlapping and share similar themes, for example, being aware of the body's cues and sensations while trusting and honoring them, focusing on and prioritizing internal motivations for eating, and honoring health and the body (40). All of these behaviors are weight-neutral; that is, they are not defined by weight or body composition and do not focus on trying to change them.

While there are not a lot of differences between these eating behavior concepts, overall, eating competence is perhaps a broader framework compared to intuitive and mindful eating. Intuitive eating focuses on eating in response to internal cues, and mindful eating focuses on being present during eating (38,39). However, in addition to these, eating competence also acknowledges the importance of structured eating and regular mealtimes to ensure that all nutritional needs are met. Discipline and permission go

hand-in-hand in eating competence; positive discipline maintains structure, ensuring reliable and consistent access to food, while permission supports choosing preferred foods and eating them in amounts that satisfy hunger and appetite (3).

As the target group of this thesis is children and the amount of studies on children's eating competence is very low, it is reasonable to look into other tools that measure eating behavior in children. One of these tools is the Children's Eating Behavior Questionnaire (CEBQ). The CEBQ is a 35-item questionnaire designed to assess eating styles in young children (41). The CEBQ is constructed of statements in eight dimensions of eating styles, four of which measure food approach behaviors: Food Responsiveness, Enjoyment of Food, Emotional Overeating, and Desire to Drink, and the other four, which measure food avoidant behaviors: Satiety Responsiveness, Slowness in Eating, Emotional Undereating, and Food Fussiness (42). Food avoidant behaviors are linked to restricted food intake and eating-related emotional or psychological challenges: they assess the sensitivity to internal cues of fullness (Satiety Responsiveness), slow eating pace (Slowness in Eating), reduced eating in response to negative emotions (Emotional Undereating), and the selectivity of accepted foods (Food Fussiness). The food approach scale is linked to greater appetite and stronger appetite regulation, enjoyment of food, and emotional balance: it assesses the sensitivity to external food cues (Food Responsiveness), interest and pleasure in eating (Enjoyment of Food), increased eating in response to negative emotions (Emotional Overeating), and requests for drinks (Desire to Drink). Preliminary correlation analyses showed that the "positive" food approach subscales tended to intercorrelate positively and correlate negatively with the "negative" food avoidant subscales, pointing to sufficient internal consistency (41). Originally, it was intended for parents to complete the CEBQ regarding their child's typical eating behaviors, but later, the questionnaire was also modified for adolescents to self-report (41,42).

While there are no studies examining the relationship between CEBQ and eating competence, there are similarities in the contents of the dimensions. In both, eating behavior is understood through factors such as enjoyment (*I enjoy food and eating* (EC); *I love food* (CEBQ)), self-regulation (*I eat until I feel satisfied* (EC)*; I have a big appetite* (CEBQ)), emotional influences (*I am relaxed about eating* (EC)*; I eat more when I'm worried* (CEBQ)), and food variety (*I eat a variety of food* (EC)*; I enjoy a variety of foods* (CEBQ)). The CEBQ is perhaps more specific and addresses problems

in eating patterns while eating competence is more of a holistic approach aiming at promoting positive eating habits. The CEBQ will be examined in relation to children's dietary quality later in chapter 2.3.

2.2 Eating competence and socioeconomic status

SES refers to the levels of economic resources, power, and prestige, which are all closely associated with an individual's, a community's, or a country's wealth (43). Socioeconomic factors include, for example, education, income, employment status, food security, and housing security. This chapter mostly focuses on education and income. SES is one of the strongest and most consistent predictors of an individual's morbidity and mortality (44). People with lower SES have higher risks for non-communicable diseases, such as cardiovascular disease and type 2 diabetes (44–46). SES also affects food purchasing behavior and dietary intake: individuals in lower socioeconomic positions are more likely to purchase foods low in fiber and high in fat, salt, and sugar and to not meet dietary recommendations (47,48).

The associations between SES and eating competence in adults have not been extensively studied. However, many studies about eating competence also consider some socioeconomic factors, especially education. In several studies among adults, conducted mainly in Western countries, higher education levels have been associated with higher eating competence (12,49–54). Similarly, higher income levels have been associated with higher eating competence (12,50,51,53). On the other hand, there have also been studies where no association between eating competence and education or income level was observed (55–57). Table 2 exhibits these findings. Higher levels of education can be associated with better knowledge of food and eating and, thus, higher eating competence (54). Higher educated people are also more likely to use online resources to search for health information and may thus have more awareness regarding food and eating (53).

Several studies have shown that participants with higher income are more often eating-competent or in general have higher eating competence scores (12,50,51). Thus, the ability to achieve eating competence may be affected by income constraints. Among low-income adults, eating competence was associated with decisional factors that guide meal and snack planning and nutrition- and health-related topics that are of interest (55). For both competent and not-competent eaters, convenience, mood,

family, and availability of food at home were factors that guided meal and snack planning the most. A noticeable difference between competent and not-competent eaters was that 12 % of the latter group highlighted weight management (including dieting and weight loss) as a guiding factor for meal planning, while none of the eating-competent participants mentioned the same. Weight management was also a more interesting nutrition- and health-related topic for not-competent eaters compared to competent eaters, who were more interested in specific nutrients and cooking. SES in general probably has something to do with the weight management interest because studies have found that lower SES is associated with a higher prevalence of overweight and obesity in both adults and children (58). However, even in a low-income population, there was a clear difference in the weight management interest between eating-competent and not-eating-competent individuals (55). This indicates that most likely there is an association between eating competence and the acceptance of body weight.

Table 2. Associations between socioeconomic status (SES) and eating competence (EC).

Reference	Study design	Sample	Measured socioeconomic factor(s)	Main results
Carbonneau et al. (12) 2024 Canada	Cross-sectional	19–74-year-olds N = 424	Education Income	Higher education level and higher household income were associated with being a competent eater.
de Oliveira et al. (57) 2022 Brazil	Cross-sectional	≥ 19-year-olds N = 1030	Education Income	Education and income levels were not associated with EC score.
Dusi et al. (53) 2023 Brazil	Cross-sectional	~37-year-olds N = 549	Education Income	Higher income and higher education levels were associated with higher EC scores.
Krall & Lohse (55) 2009 USA	Cross-sectional	~31-year-olds N = 70	Education	Education level was not associated with EC score.
Krall & Lohse (35) 2011 USA	Cross-sectional	18–45-year-olds N = 507	Education	Education level was not associated with EC score.
Kravets et al. (52) 2022 USA	Longitudinal cohort	18–24-month-olds[a] N = 288	Education	Lower education was associated with being not-eating-competent.
Lee et al. (54) 2017 Taiwan	Cross-sectional	65–76-year-olds N = 564	Education	High school or a higher level of education was associated with higher EC scores.
Lohse et al. (49) 2010 Spain	Cross-sectional	55–83-year-olds N = 638	Education	Formal education was associated with higher EC score.

Table 2. Continues

Reference	Study design	Sample	Measured socioeconomic factor(s)	Main results
Quick et al. (56) 2015 USA	Cross-sectional	18–24-year-olds N = 1035	Education (study year)	The study year (freshman, sophomore, junior, senior) was not associated with EC score.
Queiroz et al. (50) 2020 Brazil	Cross-sectional	≥ 18-year-olds N = 1810	Education (schooling level) Income	Higher education level and higher family income were associated with higher EC scores.
Tilles-Tirkkonen et al. (51) 2019 Finland	Cross-sectional	18–74-year-olds N = 3147	Education Income	Higher education level and annual household income were associated with higher EC score.

[a] The study examined caregivers of toddlers. However, the age of the examined children is presented since the age of the caregivers was not reported.

There were somewhat conflicting results on whether SES is associated with eating competence in adults. However, no literature was found where the relationship between SES and eating competence would have been examined in children. Children learn from their parents and other adults and “inherit” their traits, habits, and behaviors. Thus, it could be presumed that eating competence scores would also be lower in children from lower socioeconomic backgrounds.

2.3 Eating competence and health

Eating competence has been examined in relation to several different health outcomes, such as physical activity, sleep, body perception, disordered eating, body mass index, food consumption, and dietary quality. Body perception, disordered eating, and body mass index are shortly discussed first, and then more focus is put on food consumption and dietary quality. As mentioned, the focus of this thesis is on children, but eating competence in children and adolescents has not been studied a lot. This chapter will emphasize the studies that have examined the relationship between eating competence and health-related behaviors and outcomes in children and adolescents but the majority of the examples are studies done on adults. In section 2.3.2, the CEBQ is examined in relation to children's dietary quality.

2.3.1 Body perception, disordered eating, and body mass index

Body perception

Many people, but especially women, are prone to body dissatisfaction and disordered eating (59). It appears that women who do not receive unconditional acceptance from others in their environment habitually monitor their appearance and strive towards an ideal version of themselves. In contrast, women who feel accepted may be less preoccupied with changing their outer appearance and focus more on how they feel and function. Body perception refers to thoughts and feelings about one's physical appearance (60). Eating competence has been associated with body and weight perception in adolescents: Tilles-Tirkkonen and colleagues observed that eating-competent adolescents perceived their body size as appropriate more frequently than not-eating-competent adolescents, who, on the other hand, more frequently perceived their body somewhat or too fat, even though there were no differences in the weight status between the two groups (25). Aligned results have been observed in adult populations, where individuals with higher eating competence were more likely to be satisfied with their weight and body compared to not-eating-competent individuals, who more often reported weight and body dissatisfaction (21,35,50,61).

