Universidade do Minho
Escola de Psicologia

Beatriz Neves Pereira

Mapping the motivational-related factors for healthy eating among elementary school students

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"The price of success is hard work, dedication to the job at hand, and the determination that whether we win or lose, we have applied the best of ourselves to the task at hand." – Vince Lombardi

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I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration.

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Mapeamento dos fatores motivacionais para a alimentação saudável em alunos do ensino básico

Resumo

A obesidade infantil é um dos maiores desafios de saúde pública do século 21. Com uma etiologia multifatorial, a maioria dos casos de obesidade está associada a fatores modificáveis relacionados ao comportamento alimentar da criança. Reconhecendo isso, têm sido levados a cabo esforços para o desenvolvimento de intervenções de mudança comportamental e ações políticas para facilitar a adoção e manutenção de uma alimentação saudável pelas crianças. Essas ações e intervenções parecem ter resultados promissores; no entanto, a quantidade e a qualidade do consumo alimentar das crianças permanecem distantes das recomendações da Organização Mundial da Saúde e as taxas de obesidade infantil continuam a aumentar. As razões podem ser, entre outras, duas: primeiro, é possível que o conteúdo das ações e intervenções desenvolvidas e os desafios e necessidades percebidos pelas crianças não estejam alinhados; segundo, a maioria das intervenções têm-se centrado na transmissão de conhecimento declarativo sobre alimentação saudável, sem considerar o background motivacional da população-alvo. Portanto, há necessidade de entender mais profundamente os fatores relacionados com a motivação que contribuem para uma alimentação mais saudável, a fim de projetar diretrizes adaptadas que possam melhorar as ações e intervenções realizadas, com o objetivo final de prevenir a obesidade infantil. A presente tese compreende quatro estudos com o objetivo de contribuir para a literatura e prática da prevenção da obesidade infantil e promoção da alimentação saudável, centrando-se numa visão motivacional do fenómeno. O primeiro capítulo permitiu conhecer as atribuições causais das crianças sobre obesidade através de um desenho qualitativo. O segundo e o terceiro capítulos contribuíram para esclarecer o papel dos fatores relacionados com a motivação, como a autorregulação, na prevenção da obesidade infantil e na promoção da alimentação saudável das crianças. Por fim, o quarto capítulo ajudou a enfatizar que, nestas idades, a autorregulação pode ser potencializada quando também são consideradas variáveis dos ambientes proximais das crianças. Com base em referenciais teóricos sólidos, os resultados dos quatro estudos corroboram a investigação que destaca a complexidade deste desafio do século 21 e a importância de considerar fatores relacionados com a motivação como aliados para o alcance de comportamentos alimentares saudáveis. Foram discutidas implicações para a prática de saúde, educacional e política, bem como ideias para investigação futura.

Palavras-chave: Atribuições causais, Autorregulação, Crianças do segundo ciclo do Ensino Básico, Prevenção de obesidade, Promoção de alimentação saudável

Mapping the motivational-related factors for healthy eating among elementary school students

Abstract

Childhood obesity is considered one of the most significant public health challenges of the 21st century. Characterized by a multifactorial etiology, most cases of obesity are associated with modifiable factors related to children's eating behavior. Recognizing this, several efforts have been made to develop behavior change interventions and policy actions to facilitate children's maintenance of a healthy eating. These actions and interventions seem to have promising results; however, the quantity and quality of children's food consumption remain far from the recommendations of the World Health Organization, and the increase in childhood obesity rates persists. The reasons can be, among others, twofold: First, it is possible that there is a mismatch between the content of the actions and interventions developed and the real challenges and needs perceived by the children; Second, most interventions focus on transmitting declarative knowledge about healthy eating, without considering the motivational background of the target population. Therefore, there is a need to understand more deeply motivational-related factors that contribute to children's healthy eating to design adapted guidelines likely to improve actions and interventions carried out with children with the ultimate goal of preventing childhood obesity. This thesis comprises four studies with the aim of contributing to the literature and practice of obesity prevention and promotion of healthy eating by focusing on the motivational side of the chain. The first chapter allowed to understand children's causal attributions to obesity through a qualitative design. The second and third chapters contributed to clarifying the potential role of motivational-related factors, such as self-regulation, in preventing childhood obesity and promoting children's healthy eating. Finally, the fourth chapter helped to emphasize that, at these ages, self-regulation can be enhanced when variables from the children's proximal environments are also considered. Based on solid theoretical backgrounds, the four studies results corroborate research that highlights the complexity of this 21st century challenge and the importance of considering motivational-related factors as allies to achieve healthy eating behaviors. Implications for practice in the domains of health, education, and policy were discussed, as well as suggestions for future research.

Keywords: Causal attributions, Elementary school-aged children, Healthy eating promotion, Obesity prevention, Self-regulation

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LIST OF ABBREVIATIONS AND ACRONYMS

AGFI – Adjusted Goodness-of-Fit Index

AMOS - Analysis of a Moment Structures

BMI – Body Mass Index

CEICSH - Comissão de Ética para a Investigação em Ciências Sociais e Humanas (Ethics Committee for Research in Social and Human Sciences)

CFI – Comparative Fit Index

CR – Composite Reliability

COSI – Childhood Obesity Surveillance Initiative

DF – Degrees of Freedom

ECVI – Expected Cross-Validation Index

EU – European Union

F/V – Fruits and Vegetables

GEN – Gender

GFI – Goodness-of-Fit Index

HE – Healthy Eating

HEPABRQ-C – Healthy Eating and Physical Activity Behavior Recall Questionnaire for Children

KHE – Knowledge about Healthy Eating

KR-20 – Kuder-Richardson Formula 20

Kurt – Kurtosis

M – Mean

ML – Maximum Likelihood

PLEE – Planification, Execution, Evaluation

RCT – Randomized Controlled Trial

RMSEA - Root-Mean-Square Error of Approximation

P_EH – Parent's Healthy Eating Behavior

P_FCO – Parental Feeding Style/Control

P_FEM – Parental Feeding Style/Emotional

P_FEN – Parental Feeding Style/Prompting and Encouragement

P_FIN – Parental Feeding Style/Instrumental

PPN – Negative Peer Pressure

PPP – Positive Peer Pressure

P_SR – Parent's Self-Regulation Processes towards Healthy Eating

RW – Regression Weights

S_ATT – Student's Attitude and Perceptions towards Healthy Eating

SD – Standard Deviation

SE – Standardized Errors

S_EH – Student's Healthy Eating behavior

SES – Socioeconomic Status

Skew – Skewness

S_KNW – Student's Knowledge about Healthy Eating

SOLO – Structure of the Observed Learning Outcome

SPSS – Statistical Package for the Social Science

SR – Self-Regulation

SRMR – Standardized Root-Mean-square Residual

SRW – Standardized Regression Weights

S_SE – Student's Self-Efficacy for Healthy Eating

S_SR – Student's Self-Regulation Processes towards Healthy Eating

TLI - Tucker-Lewis Index

US – United States

WHO – World Health Organization

Introduction

Introduction

Worldwide, about 216 million children aged between five and 19 years currently have overweight and 124 million have obesity (Abarca-Gómez et al., 2017). Living with this chronic and relapsing disease means that children will have to face several health (e.g., diabetes, sleep apnea), economic (e.g., costs with inpatient care, prescription drugs), social (e.g., isolation, retreating to safe places due to weight stigma), and psychological (e.g., low self-esteem, poor academic performance) consequences throughout their life (Cawley et al., 2021; Sahoo et al., 2015). In an attempt to reverse the growing trend in obesity rates, several efforts have been made to facilitate the adoption of heathy lifestyles by children, including setting interventions focused on eating behavior (Angawi & Gaissi, 2021; Deemer et al., 2022; Kracht et al., 2022). However, adopting and maintaining healthy eating behaviors are two complex phenomena, in which the motivational component can play an important role (Ridder et al., 2017).