It has been demonstrated that instead of weight itself, perceived body weight is, in fact, a better predictor of dieting-related behaviors (62). This is related to the fact that in adults, especially among women, dieting is often unrelated to body fatness, and even

lean women may want to lose weight to enhance their appearance. The dieting behavior is primarily defined by attempts to lose weight, which lead to changes in eating habits (61). This is further related to eating competence and indicates why individuals who desire to lose weight often are not-eating-competent. Additionally, weight status is often misclassified so that individuals perceive themselves as over- or underweight when, in fact, they are of normal weight (according to body mass index) (62–64). More often, girls overestimate, and boys underestimate their weight status, which perfectly reflects the Western beauty ideals that promote thinness for girls and muscular bodies for boys (64,65).

Disordered eating

Body dissatisfaction increases the risk of eating disorders (66), and eating competence has been associated with eating disorder-related attributes (26,35). Claes and colleagues used the Eating Disorders Inventory-3 (EDI) tool on adolescents and observed that a higher total eating competence score was associated with lower scores on all measures assessing eating disorder symptomatology (Drive for Thinness, Bulimia, Body Dissatisfaction, and Interoceptive Deficits) (26). In an adult sample, Krall and Lohse found that ecSI/LI scores were inversely associated with disordered eating, and all EDI subscales (except for perfectionism) had higher scores in not-eating-competent participants (35). Further, Brown and colleagues observed that college students who reported never having an eating disorder had higher eating competence scores compared to students who reported having a past or current eating disorder (67).

Disordered eating can be linked to weak internal regulation skills (35). Competence in the Internal Regulation component includes, for example, being relaxed with food items varying in energy densities, being able to stop eating when satisfied, and accepting one's body weight (3). However, all of these behaviors are disturbed in different forms of disordered eating (68). Restricting food and striving for weight loss is systematically ignoring and overruling the internal regulators of hunger, appetite, and satiety (3). Food restriction is also related to the Food Acceptance component of eating competence (26). People with disordered eating behaviors are prone to label foods as "good" and "bad" and thus, not accepting a variety of foods. Additionally, being around food may cause anxiety and uncomfortable feelings, which is also against the principles of Food Acceptance.

Body mass index

Body mass index (BMI) is used to evaluate weight status by comparing a person's weight to their height (69). In adults, a BMI between 18.5 and 25 kg/m^2 is considered normal. An adult has overweight if their BMI is equal to or greater than 25 kg/m^2, and obesity if their BMI is equal to or greater than 30 kg/m^2. BMI in children is calculated the same way as in adults but is not comparable as such because children's body proportions change all the time throughout growth and are different from those of adults (70). Therefore, children's BMI is adjusted for age and sex to correspond to adults' BMI (ISO-BMI) or defined as at or above the age- and sex-specific 95th percentile of BMI-for-age growth charts (z-scores) (70,71).

Claes and colleagues found that the total eating competence score and the Eating Attitudes subscale showed small but negative correlations with BMI, meaning that eating-competent adolescents had slightly lower body weight compared to their not-eating-competent peers (26). Additionally, several studies done on the adult population have found that higher eating competence was associated with lower BMI (21,35,49,50,61,72). These studies are all cross-sectional, thus, causality couldn't be established. However, one intervention study by Aittola and colleagues gives small indications of causality, because they found that in adults with an increased risk of type 2 diabetes, an increase in eating competence during intervention was associated with a decrease in BMI, regardless of the baseline eating competence (18).

Table 3 summarizes the evidence of the associations between eating competence and body perception, disordered eating, and BMI.

Table 3. Associations between eating competence (EC) and body perception, disordered eating, and BMI.

Reference	Study design	Sample	Outcome(s)	Main results
Tilles-Tirkkonen et al. (25) 2015 Finland	Cross-sectional	10–17-year-olds N = 976	Body perception	Higher EC score was associated with more frequent perception of an appropriate body size.
Boeira et al. (61) 2023 Brazil	Cross-sectional	≥ 18-year-olds N = 593	Body perception BMI	Lower EC was associated with participant's perception of themselves as overweight, and obesity (according to BMI).
Queiroz et al. (50) 2020 Brazil	Cross-sectional	≥ 18-year-olds N = 1810	Body perception BMI	Higher EC score was associated with good perception of body size, and lower BMI.
Lohse et al. (21) 2007 USA	Cross-sectional	18–71-year-olds N = 832	Body perception BMI	Higher EC score was associated with greater body weight satisfaction and lower BMI.
Brown et al. (67) 2013 USA	Cross-sectional	18–26-year-olds N = 557	Disordered eating	Higher EC score was associated with participants who never had had an eating disorder, compared to participants with past or current eating disorder.
Aittola et al. (18) 2021 Finland	Randomized controlled trial	18–70-year-olds N = 2291	BMI	Increase in EC after 1-year intervention was associated with a decrease in BMI.
Lohse et al. (49) 2010 Spain	Cross-sectional	55–83-year-olds N = 638	BMI	Higher EC score was associated with lower BMI.
Quick et al. (72) 2014 USA	Cross-sectional	18–24-year-olds N = 1252	BMI	Lower EC score was significantly associated with overweight and obesity.

Table 3. Continues

Reference	Study design	Sample	Outcome(s)	Main results
Claes et al. (26) 2023 Belgium	Cross-sectional	13–21-year-olds N = 900	Body perception Disordered eating BMI	Higher EC score was associated with lower scores on all eating disorder-related symptoms, body dissatisfaction being one of them, and a lower BMI.
Krall & Lohse (35) 2011 USA	Cross-sectional	18–45-year-olds N = 507	Body perception Disordered eating BMI	Higher EC score was associated with lower body dissatisfaction, less eating disorder-related attributes, and grater incidence of normal weight.

2.3.2 Food consumption and dietary quality

Food consumption refers to the amount and nutritional value of foods eaten by individuals or households (73). Among Finnish adolescents, higher eating competence has been associated with more frequent consumption of vegetables, fruits, milk or sour milk, porridge, and rye and crisp bread and lower consumption of fast foods, salty and sweet snacks, and energy-containing beverages (25). Similar observations of the associations between eating competence and food consumption have been observed in adults (35,49–51,74). While examining the consumption of certain foods and food groups is important, it is unlikely that it accurately describes the whole diet, which, in the end, is what affects an individual's health.

The whole diet can be evaluated with different theory-based dietary indexes and data-based dietary patterns. Dietary indexes can be based only on intake of nutrients, consumption of foods and/or food groups, or a combination of both (75). Data for an index is typically collected from food frequency questionnaires (FFQ), 24-hour dietary recalls, or food records (76). The two latter provide more precise and detailed information about food consumption, while FFQs assess the diet more broadly and usually from a longer time period (e.g., one month) (77). Some FFQs include specific portion sizes while others do not specify them but use only the consumption frequencies of foods. The dietary index is a sum score of individual food categories, reflecting the frequencies or amounts of foods and/or nutrients consumed (75). Dietary indexes can be used to evaluate dietary quality (78). Oftentimes, dietary quality is used in the literature as an umbrella term to describe how well an individual's diet aligns with the dietary recommendations and how a 'good quality diet' supplies adequate levels of food and nutrients to maintain optimal health. However, the concept of dietary quality is broader and includes aspects of food safety, food diversity, and food preferences that depend on social and cultural backgrounds.

The difference between dietary indexes and patterns is that indexes assess adherence to dietary guidelines, while dietary patterns provide a comprehensive view of an individual's overall dietary habits (76,79). Additionally, dietary patterns don't assess dietary quality as directly as dietary indexes. Dietary pattern refers to the quantities, proportions, variety, or combination of foods and drinks an individual habitually consumes (79). Dietary patterns can be identified using predefined indexes, data-

driven methods (e.g., principal component analysis, factor analysis, or cluster analysis), or the distribution of nutrients. Dietary patterns are named with descriptive names, such as “healthy”, “Western”, or “sweet”.

In adults, higher eating competence has been associated with higher Healthy Eating Index and Healthy Diet Index scores (18,74) and better adherence to the Mediterranean diet (49). The Mediterranean diet emphasizes foods such as whole grains, legumes, vegetables, fruits, extra virgin olive oil, nuts, seeds, and fish (80). A combination of data from epidemiological, animal, molecular, and human clinical trial studies suggests that the Mediterranean diet may have a protective effect against, for example, major cardiovascular events and certain cancers. Considering dietary patterns, the analyses in the study by Lohse and colleagues among low-income females revealed two dietary patterns: Prudent and Western diets (74). The Prudent diet was characterized by higher consumption of fruits, vegetables, whole grains, the use of fat-reduced products, and fruit juices, while the Western diet was characterized by higher consumption of dietary fat, lower intakes of most vitamins and minerals, and lower dietary quality. The Prudent dietary pattern correlated positively with the eating competence scores, but the Western dietary pattern was not associated with eating competence. In conclusion, when looking both theoretically and data-driven, studies indicate that eating competence is associated with a more healthful diet. However, these studies have been done on adults. In children, the associations could be different because they don’t necessarily have as much freedom to influence their food choices, and also eating habits could be different. On the other hand, as discussed earlier, higher eating competence in children has also been associated with a higher consumption of healthy foods.

Because the number of studies examining the relationship between eating competence, food consumption, and dietary quality in children and adolescents is limited, it is worth looking at another tool assessing children’s eating behavior in relation to diet. The CEBQ was presented already earlier in this literature review, and here, it is shortly examined in relation to children’s dietary quality. Studies using the CEBQ have found that the food avoidant subscales (Satiety Responsiveness, Slowness in Eating, Emotional Undereating, and Food Fussiness) were more often associated with lower dietary quality (measured with different indexes) and the consumption of foods considered unhealthy, such as refined grains and salty snacks (81–83). On the other

hand, the food approach subscales (Food Responsiveness, Enjoyment of Food, Emotional Overeating, and Desire to Drink), were associated with higher dietary quality.

Tarro and colleagues conducted a study on Finnish preschool children aged 2 and 5 years, where they examined the relationship between eating behaviors and dietary quality using a modified version of the Index of Diet Quality (81). The authors observed that Enjoyment of Food was associated with higher dietary quality, while Desire to Drink was associated with lower dietary quality in both 2- and 5-year-olds. The food avoidant dimension was associated with lower dietary quality.

Fox and colleagues examined the associations between food approach and food avoidant eating behaviors and preschool-aged children's dietary quality, using a modified version of the Diet Quality Index (82). Some eating behaviors were associated with diet subcategories. Food Fussiness and Satiety Responsiveness correlated positively, and Enjoyment of Food correlated negatively with the score for refined grains. Food Fussiness correlated negatively with the score for vegetables, and Satiety Responsiveness correlated negatively with the scores for whole fruits and sugar-sweetened beverages. Food Responsiveness and Enjoyment of Food correlated positively with the score for whole fruits. However, no eating behaviors were significantly associated with overall dietary quality.

In a longitudinal study, da Costa and colleagues examined the relationship between eating behaviors and dietary quality (measured with the Healthy Eating Index) in children from 7 to 10 years old (83). They found that children with high Enjoyment of Food and low Food Fussiness at 7 years were associated with a high-quality diet at 10 years, and children with a high-quality diet at age 7 were more likely to have lower Food Fussiness and Satiety Responsiveness at age 10. Out of the eight dimensions, Enjoyment of Food had the most favorable association with dietary quality.

Based on the literature found, in adults and adolescents, higher eating competence was associated with higher consumption of healthful foods and better dietary quality. In children, the food approach behaviors of the CEBQ have been associated with better dietary quality, while the food avoidant behaviors have been associated with lower dietary quality. Table 4 summarizes this evidence.

Table 4. Associations between eating behaviors (EC and CEBQ) and food consumption and dietary quality.

Studies examining eating competence (EC)				
Reference	Study design	Sample	Outcome(s)	Main results
Tilles-Tirkkonen et al. (25) 2015 Finland	Cross-sectional	10–17-year-olds N = 976	Food consumption	Higher EC score was associated with higher consumption of vegetables, fruits, milk/sour milk, porridge, and rye and crisp bread, and lower consumption of fast food, salty and sweet snack, and energy-containing beverages.
Queiroz et al. (50) 2020 Brazil	Cross-sectional	≥ 18-year-olds N = 1810	Food consumption	Higher EC score was associated with more frequent consumption of fruits and vegetables, and lower consumption of artificial juices and soda.
Krall & Lohse (35) 2011 USA	Cross-sectional	18–45-year-olds N = 507	Food consumption	Higher EC score was associated with more frequent consumption of fruits and vegetables.
Lohse et al. (74) 2012 USA	Cross-sectional	18–50-year-olds N = 149	Dietary patterns Dietary quality	Higher EC score was positively associated with the Prudent dietary pattern but not associated with the Western dietary pattern. Higher EC score was associated with higher Healthy Eating Index scores.
Aittola et al. (18) 2021 Finland	Randomized controlled trial	18–70-year-olds N = 2291	Dietary quality	Higher EC score after the intervention was associated with a higher Healthy Diet Index score.
Tilles-Tirkkonen et al. (51) 2019 Finland	Cross-sectional	18–74-year-olds N = 3147	Food consumption	Higher EC score was associated with more frequent consumption of fruits, vegetables, nuts and seeds, and vegetarian dishes.
Lohse et al. (49) 2010 Spain	Cross-sectional	55–83-year-olds N = 638	Food consumption Dietary quality	Higher EC score was associated with higher fruit intake and the consumption of fish, lower consumption of dairy products, and better adherence to the Mediterranean diet.

Table 4. Continues

Studies using the Children's Eating Behavior Questionnaire (CEBQ)				
Reference	Study design	Sample	Outcome(s)	Main results
Tarro et al. (81) 2022 Finland	Longitudinal cohort	2- and 5-year-olds N = 1433	Dietary quality	Food approach subscale Enjoyment of Food was positively associated with higher dietary quality, and subscale Desire to Drink and the food avoidant dimension were associated with lower dietary quality in both age groups.
Fox et al. (82) 2024 USA	Cross-sectional	2–5-year-olds N = 61	Dietary quality	No eating behaviors were associated with overall dietary quality. Food avoidant subscales were more often associated with lower dietary quality and the food approach subscales were associated with higher dietary quality.
Da Costa et al. (83) 2022 Portugal	Longitudinal prospective cohort	From 7 to 10 years N = 3879	Dietary quality	High Enjoyment of Food and low Food Fussiness at 7 years were associated with a high-quality diet at 10 years. Children with a high-quality diet at age 7 were more likely to have lower Food Fussiness and Satiety Responsiveness at age 10.

2.3.3 Summary

This literature review has demonstrated that eating competence has been mainly studied in adults and that there is a lack of evidence measuring eating competence specifically in children and adolescents. The studies examining eating competence have mostly been cross-sectional, and thus, they can't establish if there is a causal relationship between eating competence and the measured outcome, for example, dietary quality.

In adults, higher SES was often associated with higher eating competence (12,49–54). Parental SES may be associated with children's eating competence, but this couldn't be confirmed because of the lack of research.

In both adults and adolescents, higher eating competence has been associated with a more positive perception of body weight and size (21,25,26,35,50,61) and lower eating disorder-related attributes, such as drive for thinness and bulimia (26,35,67). Higher eating competence has also been associated with lower BMI, in general, or being more often in the normal BMI range (18,21,26,35,49,50,61,72).

Children's dietary quality has been examined in relation to their behavior, measured with other tools, for example, the CEBQ, where food approach behaviors were associated with higher dietary quality (81–83). Only one study was found that examined the relationship between children's eating competence and food consumption (25). In the study, higher eating competence was associated with higher consumption of healthy foods.

3 Aims and Objectives

To fill in the research gaps presented in the literature review, the main aim of this Master's Thesis was to examine the associations between 10–14-year-old children's eating competence and whole diet. Additionally, the aim was to examine how caregivers' SES is associated with their child's eating competence.

Research questions:

1. How is children's eating competence associated with their dietary patterns and dietary quality?
2. How is a caregiver's educational level and income associated with their child's eating competence?

Based on the found literature, the hypothesis is that children with higher eating competence scores have healthier dietary patterns and better dietary quality (when measured with the HFII) compared to children with lower eating competence scores. We also hypothesized that children of caregivers with higher SES have higher eating competence scores compared to children of caregivers with lower SES.

4 Materials and Methods

4.1 Study design and participants

This cross-sectional study used data from the DAGIS Next follow-up study, which is a joint project between the University of Helsinki and the Folkhälsan Research Center. The data collection was conducted in the spring of 2023. All families from the DAGIS Survey (84) who consented to future contact and provided contact information were invited to the eight-year follow-up study. Out of the 864 participating children in the DAGIS Survey, 703 were invited to the DAGIS Next study. Consenting children (N=269, 38 %) were 10 to 14 years old at the time of data collection. During the DAGIS Survey, the participants lived in eight Southern and Western Finland municipalities. During the DAGIS Next data collection, some had moved elsewhere but many families still lived in the same municipalities.

Participating children and their caregivers were asked to fill out a first caregiver's, a child's, a child-caregiver's, and a second caregiver's (if the child had two caregivers) questionnaires online or on paper. The questionnaires were available in Finnish and in Swedish. A total of 202 children answered the child's questionnaire in Finnish, while 18 completed it in Swedish. For the child-caregiver questionnaire, 200 participants answered in Finnish and 16 in Swedish. Not all variables from the questionnaires were used, but only the ones relevant to this study were selected. These variables were retrieved from the first three questionnaires and compiled the final data. In total, 223 (83 % of the consenting participants) children and their families participated in the study and provided at least some child-related data (the child's questionnaire and/or the child-caregiver's questionnaire).

4.2 Ethical considerations

Informed consent forms were obtained from the participating children as well as their caregivers. Participating in the study was voluntary, and participants had the right to withdraw from the study at any point without giving a reason or facing any consequences. The study followed ethically acceptable principles based on the Declaration of Helsinki, the UNESCO Guidelines for Biological and Medical Research, and the Finnish Code of Conduct for Research Integrity.