The present thesis maps motivational-related factors underlying children's healthy eating behaviors and childhood obesity. The conclusions drawn from this thesis are expected to provide health professionals, educators, and policy makers guidelines and tools to help them design actions and interventions capable of stimulating children's agency to adopt and maintain a healthier diet and a healthy weight. Moreover, by establishing these guidelines for practice, the results of this thesis also aim to support children by helping educators transform children's environments (e.g., home, school) into settings that promote motivation to make healthier eating decisions. In this way, it is expected that children will be better prepared to overcome the internal and external barriers they encounter in their healthy life journey.

Theoretical Background

Childhood obesity has a multifactorial etiology, with numerous causes directly or indirectly related to eating behaviors (Harrison et al., 2011; Sahoo et al., 2015). The Six-Cs developmental ecological model of contributors to overweight and obesity in childhood from Harrison et al. (2011) summarizes these causes and organize them into six spheres: cell, child, clan, community, country, and culture. The cell sphere comprises genetic and biological factors, such as food allergies (Mahmoud & Grigoriou, 2022); the child sphere comprises personal and behavioral characteristics, such as self-regulation (Miller et al., 2018); the clan sphere comprises family characteristics and interactions, such family socioeconomic status (Dennis et al., 2022); the community sphere comprises children's social world outside the home, such as peer food choices (Ragelienė & Grønhøj, 2020); the country sphere comprises the influences

that the state and the national institutions have on the individual's priorities, as well as constraints to opportunities, such as media food marketing (van der Bend et al., 2022); and the culture sphere comprises the norms, myths, and biases that guide the fundamental assumptions about health and eating, such as norms for oversized portions (Johnson et al., 2014).

The interplay between factors across all spheres of the Six-Cs model should be considered when targeting the promotion of healthier diets among children. Previous initiatives include actions from several spheres often in isolation, such as: school-based interventions to increase nutritional knowledge (Verdonschot et al., 2022); interventions targeting parents to help them face barriers related to snacking, fruit and vegetables intake, and healthy cooking at home (Tripicchio et al., 2021); banning vending machines with unhealthy snacks from schools (Capacci et al., 2018); applying taxes to sugar-sweetened beverages (Nava & Dong, 2022); restricting child-directed marketing of foods and beverages considered high in energy (Jensen et al., 2021); and, with very limited use, medication-based approaches targeting metabolic issues for weight management (Cuda & Censani, 2019). Most of these initiatives to promote healthy eating and prevent childhood obesity presented promising results. Nevertheless, the quantity and quality of children's food consumption remain far from the recommendations of the World Health Organization – i.e., per day, consumption of at least five portions of fruit and vegetables, less than 12 teaspoons of sugar, and limitation or avoidance of saturated fats (World Health Organization, 2020). For example, in a sample of Portuguese elementary school students, even those who presented a mainly healthy diet profile (34.62% of the sample) only consumed around three portions of fruit and vegetables per day (Pereira et al., 2021). Worryingly, those who presented a mainly unhealthy diet profile (14.78% of the sample) consumed more than three portions of unhealthy foods per day (Pereira et al., 2021). As a consequence, it is no surprise that childhood obesity rates present alarming numbers (Abarca-Gómez et al., 2017).

Considering the plethora of existent actions and interventions, and the difficulties in achieving healthier eating patterns for children and in reversing childhood obesity rates, it seems important to stepping back while trying to understand the possible reasons underlying these outcomes before designing and implementing new initiatives. According to Bandura (2005), initiatives focusing in external factors are important, but they are unlikely to produce lasting behavioral change unless individuals develop the means to exercise control over their motivation and health-related behaviors. Thus, adopting a motivational perspective is a way of looking at this challenge. Motivation is the process by which individuals initiate and sustain their actions (Rosário et al., 2007) and can, therefore, be key in healthy

eating promotion and childhood obesity prevention. Based on this perspective, the reasons for children's eating behaviors remaining far from recommendations and for the persistence of childhood obesity rates can be, among others, two: first, it is possible that there is a mismatch between the content of the actions and interventions developed and the real challenges and needs perceived by the children; second, most interventions focus on transmitting declarative knowledge about healthy eating, without considering the motivational background of the target population.

As previously mentioned, failure in achieving better and long-lasting health outcomes can be the result of a mismatch between what children believe are their needs and challenges in adopting and maintaining a healthy diet and reaching a healthy weight, and the actual content delivered in actions and interventions. In fact, research suggests that meeting the needs of the target audience, and taking into account their current knowledge and perceptions, is critical to promote engagement with interventions and behavior change (Ingoldsby, 2010; Nitsch et al., 2016). Based on this premise, it is expected that a child who perceives obesity as determined by genetic factors is unlikely to engage actively in an intervention that promotes changes in eating behavior. The Weiner's Attributional Theory (Weiner, 1982, 2012) provides a relevant theoretical framework for better understanding the influence that children's believes and perceptions can play in the success of actions and interventions. According to Weiner's model (1982, 2012), individuals tend to search for causal explanations for the events of their lives. The causal attribution taxonomy classifies causal explanations into three dimensions: locus, stability, and controllability. Locus classifies the causes as internal or external to the self, stability classifies the causes as stable or unstable according to their permanence over time, and controllability classifies the causes as controllable or uncontrollable according to the amenability of being manipulated by the individuals or proximal others (Weiner, 1982, 2012). Then, the causal explanations that an individual give to an event - i.e., how they interpret and ascribe meaning to what happens - will influence their future behavior through their expectations, motivation, and emotions (Weiner, 1982, 2012). For example, in the school domain, when children attribute their success or failure to internal, unstable, and controllable causes (e.g., effort), it produces motivation for engaging in behavioral change and persistence in a course of action (Almeida et al., 2008; Weiner, 2012). In fact, perceiving a cause as self-generated may display a sense of control over the phenomenon, particularly when the cause is amenable to change (Bulman & Wortman, 1977). On the other hand, if children attribute their results to internal, stable, and uncontrollable causes (e.g., ability), this may lead to acceptance of their circumstances without an attempt to change, because they do not expect changes over time and feel little control over the situation (Almeida et al., 2008; Licht & Kistner, 1986; Weiner, 1982). Thus, based on this theoretical framework, considering children's causal

attributions for obesity can help in designing interventions that correspond to their needs and challenges in the adopting and maintaining a healthier diet and, therefore, supporting behavior change.