The study burden mainly consisted of the time spent filling in the questionnaires. The participants could fill in the questionnaires in several stages, thus being less burdening at once. Especially the children's questionnaire focused on clear language and ease of the questions.

The data was collected using identification (ID) numbers. Because the DAGIS Next is a joint project, the data is stored partly by the University of Helsinki and partly by the Folkhälsan Research Center. All data is stored in password-protected servers. Only the members of the research group have access to the research material.

The University of Helsinki Ethical Review Board in Humanities and Social and Behavioral Sciences stated that the DAGIS Next study was ethically acceptable in January 2023 (Statement number 6/2023).

4.3 Measures

Eating competence

Children's eating competence was assessed with the Finnish translation of the original ecSI (Appendix 2). The ecSI consisted of 16 statements, to which the children denoted a level of agreement: never, rarely, sometimes, often, always. These answer options were scored with 0, 0, 1, 2, and 3 points, respectively, and summed up together to create the total eating competence score (maximum score of 48 points). The construct validity of the ecSI tool has been found acceptable in studies done on Finnish and Flemish adolescents (25,26). Thus, the original ecSI tool was also used in the DAGIS Next study among 10 to 14-year-olds.

The child answered the ecSI alone. Of the 223 participants, 220 (99 %) filled in the child's questionnaire. Out of these, two participants (0.9 %) did not answer the ecSI at all, and 13 participants (5.8 %) had one or two missing items. When counting the sum variable for the total eating competence score for participants who had one or two missing items, the scores for the missing statements were given as the average of the answered statements. Thus, finally, the total eating competence score was calculated for 218 participants (98 % of the participants). Based on the total eating competence score, a dichotomized variable indicating eating competence was constructed: not-eating-competent (< 32 points) and eating-competent (≥ 32 points) participants. This

cutoff value has been consistently used in both adult (21) and adolescent (25,26) populations.

Dietary assessment

Children's food consumption was assessed with a 66-item food frequency questionnaire (FFQ) to determine how often during the preceding week the child had consumed certain foods. The child and caregiver were instructed to fill in the FFQ together. Only one child in the data reported filling in the FFQ alone.

The FFQ included the following nine food groups: 1) Vegetables, fruits, and berries; 2) Dairy products; 3) Plant-based drinks, snacks, and cheeses; 4) Fast food in a restaurant, take-away; 5) Main meals and cold cuts; 6) Grain products; 7) Beverages; 8) Sweets and snacks; and 9) Dietary fats. Foods consumed were evaluated on a seven-point scale: not once, once per week, 2–3 times per week, 4–5 times per week, daily or almost daily (6–7 times per week), 2 times a day, and 3 times a day or more. For dietary pattern analysis and the HFII, the consumption frequencies were converted to correspond to weekly consumption with the following conversion factors: not once = 0, once per week = 1, 2–3 times per week = 2.5, 4–5 times per week = 4.5, daily or almost daily (6–7 times per week) = 6.5, 2 times a day = 14, and 3 times a day or more = 21.

Dietary pattern analysis

Principal Component Analysis (PCA) is a technique aiming to reduce a large set of variables into a smaller set of "principal components," which are new artificial variables that capture most of the variance present in the original variables (85). PCA was conducted to identify dietary patterns from the children's FFQ data. All 66 FFQ variables were inputted. After the initial run, the loadings of inputted FFQ variables in the first six components with eigenvalues > 2 were examined. Loadings of ≥ 0.3 and ≤ -0.3 were considered significant in interpreting the components. Based on the described interpretation of the components, the research group agreed that two components (patterns) had the potential to illustrate children's dietary habits. After re-running the analyses with a fixed number of components (2), the two resulting components were easily interpretable. Varimax rotation was used to ensure that the components were uncorrelated. All participants with full FFQ data (N=208, 93.3 % of the participants) were included in the PCA. However, one participant was a significant

multivariate outlier in the distribution of Pattern 2. A sensitivity analysis showed that this participant significantly affected the loadings of Pattern 2 and thus, the participant was excluded from the final PCA (N=207, 92.8 % of the participants). Based on food loadings and consumption frequencies, standardized dietary pattern scores with a mean of zero and a standard deviation of 1 were calculated for the participants, describing their adherence to both identified patterns. A higher score on a dietary pattern indicates stronger adherence to that pattern.

Pattern 1 (from here on called the Health-conscious dietary pattern) was characterized by frequent consumption of food products typically considered healthy, such as berries; fresh, cooked, and canned vegetables; fruits; and fruit- and berry purees, and ready-made smoothies. In contrast, Pattern 2 (from here on called the Meat-and-discretionary-foods dietary pattern) was characterized by frequent consumption of foods considered unhealthy, such as sweets; sausage dishes; crisps and popcorn; sweet biscuits; and ice cream, sorbet, and popsicles. All food loadings are presented in Appendix 3.

Healthy Food Intake Index

Healthy Food Intake Index (HFII) was used in this thesis to assess the participants' dietary quality. HFII was initially developed as part of the Finnish Gestational Diabetes Prevention Study (RADIEL) because there was a lack of an appropriate food frequency -based diet quality index (86). The HFII score was designed to align with the food-based guidelines of the Nordic Nutrition Recommendations (NNR, 2012) wherever possible, and when not feasible, the Finnish Nutrition Recommendations (2014) were applied. The original HFII consisted of 11 food groups/components. The score ranged between 0 and 17, with higher scores reflecting better adherence to the NNR. The authors concluded that the HFII can be applied to rank participants based on their level of adherence to the NNR, particularly among pregnant women with overweight or obesity or those with a history of gestational diabetes. The development of the HFII is described in more detail in the original paper (86).

Many indexes are based on quantitative use of food, but because for this study an index based on food consumption frequencies was needed, the HFII was chosen. The original HFII was modified because, as such, it is not compatible with the FFQ data from the DAGIS Next study. Slight modifications were made from the original HFII to construct

this current HFII (Table 5). One component (cooking fat) in the original HFII was removed, because this component was not in the DAGIS Next FFQ. Two components (processed and red meat and nuts and seeds) not included in the original HFII were included in this current index to better describe the NNRs. Similar additions have been made to the modified version of the original HFII (87). The HFII used in this study has a total of 12 components and the score ranges from 0 to 18.

Table 5. Components, included food items, cut-offs based on consumption frequencies, and scoring for the Healthy Food Intake Index (HFII) in the DAGIS Next study.

Component	Food items included	Intake frequency	Score
Vegetables	Fresh vegetables (not potatoes)	> 2 times/day	2
	Cooked and canned vegetables	≥ 1, ≤ 2 times/day	1
	Legumes (peas, beans, lentils, soya)	< 1 time/day	0
Fruits and berries	Fresh and canned fruits	≥ 1 time/day	1
	Berries (fresh and frozen)	< 1 time/day	0
High-fiber foods	Rye bread and crisp bread	≥ 3 times/day	2
	Wholegrain bread	≥ 1, < 3 times/day	1
	Brown rice, pasta, and noodles	< 1 time/day	0
	Porridge (without added sugar)		
Milk	Fat-free milk and sour milk Milk and sour milk with 1–1.5 % fat Whole milk and sour milk	Fat-free milk/sour milk > 0 times/week and milk/sour milk with 1–1.5 % fat 0 times/week and whole milk/sour milk 0 times/week	2
		Fat-free milk and sour milk > 0 times/week and milk and sour milk with 1–1.5 % fat > 0 times/week or whole milk and sour milk > 0 times/week	1
		Fat-free milk and sour milk 0 times/week and milk and sour milk with 1–1.5 % fat ≥ 0 times/week or whole milk and sour milk ≥ 0 times/week	0
Cheese	Low-fat cheese (17 % or less fat) High-fat cheese (more than 17 % fat)	Low-fat cheese > 0 times/week and high-fat cheese 0 times/week	1
		Low-fat cheese 0 times/week or high-fat cheese > 0 times/week	0

Table 5. Continues

Component	Food items included	Intake frequency	Score
Fat spread	Low-fat margarine (< 60 % fat) High-fat margarine (≥ 60 % fat) Butter and butter blends	Margarine (low- or high-fat) > 0 times/week and butter/butter blends 0 times/week	1
		Margarine (low- or high-fat) 0 times/week or butter/butter blends > 0 times/week	0
Fish	Fish and fish dishes	≥ 1 time/week	2
		< 1 time/week	0
Processed and red meat	Red meat	≤ 3 times/week	2
	Sausages	> 3, ≤ 5 times/week	1
	Cold cuts (Deli meat)	> 5 times/week	0
Nuts and seeds	Unflavored nuts and seeds	≥ 3 times/week	1
		< 3 times/week	0
Snacks	Chocolate	≤ 4 times/week	2
	Sweets	> 4, ≤ 6 times/week	1
	Sweet pastries	> 6 times/week	0
	Savory pastries		
	Sweet cookies and snackbars		
	Crisps and popcorn		
	Flavored nuts and seeds		
	Ice cream		
Fast food	Pizza	< 1 times/week	1
	Hamburgers	≥ 1 times/week	0
	Hotdogs		
	Kebab		
Sugar-sweetened beverages	Sugar-sweetened juice	< 1 time/week	1
	Sugar-sweetened soft drinks	≥ 1 time/week	0
Total HFII, maximum score			18

The food items (all except milk, cheese, and fat spread components) were summed to create the components. To comply with the cut-offs and scoring, vegetables, fruits and berries, and high-fiber food -components were converted to correspond to daily consumption. HFII score was calculated for 209 participants (all participants without missing data for the FFQ items used, 94 % of the participants) according to the scoring criteria described in Table 5.

Background characteristics and socioeconomic factors

Children filled out the child's questionnaire, where they reported their gender. The age of the children was counted based on the date of birth of the child reported by the caregiver in the consent form. Gender and age were used as confounding factors in regression analyses.

Caregivers of the participating children filled in a questionnaire about the family's background, which included also questions about socioeconomic factors. The socioeconomic variables that were used when examining the associations with eating competence were education level and income.

Using six predefined answer options, the caregiver was asked to report their own and their partner's (if had one) highest completed education. If the caregiver reported both their own and their partner's education level, the higher level of education was chosen for the variable. The education variable was divided into three categories: low (comprehensive/elementary school, vocational school, high school), medium (Bachelor's Degree), and high (Master's Degree, Licentiate/Doctoral Degree).

The first caregiver reported the number of household members (adults, children 15 years and older, and children under 15 years), and the monthly household net income on a ten-point scale: less than 500 euros, 500–999 euros, 1000–1499 euros, 1500–1999 euros, 2000–2499 euros, 2500–2999 euros, 3000–4999 euros, 5000–7499 euros, 7500–10000 euros, or over 10000 euros. Relative household income was calculated by dividing the reported household net income by the number of household members, for which different coefficients were used: first adult = 1.0, other adults and children 15 years old and older = 0.5, and children under 15 years = 0.3). The relative income variable was divided into tertiles: lowest tertile (≤ 2399 €/month), middle tertile (2400–2999 €/month), and highest tertile (≥ 3000 €/month).

In addition to being used in the analyses examining the association between education, income, and eating competence, the highest family education level and relative household income were used as confounding factors in regression analyses examining eating competence and diet.

4.4 Statistical methods

All analyses were performed using IBM SPSS Statistics software (version 29.0.2.0). In all analyses, a P-value < 0.05 was considered statistically significant.

Descriptive statistics were examined first. Of categorical variables, frequencies were examined. Of continuous variables, mean, standard deviation (SD), minimum, and maximum values were examined. Eating competence, HFII, and dietary pattern scores were approximately normally distributed when histograms were inspected visually. Basic characteristics were counted for the analytical sample (N=206), i.e., for those participants who had the eating competence score and at least one of the following: HFII score or dietary pattern scores.

Linear regression analyses were used to examine the associations between eating competence (exposure) and dietary pattern scores (outcome) and eating competence and HFII (outcome). Adjusted R Square, Unstandardized B coefficient, 95 % Confidence Intervals, and the P-value were reported.

Three models were constructed: Model 1 was unadjusted, Model 2 was adjusted for age and gender, and Model 3 was further adjusted for parental education and relative household income. In models with the Health-conscious and the Meat-and-discretionary-foods dietary pattern scores as outcomes, Models 2 and 3 were additionally adjusted for the opposing dietary pattern. Both dietary pattern scores had two to three outliers that required closer examination. A sensitivity analysis (data not shown), where outliers were excluded, was conducted. However, the results did not change significantly, and thus, the outliers were not removed from the analyses.

The associations between socioeconomic factors (parental education and relative household income) and eating competence were examined by using eating competence as both a categorical (dichotomous) and a continuous variable because not one specific way was used in the literature. With eating competence as a categorical variable, a Chi-square test was performed. Counts and percentages, Pearson Chi-Square value, and the P-value were reported. With eating competence as a continuous variable, first, a One-way ANOVA test was attempted, but the eating competence variable was not normally distributed in all the categories in either of the SES variables. Thus, the nonparametric Kruskal-Wallis test was performed. Mean ranks, medians, Kruskal-Wallis H value, and P-value were reported.

5 Results

5.1 Basic characteristics

The basic characteristics of the study participants are presented in Table 6. Of the analytical sample, 51 % were boys, and 49 % were girls. The majority (82 %) of children filled in the FFQ with their mother or stepmother. In 58 % of the families, at least one of the caregivers had a Master's Degree or a Licentiate/Doctoral Degree. The average eating competence score was 29.7 (SD 7.0), and 56 % of the children were considered not-eating-competent (EC score < 32). The average HFII score was 6.9 (SD 2.4).

Table 6. Basic characteristics of the study sample (N = 206).

Categorical variable	N (%)
Gender	
Girl	101 (49.0)
Boy	105 (51.0)
School grade	
4th–5th grade	100 (48.6)
6th grade	72 (35.0)
7th–8th grade	31 (15.0)
Missing	3 (1.5)
Food Frequency Questionnaire filled in by	
Child + mother/stepmother	168 (81.6)
Child + father/stepfather	17 (8.3)
Child + both caregivers	18 (8.7)
Child alone	1 (0.5)
Missing	2 (1.0)
Highest family education level[a]	
Low	17 (8.3)
Medium	67 (32.5)
High	120 (58.3)
Missing	2 (1.0)
Relative household income tertiles	
Low (≤ 2399 €/month)	65 (31.6)
Medium (2400–2999 €/month)	78 (37.9)
High (≥ 3000 €/month)	50 (24.3)
Missing	13 (6.3)

Table 6. Continues

Categorical variable	N (%)		
Eating competence			
Eating-competent (score ≥ 32)	91 (44.2)		
Not-eating-competent (score < 32)	115 (55.8)		
Continuous variable	Mean (SD)	Minimum	Maximum
Child age (years)	12.2 (0.9)	10.2	14.4
Eating competence score (scale 0–48)	29.7 (7.0)	11	46
Healthy Food Intake Index (scale 0–18)	6.9 (2.4)	1	12

[a] Low: comprehensive/elementary school, vocational school, high school
Medium: Bachelor's Degree
High: Master's Degree, Licentiate/Doctoral Degree

5.2 Eating competence, dietary patterns, and Healthy Food Intake Index

Eating competence and dietary patterns

Table 7 presents the results of the regression analysis between eating competence and the two dietary pattern scores.

Table 7. Associations between eating competence (EC) and the two dietary patterns.

Regression models	Adjusted R^2	B	95% CI	P-value
Health-conscious dietary pattern				
Model 1*	0.083	0.042	[0.023, 0.061]	< 0.001
Model 2**	0.078	0.044	[0.025, 0.064]	< 0.001
Model 3***	0.113	0.045	[0.024, 0.065]	< 0.001
Meat-and-discretionary-foods dietary pattern				
Model 1*	0.034	-0.028	[-0.048, -0.009]	0.005
Model 2**	0.044	-0.032	[-0.053, -0.012]	0.012
Model 3***	0.063	-0.033	[-0.055, -0.011]	0.010

* Model 1: unadjusted
** Model 2 adjusted for age, gender, and the opposing dietary pattern
*** Model 3 adjusted for age, gender, the opposing dietary pattern, education, and income

Eating competence was positively associated with the Health-conscious dietary pattern. The associations remained significant even when adjusting for confounding factors (Model 3: B=0.045, 95% CI 0.024, 0.065, p<0.001). The B coefficients were consistent and indicate that the score for the Health-conscious pattern was, on average,

0.04, 0.04, and 0.05 points higher for each additional point of eating competence score in Models 1, 2, and 3, respectively.

Eating competence was negatively associated with the Meat-and-discretionary-foods dietary pattern. This suggests that higher eating competence is linked to lower adherence to the Meat-and-discretionary-foods dietary pattern. The associations remained significant even after controlling for confounding factors (Model 3: B=-0.033, 95% CI -0.055, -0.011, p=0.010). Again, the B coefficients were consistent. The scores for the Meat-and-discretionary-foods pattern were, on average, 0.03 points lower for each additional point of eating competence score in all of the regression models.

Eating competence and dietary quality

Table 8 presents the results of the regression analysis between eating competence and the HFII.

Table 8. Associations between Eating Competence and Healthy Food Intake Index.

Regression models	Adjusted R^2	B	95% CI	P-value
Model 1*	0.139	0.129	[0.085, 0.173]	< 0.001
Model 2**	0.130	0.129	[0.085, 0.173]	< 0.001
Model 3***	0.181	0.120	[0.074, 0.166]	< 0.001

* Model 1: unadjusted

** Model 2 adjusted for age and gender

*** Model 3 adjusted for age, gender, education, and income

In all regression models, eating competence was positively associated with HFII. The HFII score was, on average, 0.13, 0.13, and 0.12 points higher for each additional point of the eating competence score in Models 1, 2, and 3, respectively. The associations remained statistically significant when controlling for confounding factors (Model 3: B=0.120, 95% CI 0.074, 0.166, p<0.001). Adjusting for confounding variables did not change the B coefficient dramatically, indicating that age, gender, parental education level, and relative household income level do not significantly influence the association between eating competence and HFII.