An exploration of what has been done allow us to conclude that several preventive interventions aimed at children (e.g., school-based programs) focus on transmitting declarative knowledge about healthy eating (i.e., nutrition education) (Cauwenberghe et al., 2010). Thus, other reason that may help explain the failure to accomplish the desired standards of healthy eating for children could be the fact that most interventions focus on nutritional knowledge without considering the motivational background of the target population. In fact, research shows that children usually already have high nutritional knowledge when initiate these interventions. For example, most children know that fruit is a healthy snack and that foods with added sugars are not good for their health (Kigaru et al., 2015). Moreover, what children believe about food (e.g., think that vegetables are good for health, think that vitamins come from pills) have a stronger influence on their eating behaviors than knowledge of nutritional facts (Schultz & Danford, 2016). This suggest that the traditional approach of delivering interventions to convey declarative knowledge on healthy eating might not suffice to promote healthier eating behaviors. For example, it could be ineffective to communicate the "five a day" message if children do not perceive fruit and vegetables as important for their health and bodies. Moreover, there is evidence that knowledge about healthy eating does not necessarily prevent individuals from consuming unhealthy foods (Spronk et al., 2014). Thus, in addition to providing knowledge about healthy eating, it seems important to consider motivational-related factors that may affect the extent to which children consider healthy eating as relevant to themselves, as well as learning their motivation, skills, and competences to adopt and maintain healthy eating behaviors (Ridder et al., 2017). For example, research shows that individuals self-efficacy to exercise control over one's eating choices, and self-regulation strategies helpful to achieve healthy eating behaviors are predictors of adopting healthy practices (Bandura, 2005; Luszczynska et al., 2016).

Purpose of the Thesis

In the past few decades, a scenario of increased production of industrialized foods, rapid urbanization, and changes in lifestyle was observed. These aspects facilitated the increase of unhealthy eating behaviors, including in children (World Health Organization, 2020). As a result, children are confronted with several new obstacles to the adoption and maintenance of healthy eating behaviors, such as easy access to sugar-sweetened beverages, proximity to fast-food restaurants, exposure to unhealthy food marketing on social media, and contact to family habits that includes watching television during meals (Davis & Carpenter, 2009; Santiago-Torres et al., 2014; Valero-Morales et al., 2023). Overcoming the

childhood obesity public health challenge amidst this reality has become an overwhelming task, with children requiring reinforced motivation and the development of skills and competences (e.g., self-regulation) that help them to make healthy food choices even when these obstacles arises (Bandura, 2005; Ridder et al., 2017). Likewise, there is an urgency of collective efforts from policymakers, researchers, and practitioners to design and deliver actions and interventions that help children to foster the required motivation, skills, and competences to attain healthy eating goals (Bandura, 2005; Sharifi & Block, 2021).

Anchored by robust theoretical models (i.e., Six-Cs model, causal attributions model), the present thesis was designed to contribute to the efforts to combat the public health challenges of childhood obesity and healthy eating behavior. This thesis aimed to respond to the literature gaps related to mapping motivational-related factors that contribute to the promotion of healthy eating in children and, ultimately, prevent childhood obesity. Hence, the knowledge gathered from this thesis is expected to shed light on two overarching research questions with important implications for practice:

- What are children's perceptions of obesity enablers from a causal attribution perspective and how might they influence children's engagement in interventions?
- What is the role of motivational-related factors in preventing obesity and promoting healthy eating?

Thesis Outline

The current thesis aims to contribute both to the practice and research, by providing knowledge on the motivational-related factors that can be key in healthy eating promotion and, consequently, childhood obesity prevention. The thesis begins by exploring children's own perspectives on the causes of the global obesity scenario and proceeds to mapping the role of some obesity' and eating behaviors' predictors that may underline children's motivation to adopt and maintain a healthier diet and a healthy weight. Therefore, four studies, in which the results of the previous informed the design of the following study, were conducted (see Figure 1) with the aim of understanding: (i) children's perspectives on enablers of obesity [chapter 1]; (ii) the role of knowledge about healthy eating and self-regulation towards healthy eating on the relationship between family's income and children's weight [chapter 2]; (iii) the role of different motivational-related factors (e.g., self-regulation, self-efficacy) on children's healthy and unhealthy food consumption; and (iv) the role of parent's and peers on children's self-regulation towards healthy eating and, consequently, on children's healthy eating behavior.

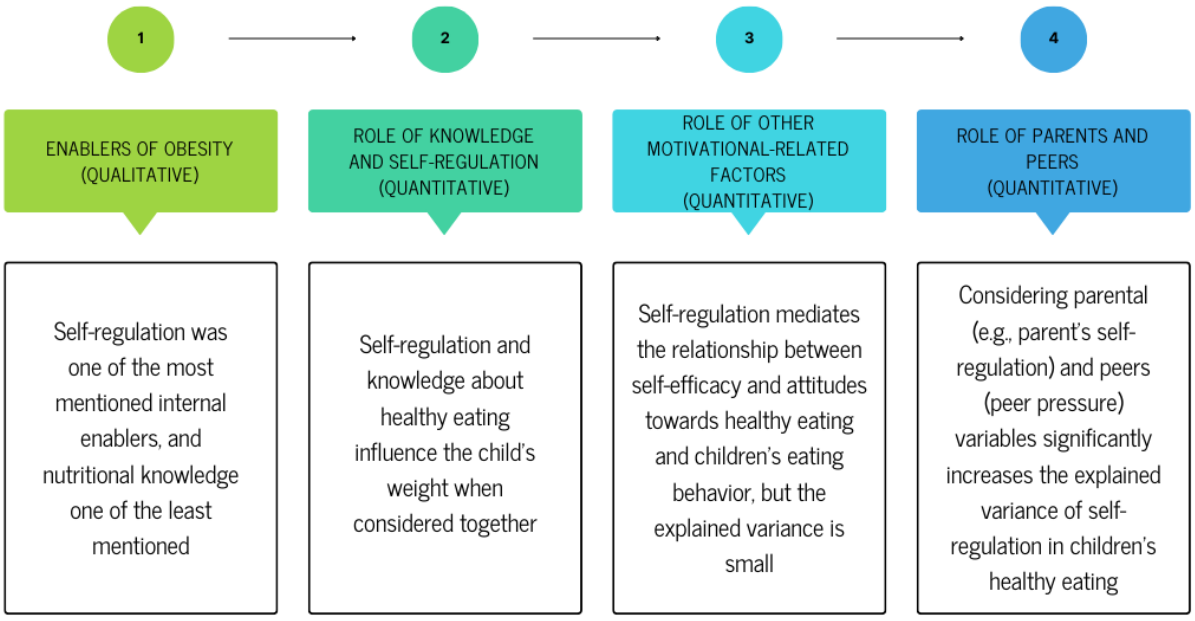


Figure 1 - Chapters sequence and cumulative interconnection[1].

The first study [chapter 1] was conducted to explore children's perspectives on the enablers of obesity from a Causal Attributions perspective (Weiner, 1982, 2012). This was a way to better understand possible reasons behind why some children are open to behavior change and others are resistant to interventions and actions aiming at behavioral change (Almeida et al., 2008; Licht & Kistner, 1986). For example, children are likely to be open to interventions when they perceive the causes of obesity as being related to themselves, modifiable, and under their control to change (Almeida et al., 2008; Bulman & Wortman, 1977; Weiner, 2012). The results of this study contributed to enrich the existent literature and provided insights about which variables to include in the following study of the current thesis (see Chapter 1 and Conclusion section for further information).

Based on chapter 1 reflections, and considering that children from families with low socioeconomic status are less likely to show healthy eating behaviors and more likely to have obesity (Dennis et al., 2022; Fismen et al., 2021), the second study of this thesis [chapter 2] was conducted with the aim of evaluating the role played by complexity of knowledge about healthy eating and self-regulation towards healthy eating in the relationship between family's income and children's weight. The conclusions of this chapter provided new insights into the role played by some motivational-related factors in preventing childhood obesity and informed the design of the following study of the present thesis (see Chapter 2 and Conclusion section for further information).