5.3 Socioeconomic status and eating competence

Table 9 presents the results of a Chi-square test of independence, which was performed to test for associations between eating competence and education and income levels, with eating competence as a dichotomous categorical variable.

Table 9. Results of the Chi-square test of independence examining the associations between eating competence, education, and income levels.

	Low N (%)	Medium N (%)	High N (%)	Pearsons Chi-Square	P-value
Education level[a]				3.875	0.144
Eating-competent	7 (7.6)	25 (27.2)	60 (65.2)		
Not-eating-competent	11 (8.9)	48 (39.0)	64 (52.0)		
Income tertiles[b]				4.513	0.105
Eating-competent	22 (25.6)	38 (44.2)	26 (30.2)		
Not-eating-competent	47 (39.8)	42 (35.6)	29 (24.6)		

[a] Low: comprehensive/elementary school, vocational school, high school
Medium: Bachelor's Degree
High: Master's Degree, Licentiate/Doctoral Degree

[b] Low: ≤ 2399 €/month
Medium: 2400–2999 €/month
High: ≥ 3000 €/month

In the lowest education group, there are more not-eating-competent children, while in the highest education group, there are more eating-competent children. In the lowest relative income group, there are more not-eating-competent children compared to the two highest income groups where there are more eating-competent children. Despite these observations, the p-value is above the significance level and thus, there were no statistically significant associations between education levels or income tertiles and eating competence.

Table 10 presents the results of the Kruskal-Wallis test, which was performed to determine if there were differences in eating competence scores (continuous variable) between different education and income levels.

Table 10. Results of the Kruskal-Wallis test examining the associations between eating competence (EC), education, and income levels.

Grouping variable	N	Mean Rank of EC	Median of EC	Kruskal-Wallis H	P-value
Education level[a]	215		30.00	4.281	0.118
Low	18	89.17	26.50		
Medium	73	100.64	28.00		
High	124	115.07	31.00		
Income tertiles[b]	204		29.43	2.304	0.316
Low	69	93.86	28.00		
Medium	80	108.01	30.50		
High	55	105.33	31.00		

[a] Low: comprehensive/elementary school, vocational school, high school
Medium: Bachelor's Degree
High: Master's Degree, Licentiate/Doctoral Degree

[b] Low: ≤ 2399 €/month
Medium: 2400–2999 €/month
High: ≥ 3000 €/month

The mean ranks of eating competence scores in the education variable increase when moving from low to high educational levels. However, this is not observed in the income variable. The p-values were not statistically significant ($p>0.05$) in either variable, in other words, no statistically significant associations between parental education, relative household income, and eating competence were observed.

6 Discussion

The aim of this Master's Thesis was to explore the associations between 10 to 14-year-old children's eating competence and their dietary patterns and dietary quality and examine the associations between family socioeconomic status and children's eating competence.

Eating competence was positively associated with the Health-conscious dietary pattern, meaning that higher eating competence indicates better adherence to that dietary pattern. In contrast, eating competence was inversely associated with the Meat-and-discretionary-foods dietary pattern. This means that higher eating competence indicates lower adherence to the Meat-and-discretionary-foods dietary pattern. Additionally, eating competence was positively associated with the Healthy Food Intake Index. Family SES, measured by parental education and relative household income, was not associated with children's eating competence.

Eating competence, dietary patterns, and Healthy Food Intake Index

Aligned with the hypothesis, the results of this study indicate that children with higher eating competence have healthier dietary patterns and higher HFII scores. There is evidence supporting the results of this study that higher eating competence is associated with healthier dietary patterns and better dietary quality, even though the study populations have been different since the majority of the previous literature has examined eating competence in adults (18,35,49–51,74). Tilles-Tirkkonen and colleagues are among the few who have examined eating competence in children and adolescents (25). Their target population was 10–17-year-old Finnish adolescents, and they examined the associations between eating competence and food selection and meal patterns, among other measures. Higher eating competence was associated with higher consumption of 'healthy' foods and lower consumption of 'unhealthy' foods. Eating-competent adolescents were also more likely to have regular family meals, greater availability of vegetables and fruits at home, and parents who prioritized diet quality, while also having more influence over food selection, preparation, and their own eating habits at home. A healthier home food environment created by the parents is known to be associated with a healthier diet in children (88,89). The building of children's eating competence is likely to be based on the home food environment and consequently affects the healthiness of the diet. However, in the context of Finland, the

role of early childhood education and care (ECEC) and schools shouldn't be forgotten since they also significantly contribute to children's diets.

The previous studies on eating competence have mainly been cross-sectional, but also one intervention study by Aittola and colleagues found results similar to this study, where an increase in eating competence was associated with improved dietary quality (18). The Healthy Eating Index was used to assess dietary quality in the study by Lohse and colleagues, where they aimed to determine if eating competence is associated with dietary intake and dietary patterns among low-income females (74). As expected, participants with higher eating competence had higher Healthy Eating Index scores. Additionally, the authors identified two dietary patterns through factor analyses: Western and Prudent dietary patterns. Although the foods included in those patterns were somewhat different from those in this current study, both studies clearly identified one healthier (Prudent; Health-conscious) and one unhealthier (Western; Meat-and-discretionary-foods) dietary pattern. In contrast to this study, Lohse and colleagues only found a correlation between eating competence and the Prudent dietary pattern. Regarding dietary patterns, another study by Lohse and colleagues examining eating competence in the Spanish elderly found that higher eating competence was associated with better adherence to the health-promoting Mediterranean diet pattern (49). The association between eating competence and healthier dietary habits seems evident because no studies in the literature were found where eating competence wasn't associated with the consumption of healthier foods and/or better dietary quality.

The specific mechanisms through which eating competence influences the diet haven't really been examined. However, insights into these mechanisms may be gained by exploring the four subcomponents of eating competence. Having positive attitudes toward eating and being accepting of different foods allows an individual to eat without guilt, shame, or anxiety. This also decreases the restriction of foods: all foods are accepted and can be eaten without rigid rules. These aspects increase dietary diversity, which is associated with a higher intake of nutrients, such as fiber, vitamins, and minerals (90,91). Being aware of hunger and satiety cues and relying on them, i.e., having good internal regulation skills, supports energy balance and reduces the likelihood of over- or undereating. Internal regulation is likely to be the dimension that contributes most to the actual body weight and why eating-competent individuals more

often are in the normal BMI range (18.5 and 25 kg/m^2) or generally have a lower BMI (26,35,49). Meal planning, grocery shopping, and food preparation promote eating home-cooked meals, which have been associated with higher dietary quality (92). In addition to these contextual skills, eating at regular, structured, and planned times (whether a full meal or a smaller snack) keeps the blood sugar more stable and decreases the frequency of unstructured, impulsive eating throughout the day. This is important, as impulsivity has been associated with greater energy intake and snacking frequency (93). To conclude, eating competence likely influences diet through both psychological and behavioral mechanisms by encouraging a varied, regulated, and structured approach to eating. However, these mechanisms should be further investigated in more detail in future studies.

Coming back to children, the results from the CEBQ studies support the results of this current study because a similar pattern is seen with eating competence in terms of the effects of "negative" and "positive" eating behaviors. The studies using the CEBQ to examine eating behaviors in children aged 2 to 5 and 7 to 10 years have found that the "negative" food avoidant eating behaviors were more frequently associated with poorer dietary quality and higher consumption of unhealthy foods, while the "positive" food approach eating behaviors tend to be associated with better dietary quality (81–83). Lower scores on eating competence, among other things, reflect "negative" eating behaviors such as increased restrained eating, disinhibition toward eating, more food dislikes, and bulimic thoughts (21). Further, as seen in this current study, lower eating competence was associated with unhealthier dietary patterns and lower dietary quality. On the contrary, higher eating competence reflects positive and relaxed eating behaviors and was associated with healthier dietary patterns and better dietary quality.

Even though eating competence and the CEBQ share similar characteristics, it should be noted that straightforwardly they aren't comparable with each other because, in the end, they measure different things. While the CEBQ is valuable for identifying specific eating behavioral tendencies in children, eating competence addresses the overall relationship with food in a broader context, also taking into account personal food choices and eating environments.

Socioeconomic status and eating competence

Contrary to the initial hypothesis, this study found no associations between the family's SES and children's eating competence. However, the results of the analyses indicate that there could be some type of pattern pointing to an association between parental education level, relative household income, and eating competence. The Chi-square test showed that within eating-competent children, there were more high-income families and fewer low-income families compared to not-eating-competent children. The Kruskal-Wallis test indicated that children from higher-educated families would have higher eating competence compared to those in lower educational levels. However, in either test, for either variable, the p-value didn't reach statistical significance. Thus, it is possible that the sample size wasn't high enough to show the associations as statistically significant. Based on the literature, it was expected that associations would have been found: Gautam and colleagues found that higher parental SES (measured with income, education, occupation, prestige, place of residence, ethnic origin, and/or religious background) can exhibit healthier behaviors in children and adolescents aged 3 to 19 years (13). Additionally, a previous DAGIS study showed that higher parental education level was associated with healthier dietary patterns in children (88). However, it should be noted that no prior studies specifically examined the associations between family SES and children's eating competence.

Results similar to this study, where SES was not associated with eating competence, have been found in some previous studies done in adult populations (55–57). Quick and colleagues observed that the study year (freshman, sophomore, junior, senior) of college students was not associated with their eating competence (56). However, such small differences in education levels might not be enough to detect an association. De Oliveira and colleagues found that high education and income were not associated with total eating competence but were associated with the Food Acceptance subscale (57). The study examined eating competence and aspects related to gluten-free diets in individuals with gluten-related disorders. The authors discussed that the association between high income and better food acceptance could potentially be because of the high costs of gluten-free foods. People with higher income have better access to these products, influencing food acceptance. In their study, Krall and Lohse found no significant differences in eating competence scores based on different education levels (55). On the other hand, their study was done in a low-income population, in which the

mean eating competence score was lower compared to corresponding results from higher SES populations, suggesting that income constraints might affect the ability to be eating competent.

In this study, no association between household income and eating competence was found. Based on earlier literature, having a lower income would suggest also a lower eating competence (12,50,51,53,55). However, because of the tertile division of the income variable, which is data-driven, we cannot straightforwardly comment on this based on the size of the tertiles. One reason why no associations were found could be that in Finland, income inequalities are low when compared internationally (94). Also, even though low income has been associated with lower eating competence in adults, it doesn't necessarily shift straight to children. While it's true that income constraints may sometimes force parents of low-income households to rely on cheaper calorie-dense, nutrient-poor foods, they might prioritize their children's diets before their own, and focus on providing nutritious meals for them.

Studies have observed that when predicting dietary habits in adults, education is a stronger determinant of socioeconomic differences compared to other socioeconomic factors, such as income or occupation (95,96). A previous DAGIS study found that parental education level was a stronger predictor of children's fruit and vegetable consumption than relative family income (97). The sample in this current study was highly educated since the majority of the families were in the highest education group. Higher-educated individuals are more likely to have better knowledge of nutrition, and they are also more likely to search for health information (53,98). Therefore, families may have the knowledge and the ability to follow eating competence principles even with limited financial resources. However, because of the small number of cases in the lowest education category (N=17), it is also possible that the tests used to examine the association between eating competence and education might not have had enough statistical power to detect significant differences.

Finally, it is important to discuss the actual target group of this thesis: the children. Children receive nutrition education from their caregivers (and other adults), which might enhance their eating competence. However, children are their own individuals who start to make more of their own food decisions with increasing independence in early adolescence. Things that may alter early adolescents' food choices are, for example, the foods available at home, concerns about environmental aspects,

knowledge about the nutritional content of foods, and the beliefs of the 'healthiness' of certain food groups, as well as the ability to buy their own foods and/or snacks (8,99). They are also more likely to be influenced by their peers and media trends and less likely to pick healthy foods. These aspects, on the other hand, may shift their eating competence in the other direction. Based on the results of this thesis, better socioeconomic status is not automatically reflected in children's higher eating competence. Early adolescents' eating competence is likely influenced by the family's background to some extent, but also by their own developing habits.

Strengths and limitations

This study has several strengths and limitations. Strengths of the study include the use of FFQ to assess food consumption. FFQ as a dietary assessment method is low-cost, not very burdensome on the participant, and doesn't affect the respondent's eating behavior (77). With small changes compared to the FFQ used in this study, the FFQ designed for earlier phases of the DAGIS project has shown acceptable validity compared to food records and acceptable reproducibility (100,101). On the downside, FFQ is typically self-reported by the respondent (77). Even though self-reporting is very common in studies with bigger study samples, there is always a risk of misinterpretation and reporting errors, which can give a wrong impression of food consumption. Recall bias is one possible reporting error: children may have had trouble remembering how often they have eaten certain foods. In this regard, the caregiver(s) is of help, which is why it was also a strength that all the children (except for one) filled in the FFQ with at least one caregiver. On the other hand, this setup creates a new social desirability bias, because, with the caregiver present, the child might give a better picture of their eating to please their parent, for example, say that they eat salad daily at school even if they don't.

In general, FFQs don't necessarily assess the whole diet, but only the consumption of foods relevant to the study in question (77). However, in this study, the FFQ was designed to correspond to the children's whole diet as well as possible. Looking at the whole diet instead of just certain food groups is one strength of this study because it decreases the possibility that some discovery was made only by chance, but also because the whole diet is what mainly affects health outcomes. Additionally, the whole diet was examined in two different ways, by using data-based dietary patterns and a theory-based index. Another strength is that the children answered the eating

competence statements alone; hence, the answers were not influenced by caregivers. On the other hand, whether the children have understood all the statements properly can be debated. However, the mean eating competence score (29.70) was in line with another Finnish study examining eating competence in children (mean EC score 31.5), indicating no dramatic errors (25).

Family SES was not associated with children's eating competence in this study. What increases the reliability of this result is that the same result was observed using two eating competence variables (continuous and categorical) and two different SES indicators.

The re-recruitment of participants can be seen as a limitation because of potential bias if participants with only certain attributes have re-participated. This study sample probably had at least partial selection bias, considering the high education level. According to Statistics Finland (Tilastokeskus), in 2023 around 25 % of the population aged 15 and over had a Bachelor's Degree or higher education level (102). As it was discussed earlier, education is a strong determinant of socioeconomic differences. Concerning this study, a high education level could indicate that the parents are more health-conscious than the average population, which can be reflected in children's higher eating competence scores. However, this doesn't seem likely, because the mean eating competence score (29.7) wasn't notably high, but, in fact, slightly lower than in other studies done on adolescents (25,26). Since there was limited variability in the education variable, it's possible that the statistical tests weren't able to detect significant associations. Also, as discussed earlier, it is possible that the sample size wasn't big enough to establish associations between the SES indicators and eating competence. Additionally, the selection bias affects the generalizability of the results. If the majority of the families in this sample were highly educated, the results don't apply to the whole population, where the education level varies more.

The cross-sectional study design is a limitation since no causal relationships can be established. Another study limitation is that the analyses were conducted only using the eating competence score (or dichotomous variable), and the eating competence subcomponents (Eating Attitudes, Food Acceptance, Internal Regulation, and Contextual Skills) were not examined separately. Conducting the analyses for all of the four subcomponents separately would have given more detailed results of whether some specific eating competence components are more strongly associated with

dietary quality than others. It would have also helped to determine possible pathways on how eating competence might affect dietary quality.

The construct validity of the ecSI tool has been found acceptable in adolescents in two studies (25,26), but the results should still be interpreted with discretion since the tool has been used only a few times in younger individuals. Whether the same scoring system and cutoff value that is used for adults is suitable also for adolescents hasn't been confirmed. If the tool isn't applicable to adolescents as such, the results might be distorted and not give a truthful view of children's eating competence. Related to the tool, another limitation is that the original ecSI was used in the DAGIS Next study instead of the ecSI 2.0 -version. Even though the changes in the different versions of the tool have not been extremely dramatic, their possible effect, for example, in terms of misinterpretation of the statements, should be considered.

Implications and future research

This study provides valuable information and support for the previous study regarding children's eating competence and its associations with their diet. While the cross-sectional design of the study prevents establishing causality it is possible that improving eating competence could also lead to better dietary quality.

Nutrition education in ECEC and schools does include already some aspects of eating competence. Especially in ECEC, the Sapere method is used to guide and support food and nutrition education (103). The Sapere method utilizes the five senses to teach children about food, food products, and how to prepare them. It is different from eating competence but similarly emphasizes supporting and listening to the child's expression. Children are encouraged to tell their own opinions and experiences are not seen as right or wrong. Additionally, children are not forced to taste anything, but other children's bravery in tasting new foods caught on well with other children.

In schools eating competence principles are seen in nutrition education through the Tasty School model. Tasty School is a tailored teacher-driven food education model for Finnish primary schools (104). It offers practical tools for integrating food education into primary schools, supporting them to meet the requirements of the School Meal Recommendations and Finnish National Curriculum. Tasty School is based on several theoretical approaches, eating competence being one of them. Other approaches are, for example, self-determination theory, health at every size approach, and sensory-

based learning (Sapere). Tasty School has been shown to be a feasible and highly acceptable model for food education in primary schools, while also promoting pupils' healthy eating patterns and strengthening their experience of social participation in school dining (104,105). Even though elements of eating competence are already present in nutrition education, there is still potential for it to be more strongly integrated into both educational settings and broader childhood health promotion. This could be a significant step forward in enhancing the quality of children's diets.

In early stages, children learn from their parents and other adults such as teachers, during which time adult influence is of great importance. Caregivers and teachers could be educated on how they can develop and support children's eating competence. Additionally, it could be beneficial that these caregivers and teachers would have the opportunity to improve also their own eating competence, considering that they are the ones guiding and educating the children. When children get older and approach adolescence, developing eating competence should be targeted at them, taking personal traits and preferences into account.

The impact of children's eating competence on their dietary quality remains a very novel topic. Future studies should investigate, through interventions and longitudinal studies, the development of eating competence over time and how it, in turn, affects children's dietary habits (and other health outcomes). This would also establish the possible causal relationships between eating competence and dietary quality and strengthen the evidence base. Examining the mechanisms of how eating competence might influence the diet is one theme worth looking into in the future.