[1] KHE = Knowledge about healthy eating; SR = Self-regulation

Grounded on the knowledge provided by the second study and on prior research and theoretical models showing the potential role of other motivational-related factors on health behaviors (Bandura, 2005; Luszczynska et al., 2016; Schultz & Danford, 2016), the third study of the current thesis [chapter 3] was designed to explore the role that knowledge about healthy eating, self-regulation towards healthy eating, self-efficacy towards healthy eating, and attitudes and perceptions on healthy eating may play in children's consumption of healthy and unhealthy foods. The results of this study enriched the conclusions of previous chapters about the relevance of considering motivational-related factors in promoting healthy eating and preventing childhood obesity, and reflections on the results guided the last chapter of this thesis (see Chapter 3 and Conclusion section for further information).

When reflecting on the conclusions gathered from the first three chapters of the present thesis, it was clear the relevant role played by motivational-related factors on children's weight and eating behavior. It was also already known that these variables, by themselves, are not enough to determine children's weight and eating behavior, and that there is a need to consider variables from different spheres of children's life that may contribute to these health outcomes (Harrison et al., 2011). Based on this premise and considering previous research that recognizes the modeling performed by parents and peers in children's eating behavior (Roberts & Pettigrew, 2013; Sleddens et al., 2010), the last study of this thesis [chapter 4] aimed to extend the model from chapter 3 by adding four new variables from the clan- and community-level spheres of children's lives (i.e., parent's healthy eating behavior, parent's self-regulation, parental feeding styles, and peer pressure). The results contributed to better understanding the complexity of the phenomena of healthy eating and childhood obesity (see Chapter 4 and Conclusion sections for further information).

Altogether, these chapters offer scientific evidence on the role of motivational-related factors in elementary school students healthy eating through studies developed with both qualitative and quantitative methodologies. The integration of the knowledge gathered from these studies has several implications for research and practice (see Lessons Learned section) and is expected to help generate debate that guides the design of future actions and interventions aimed at promoting healthier diets and preventing childhood obesity.

Chapter 1

Understanding children's voices about enablers of obesity from a causal attribution's stance: a vignette study[2]

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1. Understanding children's voices about enablers of obesity from a causal attribution's stance: a vignette study

Abstract

Childhood obesity is a public health challenge with health, economic and psychosocial consequences. The design of interventions addressing childhood obesity seldom considers children's perspectives on the topic. Weiner's causal attribution framework was used to explore children's perspectives on enablers of obesity. Children (N = 277) responded to a vignette with an open-ended question. Data were analyzed using content analysis. Children perceived *internal, unstable, and controllable* causes (e.g., dietary intake, self-regulation and emotionality) as the main enablers (76.53%) of obesity, while some (11.91%) highlighted *external, unstable and controllable* causes (e.g., parent food restrictions). A focus on children with healthy body weight showed that they mentioned more *internal, stable, and controllable* causes for obesity than children with unhealthy body weight/obesity did. The latter mentioned more *external, unstable, and controllable* causes than their counterparts. Understanding children's causal attributions for obesity is expected to deepen our knowledge of obesity enablers and help design interventions matching children's perspectives.

Keywords: Obesity, Causal attributions, Children, Qualitative design, Enablers of obesity

1.1 Introduction

Obesity is considered a chronic disease and a growing epidemic, with childhood obesity being one of the most serious public health challenges of the XXI century (Bray et al., 2017; Inchley et al., 2017). Obesity has health (e.g., insulin resistance), economic (e.g., costs with remediation), social (e.g. isolation) and psychological (e.g. low self-esteem) related consequences (Cawley et al., 2021; Datar et al., 2004; World Health Organization [WHO], 2021). In particular, literature has emphasized the psychosocial impact of obesity. For example, children with unhealthy body weight/obesity are likely to be the target of prejudice, blame and stigmatization, which may lead to feelings of self-blame (e.g., feelings of failure and guilt for having obesity) (Datar et al., 2004; Pearl & Lebowitz, 2014; Trainer et al., 2022).

To address this public health problem, literature has focused on understanding childhood obesity's etiology. For example, the Six-Cs Model summarizes a vast body of research on variables likely to contribute to childhood obesity, including genetic factors and others related to eating behavior and physical activity (Harrison et al., 2011). Accordingly, there has been considerable investment in designing interventions based on these factors (e.g., nutrition education and interventions to increase physical

activity) to prevent and mitigate childhood obesity with promising results (Comeras-Chueca et al., 2020; Lee et al., 2020). However, evidence indicates that childhood obesity rates remain high, suggesting the need to analyze the reasons behind these data (Bogle & Sykes, 2011; Childhood Obesity Surveillance Initiative [COSI], 2019; Kamath et al., 2008).

One possible explanation for the high childhood obesity rates could be that most previous research and interventions targeting obesity did not consider children's perspectives on their causes (Baranowski, 2006). Considering children's perspectives on the various causes of obesity is relevant because research indicates that meeting the needs of the target audience, and taking into account their current knowledge and perceptions, is critical to promote engagement with interventions and behavior change (Ingoldsby, 2010; Nitsch et al., 2016). A study by Brogan et al. (2019) with children with obesity and their parents showed great heterogeneity in their perceived causes of obesity. Thus, individual beliefs could be a key determinant when addressing behavior change to design tailored approaches and increase children's willingness to change (Amiri et al., 2011; Rendón-Macías et al., 2014). For example, children who perceive obesity as determined by genetic propensity are not likely to engage positively in an intervention that promotes "eating more fruit and vegetables".

Weiner's Attributional Theory (Weiner, 1982, 2012) provides a relevant theoretical framework for the current study. According to this model, individuals tend to search for causal explanations for the events of their lives. The causal attribution taxonomy classifies causal explanations into three dimensions: locus, stability, and controllability. Locus classifies the causes as internal or external to the self, stability classifies the causes as stable or unstable according to their permanence over time and controllability classifies the causes as controllable or uncontrollable according to the amenability of being manipulated by the individuals or proximal others (Weiner, 1982, 2012). Weiner's theory (1982, 2012) states that how individuals interpret and ascribe meaning to events will likely influence their future behavior. For example, in the school domain, when children attribute their success or failure to *internal, unstable, and controllable* causes (e.g., effort), it produces motivation for engaging in behavioral change and persistence in this course of action (Almeida et al., 2008; Weiner, 2012). Perceiving a cause as self-generated may display a sense of control over the phenomenon, particularly when the cause is amenable to change (Bulman & Wortman, 1977).

1.1.1 Purpose

A vast body of literature analyzes the causes of childhood obesity (Harrison et al., 2011). However, most of the prior studies are: (a) grounded on bodies of knowledge rather than on a theoretical framework (e.g.,

Brogan et al., 2019; Pearl & Lebowitz, 2014); (b) focused only on one dimension of the complex net of causal explanations (e.g., only locus) (Pearl & Lebowitz, 2014); and (c) seldom focused on children's perspective, which may differ from that of experts. In contrast, our study will examine children's perspectives based on Weiner's model (1982, 2012). We followed the suggestions made by previous research while considering that children's perspectives could be key to deepening our knowledge of childhood obesity and explaining their subsequent behavior (Kornilaki, 2015). Moreover, grounding research in a robust theoretical framework helps provide clear implications for practice.