As social media and media marketing have grown enormously, examining the impact of the digital environment in shaping children's eating competence could also be a topic of interest. Larger sample sizes and participants from more diverse geographical areas, socioeconomic positions, and cultural settings would provide a wider view of the differences within the Finnish population.

7 Conclusions

The primary objective of this thesis was to explore the associations between 10–14-year-old children's eating competence, dietary patterns, and dietary quality. Additionally, the aim was to examine how caregivers' socioeconomic status was associated with their child's eating competence. The findings revealed that eating competence was positively associated with an overall healthier diet, regardless of whether it was examined using data-based dietary patterns or a theory-based dietary index. In this sample, parental education and relative household income were not associated with children's eating competence.

The results bring valuable information regarding children's eating competence and its associations with dietary quality, which is a topic with only little evidence. Future studies should examine the development of eating competence and dietary quality in children through interventions and longitudinal studies to establish the possible causal relationship between the two. Studies should be conducted with larger sample sizes and with participants from all around Finland and from a wider range of socioeconomic positions.

Eating competence is still a fairly novel topic, especially among children and adolescents. However, based on previous research and the findings of this study, eating competence has significant potential to improve children's dietary quality and thus, promote their health. Solely providing information about healthy nutrition might not be sufficient in enhancing children's diets; in addition, it should be complemented by efforts to develop eating competence. This could involve more fully integrating the concept of eating competence into daycare centers' and schools' nutrition education. Moreover, fostering eating competence also among the adults who influence children's eating habits should be considered essential. Ultimately, strengthening eating competence across all levels of a child's environment may be a valuable strategy for creating sustainable dietary behaviors and supporting long-term public health outcomes.

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Appendices

Appendix 1 Changes in the different versions of the ecSI tool

Subscale	ecSI	ecSI/LI / ecSI2.0	ecSI2.0™
Eating Attitudes	I am relaxed about eating.	I am relaxed about eating.	I am relaxed about eating.
	I am comfortable about eating enough.	I am comfortable about eating enough.	I am comfortable about eating enough.
	I enjoy food and eating.	I enjoy food and eating.	I enjoy food and eating.
	I am comfortable with my enjoyment of food and eating.	I am comfortable with my enjoyment of food and eating.	I am comfortable with my enjoyment of food and eating.
	I feel it is okay to eat food that I like.	I feel it is okay to eat food that I like.	I feel it is okay to eat food that I like.
			I trust myself to eat enough for me.*
Food Acceptance	I experiment with new food and learn to like it.	I experiment with new food and learn to like it.	I experiment with new food and learn to like it.
	If the situation demands, I can “make do” by eating food I don’t much care for.	If the situation demands, I can “make do” by eating food I don’t much care for.	If the situation demands, I can “make do” by eating food I don’t much care for.
	I eat a wide variety of food.	I eat a wide variety of food.	I eat a wide variety of food.
Internal Regulation	I assume I will get enough to eat.	**I trust myself to eat enough for me.***	
	I eat as much as I am hungry for.	I eat as much as I am hungry for.	I eat as much as I am hungry for.
	I eat until I feel satisfied.	I eat until I feel satisfied.	I eat until I feel satisfied.
Contextual Skills	I tune in to food and pay attention to myself when I eat.	**I tune in to food and pay attention to eating.***	I tune in to food and pay attention to eating.
	I make time to eat.	I make time to eat.	I make time to eat.
	I have regular meals.	I have regular meals.	I have regular meals.

Subscale	ecSI	ecSI/LI / ecSI2.0	ecSI2.0™
	I think about nutrition when I choose what I eat.	**I consider what is good for me when I eat.***	I consider what is good for me when I eat.
	I generally plan for feeding myself. I don't just grab food when I get hungry	**I plan for feeding myself.***	I plan for feeding myself.

* Bolded text shows the changes from the previous version of the tool.

Appendix 2 Finnish translation of the Satter Eating Competence Inventory

Syömisen taito -kysely

34. Vastaa kaikkiin alla oleviin väittämiin rastittamalla parhaiten itseäsi kuvaava vaihtoehto.

	En koskaan	Harvoin	Joskus	Usein	Aina
a. Suhtaudun syömiseen rennosti					
b. Tunnistan helposti, milloin olen syönyt tarpeeksi					
c. Nautin ruoasta ja syömisestä					
d. Mielestäni ruoasta ja syömisestä saa nauttia					
e. Mielestäni jokainen voi syödä sellaista ruokaa, josta pitää					
f. Kokeilen uusia ruokia ja opettelen pitämään niistä					
g. Jos tilanne vaatii, voin syödä ruokaa, josta en erityisemmin pidä					
h. Syön monenlaisia ruokia					
i. Luotan siihen, että syön tarvettani vastaavasti					
j. Syön niin paljon kuin nälkä vaatii					
k. Syön, kunnes tunnen itseni kylläiseksi					
l. Ruokaillessani keskityn syömiseen					
m. Varaan aikaa syömiseen					
n. Minulla on säännölliset ruokailuajat					
o. Otan huomioon, millainen ruoka on minulle hyväksi					
p. Suunnittelemalla ruokailuni varmistan, että saan syödyksi					

Appendix 3 Dietary pattern characteristics and food loadings

FFQ row	Pattern 1*	Pattern 2**
Fresh vegetables	**0.58**	-0.05
Cooked and canned vegetables	**0.49**	-0.03
Pulses as a side dish: peas, beans and lentils	**0.43**	-0.06
Potato	0.23	0.23
Fruits	**0.55**	-0.08
Berries	**0.65**	-0.02
Fruit- and berry puree, ready-made smoothies	**0.47**	0.08
Berry and fruit kisels and soups	0.24	0.14
Skimmed milk and sour milk as such	0.25	-0.18
1% fat milk and sour milk, semi-skimmed milk and sour milk, whole milk and sour milk	0.06	0.24
Flavored or sweetened milk-based drinks	0.05	0.25
Natural yogurt, fermented curdled milk products	**0.41**	-0.16
Flavoured or sweetened yogurt, fermented curdled milk products	0.23	0.03
Puddings and other milk-based desserts	0.12	**0.35**
Low-fat cheese	0.25	-0.22
High-fat cheese	0.07	0.25
Natural plant-based drinks	0.02	-0.02
Flavoured or sweetened plant-based drinks	0.09	0.12
Natural plant-based yogurts and quarks	0.06	0.00
Flavoured or sweetened plant-based yogurts and quarks	0.06	-0.04
Plant-based puddings and other desserts	0.12	-0.03
Plant-based (vegan) cheese	-0.08	0.00
Pizza, hamburgers, hotdogs, or kebab	-0.24	**0.43**
Filled sandwiches, tacos, or tortillas	0.18	0.26
Deep fried foods	-0.15	**0.40**
Meat dishes	0.11	**0.31**
Sausage dishes	-0.04	**0.52**
Chicken and turkey dishes	**0.46**	0.17
Fish dishes and fish products	**0.31**	0.10
Vegetable dishes	0.26	-0.18
Egg dishes	**0.33**	0.17
Deli meats and sliced sausage	0.04	0.19
Brown rice, noodles, and other high-fiber sides	**0.42**	0.04
White rice, pasta, and noodles and other sides	0.04	0.26
Rye bread, crisp bread, and sourdough crisp bread	**0.35**	-0.03
White wholegrain bread	0.28	0.18
White bread	-0.03	0.16
Sugar-sweetened breakfast cereals and muesli	-0.01	0.20
Sugar-free or low-sugar breakfast cereals and muesli	**0.41**	-0.07
Porridges	**0.34**	0.08
Cereal bars, snack biscuits	**0.42**	0.14
Sweet biscuits	-0.03	**0.48**
Donuts, Danish pastries, cakes, cupcakes, buns, pies, and other sweet pastries	-0.02	**0.30**
Savoury pastries	**0.36**	0.19
Sugar-sweetened juice drinks	0.12	**0.33**
Fruit juice	0.21	0.17
Sugar-sweetened soft drinks	0.04	**0.52**
Reduced sugar juices and soft drinks	-0.25	0.22
Energy drinks	-0.19	0.14
Bottled water and mineral water	-0.03	**0.31**
Coffee	0.04	-0.07
Tea	0.21	0.08
Alcoholic beverages	-0.17	-0.02
Chocolate	0.21	**0.42**
Sweets	0.04	**0.52**
Ice cream, sorbet, popsicles	0.06	**0.47**
Added sugar, honey or syrup	0.15	0.09
Jams and marmalades	0.08	0.01
Plain nuts, almonds, and seeds	**0.36**	0.07
Flavoured nuts, almonds and seeds	0.16	0.16
Crisps and popcorn	-0.12	**0.48**
Vegetable oils	**0.33**	0.11
Oil-based salad dressings	0.10	0.11
Butter and butter blends	0.15	0.25
Margarine, fat content ≥ 60%	0.20	-0.18
Margarine, fat blends, fat content < 60%	0.07	-0.09
SS loadings***	4.49	3.63
% of total variance explained	7 %	6 %

* Pattern 1 = Health-conscious pattern

** Pattern 2 = Meat-and-discretionary-foods pattern

*** SS loadings = Sum of square (SS) loadings = The sum of the squares of the loadings