The novelty of analyzing children's perspectives based on the three dimensions of Weiner's causal attribution model allows us to go beyond the common reflections focused only on the locus of the causes of obesity. For example, a study by Wang et al. (2016) analyzed nurses' perspectives regarding the locus of causality of obesity and found that most believe the causes of obesity to be beyond the individual's control. Results also suggested that nurses who make these attributions are more likely to have positive attitudes toward individuals with obesity (Wang et al., 2016). Despite being relevant, this information is limited since the authors did not consider whether these external causes of obesity are expected to change over time or are amenable to being manipulated. Thus, in addition to considering the relevance of the locus of causality, the literature suggests that the causes of obesity could also be understood as unstable, triggering individuals' motivation to change, or, in contrast, as stable, leading individuals to learn discouragement, which may prevent behavioral change (i.e. individuals avoid making efforts to fight obesity because they do not expect changes) (Amiri et al., 2011; Weiner, 1982). Furthermore, the internal/external and stable/unstable causes could be perceived as controllable – leading to increase motivation and persistence in the case of success or to blame or discouragement in the case of failure – ; or as uncontrollable, leading to passive acceptance of their circumstances (Almeida et al., 2008). All considered, we believe that Weiner's Attributional Theory-inspired way of looking at the causes of childhood obesity from the child's perspective is likely to help better understand children's obesogenic-related behaviors and attitudes (e.g., adherence to healthy eating, blame).

In sum, the main goal of the present study is to examine children's perspectives on enablers of obesity from a causal attribution stance. The study enrolls children from a school community sample due to the importance of preventing childhood obesogenic-related behaviors before they arise; as Mikkilä et al. (2005) reported, habits developed during childhood are likely to persist throughout adulthood. The second goal of the present study is to understand whether causal attributions differ by a child's Body Mass Index (BMI). Braet et al. (2012) emphasized that the psychological mechanisms underlying the

perceived causes of obesity could differ in distinct subgroups of children. Understanding these possible differences could help researchers and practitioners develop tailored strategies (Braet et al., 2012) likely to increase children's adherence to interventions and, consequently, increase interventions' efficacy in promoting healthy behaviors.

1.3. Materials and Methods

1.3.1. Setting and Sample

Our sample comprises children enrolled in an intervention to promote healthy eating carried out in September 2019 in two schools in the north of Portugal. Data collection took place before the beginning of the intervention. During this initial session, data about the worldwide obesity scenario was presented to children (see the measurement section). Participants were asked to reflect and write about the possible explanations for this scenario.

All children enrolled in the intervention were invited to partake in this research (see Figure 2). The reasons were: (i) gathering a diverse, maximum variation sample (Sandelowski, 1995), with the variation sought across BMI and gender; and (ii) using a vignette with an open-ended question to collect the data. This method requires collecting data from a large sample to achieve the large variability of responses possible and gather representativeness of the phenomenon (Creswell, 2012).

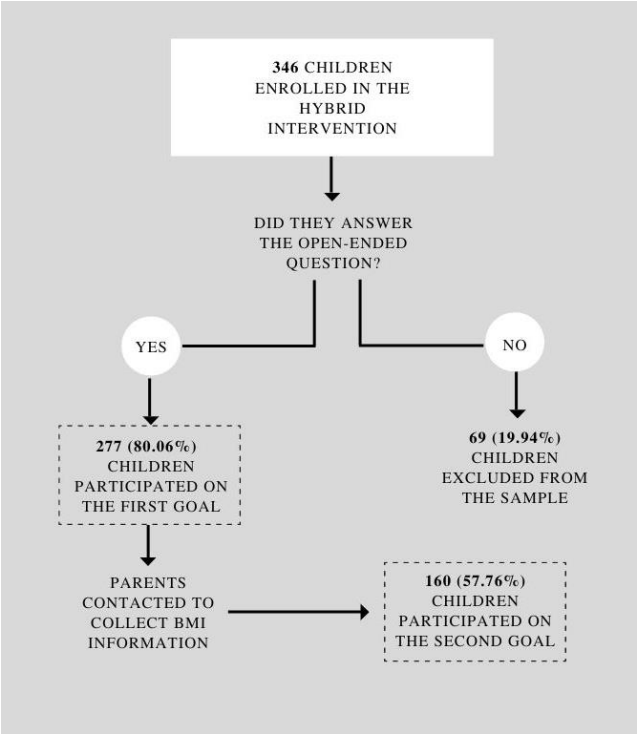


Figure 2 - Participants' selection for the qualitative analysis[3].

[3] First goal - examine children's perspectives of enablers of obesity from a causal attribution stance; Second goal - understand whether causal attributions differ depending on the children's BMI.

The sample of our first goal was composed of 277 elementary-school children (132 girls, 47.65%) from the 5th and 6th grades, aged between 9 and 14 (M = 10.92, SD = 0.80). For the second goal, to calculate children's BMI, despite all parents/caregivers being asked about children's weight, height, gender, and date of birth, just 160 responded positively (response rate of 57.76%; Figure 2).

To guarantee that the included and excluded samples (i.e., without BMI information) were similar regarding weight distribution, we compared both regarding their income. Income could be a good indicator because there is a close relationship between a family's income and children's BMI (Pereira et al., 2019). No significant differences between group × income were found [t (0.412; 275), p-value = .680], which may suggest no differences in the BMI of the children in both samples.

Data on the BMI information show that two (1.2%) participants had underweight, 108 (67.5%) had healthy body weight, 38 (23.8%) had unhealthy body weight and 12 (7.5%) had obesity (see measurement section for details on BMI calculation). Considering the purpose of the second goal, participants with underweight were excluded from the analysis and participants with unhealthy body weight and obesity were included in the same group. The BMI distribution is not balanced, which might be due to being a school community sample – the distribution is close to what is expected in the general population (e.g., 29.6% of children with unhealthy body weight; COSI, 2019).

1.3.2. Measurement

1.3.2.1. Vignette with an Open-ended Question

Compared with closed-format questions, open-ended questions reduce the likelihood of biased responses and are better suited to capture the diversity of participants' perceptions about a topic. Vignettes consist of written scenarios with brief descriptions of situations likely to prompt participants' judgments (Wason et al., 2002). Advantages of using vignettes include: (i) providing the participants an evaluation of the situation presented and their position towards it; (ii) providing a standardized stimulus for all participants; (iii) reducing social convenience bias; and (iv) increasing the involvement of participants (Evans et al., 2015; Wason et al., 2002). In the present study, the vignette with an open-ended format question presented the following scenario:

"It is estimated that: 1.9 billion adults have unhealthy body weight, and 650 million have obesity; 30% of children have unhealthy body weight or obesity, and 38 million under the age of 5 have unhealthy body weight or obesity.

What do you think are the causes for this scenario worldwide?"

1.3.2.2. BMI

To evaluate children's BMI, the *Z*-score classification system was used (Onis & Blössner, 1997). The *Z*-score system expresses the anthropometric value as the number of standard deviations below or above the mean or median value of reference. Parents/caregivers were asked about their child's height, weight, gender and date of birth. With this information, we used the *WHO AnthroPlus* software to calculate children's *Z*-scores. The classification through *Z*-scores for five-19 years is as follows: Obesity: > +2 *SD*, Unhealthy body weight: > +1 *SD*, Healthy range weight: between +1 *SD* and −1 *SD*, Underweight: between −1 *SD* and −2 *SD* and Severe thinness: > −2 *SD*.

1.3.3. Data Collection

This study is part of a research project approved by the University of Minho Ethics Committee for Research in Social and Human Sciences (CEICSH) (CEICSH 032/2019). Consent to conduct the study in a school setting was obtained from the Portuguese Ministry of Education. Parents/caregivers of the participants provided written informed consent, and the children provided assent to participate.

Researchers collected data in person. The scenario's presentation and the open-ended question completion took approximately 15 min. Afterward, responses were transcribed verbatim. Finally, a form was sent to parents/caregivers asking for their children's BMI-related information. The information provided by the parents was matched to the children's qualitative transcriptions via an assigned code.

1.3.4. Data analysis

Qualitative data were analyzed through content analysis, following the steps (i.e. pre-analysis, exploration of data and treatment) described by Bardin (1977). The identification of categories and subcategories followed a deductive and an inductive iterative process. In the former, based on the three dimensions of Weiner's model (Weiner, 1982, 2012), the eight possible categories were organized a priori in a code-book. Additionally, the subcategories were established based on the Six-Cs model, presenting contributors to childhood obesity (Harrison et al., 2011). As part of the inductive process, new subcategories were added based on new insights that emerged from the data as the analysis was carried out. The QSR International's NVivo 10 software was used to assist with the data organization, management, coding and querying process (Richards, 2005).

Methodological procedures to enhance the trustworthiness of the findings were set up (Goodell et al., 2016). Before the treatment phase, two researchers (i) discussed the distinguishing criteria of each of the categories and subcategories; (ii) practiced together applying the codebook to a selection of transcriptions comprising most categories and subcategories until they agreed on coding; (iii) codified a

distinct selection of transcriptions independently, compared codifications and resolved any differences through discussion; until (iv) reached consistency on codification. Afterward, one researcher coded all the data, and a second coded 40% independently. The two researchers reviewed all categories and subcategories and discussed the differences found to reach a consensus. The Kappa value obtained was 0.83, considered excellent according to Landis and Koch (1977).

To meet our first goal (i.e. examine children's perspectives on enablers of obesity), the NVivo 10 software provided the number of participants in each category and subcategory, and the researchers calculated the respective frequencies and percentages. Then, the causal attributions more frequently referenced by children were analyzed. Finally, to meet the second goal, coding matrices were analyzed to investigate possible category frequency differences according to participants' BMI.

1.4. Results

Attributions of obesity were highly diverse, with some children indicating a single cause and others a complex array of factors. Weiner's model comprises eight possible attribution categories. In the present study, six out of these eight attribution categories were found: (i) Internal, unstable, and controllable causes, (ii) External, stable, and uncontrollable causes, (iii) Internal, stable, and controllable causes, (iv) External, unstable and controllable causes, (v) External, stable and controllable causes and (vi) Internal, stable and uncontrollable causes. In the present section, the categories and subcategories were presented in decreasing order, from the most mentioned to the least mentioned.

To clarify the reporting process of the frequency of responses for each category and subcategory, we followed the Cooper and Rodgers (2006) scoring scheme set for qualitative analyses with samples of 23 participants [all = 23 cases (100% of the participants); near all = 21 to 22 cases (100% minus 2 of the participants); most = 13 to 20 cases (50% plus 1 to 100% minus 2 of the participants); around half = 11 to 12 cases (50% minus 1 of the participants); some = 3 to 10 cases (3 to 50% plus 1 of the participants); a couple = 2 participants; one = 1 case]. In the current study, we used an adapted version while maintaining the proportionality of the frequencies. Scores were as follows: all = 277 cases (100% of the participants), nearly all = 253 to 276 cases (100% minus 24 to 100% minus1 of the participants), most = 163 to 252 cases (50% plus 24 to 100% minus 24 of the participants), around half = 114 to 162 cases (50% minus 24 to 50% plus 24 of the participants), some = 26 to 113 cases (26 to 50% minus 24 of the participants), a few = 2 to 25 cases (2 to 1 plus 24 participants) and one = 1 case. Table 1 presents all the subcategories emerging in each category, with the respective response distribution and

representative quotes. However, we only explored the categories and subcategories with reasonable representation in the data (categories and subcategories scoring $n \geq 8$).

1.4.1. Internal, unstable, and controllable causes (76.53% of the total cases)

An excerpt of a response was classified as *internal, unstable, and controllable* when children attributed obesity to causes related to themselves, likely to change over time and amenable to manipulation (i.e., children could change these factors). This attribution was the most mentioned category. Six subcategories were identified: *dietary intake*, *self-regulation and emotionality*, *sedentary behavior and excessive media use*, *perceived risk*, *nutritional knowledge seeking* and *body image*.

1.4.1.1. Dietary Intake (44.40% of the cases within this category)

Around half of children perceived *Dietary intake* as a major cause of obesity. Participants indicated that not practicing a healthy and balanced diet and, conversely, practicing an unhealthy one contributes to obesity. Specifically, participants said that the consumption of large amounts of unhealthy food, such as junk food, candies, and food with added salt, could lead to an excessive caloric intake.

"They [people with obesity] *only eat, for example, pizzas, hot dogs, schnitzels, many others* [unhealthy foods]. *People with obesity do not eat vegetables, fruits, soups; they do not eat healthy things."* (CGA4, 12-year-old boy)

1.4.1.2. Self-regulation and Emotionality (23.10% of the cases within this category)

Some children attributed obesity to a lack of self-control to avoid certain unhealthy foods that people feel like eating. Participants mentioned that after eating these unhealthy foods, individuals struggle to stop and tend to overeat. Consequently, eating becomes an addiction. It also emphasized the lack of motivation to plan and control diets.

"They think like this: I am going to eat one more, just one more. In the end, they are already with obesity." (ARGB2, 12-year-old girl)

1.4.1.3. Sedentary behavior and excessive media use (18.05% of the cases within this category)

Some children mentioned a lack of physical activity as a cause of obesity. Participants declared that individuals are decreasing their regular exercise practice, especially in outdoor activities such as hiking. Moreover, participants stressed that increasing levels of sedentarism were related to the growing use of technology (e.g., individuals spend many hours sitting on the sofa watching television and playing with their smartphone/computer).

"Nowadays, people prefer to watch television or play on the computer for long hours than to exercise." (PVBG20, 12-year-old boy)

1.4.1.4. Perceived risk (14.8% of the cases within this category)

Some participants reported that individuals have obesity because they are unaware of its consequences and are not careful with their diets or general health. Some children stated that sometimes individuals only realize the health consequences of their excess weight when they already have unhealthy body weight.

"People think that if they overeat and put on weight, nothing will happen to them." (IMCS12, 9-year-old girl)

1.4.1.5. Nutritional knowledge seeking (6.86% of the cases within this category)

A few children attributed obesity to a lack of knowledge about healthy eating-related topics (e.g., food wheel). Participants mentioned that individuals often lack knowledge about what they eat and how to gather and apply information about a healthy diet.

"They are unaware of the mistakes they make when eating certain foods." (JGGN14, 11-year-old boy)

1.4.2. External, stable, and uncontrollable causes (27.08% of the total cases)

An excerpt of a response was classified as *external, stable, and uncontrollable* when children attributed obesity to causes related to environmental factors, unlikely to change over time and not amenable to being manipulated by individuals or proximal others. Five subcategories were identified: *unhealthy vending options*, *proximity to food outlets*, *food industrialization*, *national food economy* and *media food marketing*. Importantly, the subcategory 'Food industrialization' emerged from our data, despite being mentioned by a few children.

1.4.2.1. Unhealthful vending options (10.47% of the cases within this category)

Some children placed the responsibility for obesity on certain types of food sold in or near the school, especially those with added fats and sugars (e.g., jellies, burgers). Participants stated that there is an increasing availability of unhealthy foods, which are seen as more appealing and tastier than healthy ones. Consequently, these foods divert children from healthy eating while making them fat.

"Processed foods are more attractive and less healthy, which makes them more consumed." (DVM6, 11-year-old boy)

Table 1 - Responses of children to the open-ended question about obesity causes.[4]

Category	*N* (%)	Subcategory	*N* (%)	Examples
Internal, stable, and uncontrollable	4 (1.44)	Genetic propensity	4 (1.44)	"It is often genetic" (ALVB6, 11-year-old girl)
Internal, unstable, and controllable	212 (76.53)	Dietary intake	123 (44.40)	"Because a lot of people consume foods with added salt and fats" (DMVA9, 12-year-old-boy)
		Self-regulation and emotionality	64 (23.1)	"People cannot avoid eating sweets despite knowing well that they are bad" (ACVF2, 10-year-old boy)
		Body image	4 (1.44)	"Because they don't like themselves and to feel 'better' they eat more; it just ends up getting worse and feeling increasingly ugly" (AP31, 11-year-old girl)
		Nutritional knowledge seeking	19 (6.86)	"People do not know what a healthy diet is" (EMP11, 11-year-old girl)
		Sedentary behavior and	50 (18.05)	"Do not exercise, and are sedentary" (JMGF13, 12-year-old-boy)

[4] Locus - if children attribute obesity to causes that reside in or outside the self (Internal – self; External – outside the self). Stability - if children attribute obesity to causes that are expected to change over time (Stable – unlikely to change; Unstable – could change). Controllability - if children attribute obesity to causes amenable to be manipulated by someone, whether the child or other person (Controllable – amenable; Uncontrollable – not amenable or only with extreme difficulty).
Categories with no responses are not shown.
Percentages = Number of children who mentioned that (sub)category/Total children*100

		excessive media use		
		Perceived risk	41 (14.8)	“Many people may not know the many problems that obesity can cause” (TG26, 12-year-old girl)
Internal, stable, and controllable	63 (22.74)	Habits formed and food preferences	63 (22.74)	“Most people like fast food and eat it many times a week” (JPMF12, 10-year-old boy)
External, stable, and uncontrollable	75 (27.08)	Proximity to food outlets	24 (8.66)	“Start to open many fast-food restaurants” (ABM3, 12-year-old girl)
		Unhealthful vending options	29 (10.47)	“Because there are foods with a lot of sugar and fat” (FABPT12, 12-year-old boy)
		Media food marketing	9 (3.25)	“Because of misleading claims about food and drinks that are harmful to human health. (FAS29, 10-year-old boy)
		National food economy	14 (5.05)	“Because the cheapest foods are foods that are not good for your health” (SBR23, 11-year-old boy)
		Food industrialization	17 (6.14)	“Increasing use of chemicals to make certain snacks and drinks” (FAS29, 10-year-old boy)

External, unstable, and controllable	33 (11.91)	Parent food restrictions	14 (5.05)	“Parents let them eat that junk” (IC13, 10-year-old girl)
		Parent encouragement of healthy eating	17 (6.14)	“Parents often don't want to know” (TO28, 10-year-old boy)
		Parent BMI	4 (1.44)	“If the parents of the children have obesity the children will tend to have obesity” (11-year-old girl)
		Food available in home	2 (0.72)	“If someone wants to eat healthy things and change the type of diet, but at home does not have these habits or products, it will be really complicated” (ALVB6, 11-year-old girl)
External, stable, and controllable	10 (3.61)	Lifestyle	10 (3.61)	“People have a very fast life” (JPCL15, 11-year-old boy)

1.4.2.2. Proximity to food outlets (8.66% of the cases within this category)

Concurrently, a few participants indicated that the evolution of fast-food chains also contributes to obesity. Children mentioned that unhealthy-food-type restaurants are easier to find and are more prevalent than healthy ones. For example, participants stated that typically malls house several unhealthy food outlets (e.g., restaurants with processed food and candy stores).

"When they go to shopping centers, there are many fast-food stores such as McDonald's, Burger King, Steak Shake, Pizza Hut, Telepizza, Hussel, etc ..." (MSPA19, 10-year-old girl)

1.4.2.3. Food industrialization (6.14% of the cases within this category)

The modernization of the food industry is a perceived cause of obesity related to the previous one. A few children pointed out that, in the past, the number of sweets and unhealthy food brands available was more restricted compared to nowadays. A few participants stated that processed products are misleading consumers because they contain additives and chemicals that create artificial flavors while making foods tastier and more addictive.

"The food is not of great quality. It is full of chemicals to make it look more appetizing. But if we look at how they are made, they are a danger to our health." (FCC6, 11-year-old girl)

1.4.2.4. National food economy (5.05% of the cases within this category)

A few children mentioned that obesity is caused by food prices (e.g., low prices for unhealthy foods [such as fast-food] and high prices for healthy foods [such as fruit and vegetables]). They believe that the food business is profitable and that companies producing unhealthy foods are more interested in economic growth than people's well-being.

"People continue to consume these [unhealthy] *foods because they are cheap and fast. The people who produce them only think to produce for less* [money] *and more profit."* (FCC6, 11-year-old girl)

1.4.2.5. Media food marketing (3.25% of the cases within this category)

A few children mentioned the importance of advertisements as a cause for obesity, specifically, the high number of advertisements (e.g., television, street mockup) with misleading messages inciting individuals to eat unhealthily. Participants also mentioned that food marketing predominantly promotes foods and drinks that are harmful to health rather than healthy foods.

"Because of advertising. Usually, when I see advertising, it is about fast food; you rarely see advertising about mineral water or fruit, making people buy more fast food than healthy food." (CBCT3, 11-year-old girl)

1.4.3. Internal, stable and controllable causes (22.74% of the total cases)

An excerpt of a response was classified as *internal, stable, and controllable* when children attributed obesity to causes related to themselves, unlikely to change over time but amenable to manipulation (i.e., children could change these factors). Just one subcategory was identified within this theme; still, this subcategory was mentioned by some participants.

1.4.3.1. Habits formed and food preferences (22.74% of the cases within this category)

Some children pointed out unhealthy eating practices that become a habit as a cause for obesity (i.e., eating junk food or going out to eat at restaurants every day or several times per week). Additionally, participants highlighted that the acquisition of these habits begins early in life. Children mentioned two reasons for grounding these habits. First, individuals prefer unhealthy to healthy foods because the former (e.g., sweet foods) taste better than the latter (e.g., vegetables). Second, individuals prefer unhealthy foods because they believe this is faster and easier than healthy options.

"People have gotten used to it, and now there are millions of people who prefer food with lots of fats and have obesity instead of eating healthier foods." (ALLCI, 11-year-old girl)

1.4.4. External, unstable, and controllable causes (11.91% of the total cases)

An excerpt of a response was classified as *external, unstable and controllable* when children attributed obesity to causes related to environmental variables, specifically family-related factors, that were amenable to being manipulated (i.e., parents could change these factors). Four subcategories were identified: *parent encouragement of healthy eating, parent food restrictions, parent BMI and food available in the home.* Some participants mentioned this category.

1.4.4.1. Parent encouragement of healthy eating (6.14% of the cases within this category)

A few children mentioned the lack of parental incentive to eat healthy as an enabler of obesity. More specifically, these participants described that some parents seldom provide their children with guidance about what they should eat or even care about their children's food habits. In contrast, other children (a few) also mentioned that some parents encourage children to eat food and gain weight rather than encourage them to eat healthily.

"Sometimes parents also don't help their children; they don't teach them what to eat." (EFD5, 11-year-old boy)

"Parents tell them [they need] *to eat and get fat."* (IC10, 10-year-old girl)

1.4.4.2. Parent food restrictions (5.05% of the cases within this category)

A few children held their parents responsible for following a non-food restriction diet education. Participants mentioned that many parents let children eat without external control, including unhealthy foods that may contribute to their obesity (e.g., junk food and desserts high in sugar). According to participants, children who want to eat unhealthy food just need to ask for it or throw a tantrum.

"Children ask their parents to eat lasagna, chips, etc... and parents give them that to eat." (MPT17, 12-year-old boy)

1.4.5. External, stable, and controllable causes (3.61% of the total cases)

An excerpt of a response was classified as *external, stable, and controllable* when children attributed obesity to causes related to environmental variables that are unlikely to change over time but amenable to being manipulated. Only one subcategory was identified within this category, and just a few children mentioned it.

1.4.5.1. Lifestyle (3.61% of the total cases)

A few children mentioned obesity as a contemporary lifestyle consequence. Participants mentioned that people who tend to live in a hurry lack time to cook healthy homemade meals. Additionally, participants mentioned that many people working in offices do not have the time to eat a proper lunch or do exercise. Another consequence of the present way of life mentioned by the participants was the easiness of ordering food online without leaving home/office.

"Lately, people are very hurried and do not have time to prepare healthy foods at home; they choose to go to processed [food] *restaurants such as MC Donald's, Burger King, etc..."* (IGC11, 11-year-old girl)

1.4.6. Differences by children's BMI

To examine response frequency by BMI, two analyses were conducted. First, an inter-category analysis has shown a similar pattern in the children's response frequency by BMI in four out of the six categories: *internal, stable, and uncontrollable* causes (i.e., genetic propensity), *internal, unstable, and controllable* causes (e.g., dietary intake), *external, stable, and uncontrollable* causes (e.g., unhealthful vending options) and *external, stable and controllable causes* (i.e., lifestyle). Regarding the other two categories, data show that children with healthy body weight mentioned *internal, stable, and controllable* causes for obesity (i.e., habits formed and food preferences) around 4% more times than their counterparts with unhealthy body weight/obesity. In contrast, the participants with unhealthy body weight/obesity mentioned *external, unstable, and controllable* causes of obesity (e.g., parent food restrictions) around

6% more often when compared with counterparts with healthy body weight. In particular, only children with unhealthy body weight/obesity mentioned their parent's BMI as a cause for obesity; additionally, these children mentioned their parents' food restrictions around 4% more often than their counterparts with healthy body weight did.

Second, a detailed within-category analysis has shown differences in some subcategories from two categories, i.e., *external, stable, and uncontrollable* and *internal, unstable, and controllable* causes. Regarding the *external, stable, and uncontrollable* categories, children with healthy body weight mentioned the *food industrialization* cause around 4% more often than their counterparts with unhealthy body weight/obesity. Conversely, children with unhealthy body weight/obesity mentioned the *proximity of food outlets* around 4% more often than counterparts with healthy body weight. Concerning the *internal, unstable, and controllable* category, children with healthy body weight mentioned the *perceived risk* factor around 4% more often than their counterparts with unhealthy body weight/obesity. Finally, children with unhealthy body weight/obesity referred to *dietary intake* as a cause approximately 8% more often than their counterparts with healthy body weight.

1.5. Discussion

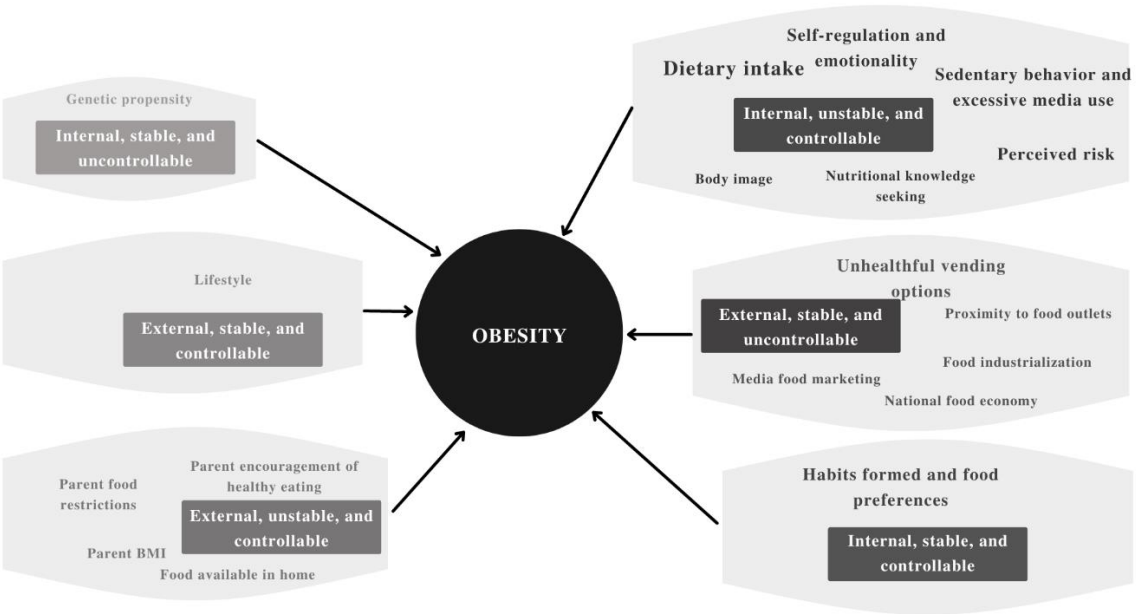


Figure 3 - Visual map of the categories, subcategories and representatively developed through content analysis[5].

[5] The kites' size represents the frequency in which the causal attributions were represented in the results (i.e. larger kites, most mentioned categories). Data are presented following Cooper and Rodgers (2006) scoring scheme. In each kite, the frequency of each subcategory within the theme is presented through font-size: big font size represents subcategories mentioned by around half of children (50% – 24 to 50% + 24, n = 114 to 162), medium font size represents subcategories mentioned by some children (25 to 50% – 24, n = 26 to 113), small font size represents subcategories mentioned by a few children (2 to 1 + 24, n = 2 to 25).

Grounded on Weiner's model (1982), this study explored the enablers of obesity from the children's perspective. To attain this goal, children were presented with a vignette focused on obesity along with an open-ended question. The qualitative analysis of the responses allowed us to understand children's causal attributions for obesity (see Figure 3). In addition, we examined whether causal attributions differed depending on children's BMI. The following subsections address the more prominent result, the non-expected result, the differences by children's BMI and the emerging enablers.

1.5.1. The main results

Internal, unstable, and controllable causes were the children's primary attributions for obesity. Children perceive obesity as the result of a combination of factors related to themselves, which are likely to change over time and under their control. Specifically, dietary practices characterized by low consumption of healthy foods and high consumption of unhealthy foods, poor self-regulation to cope with food temptations, sedentary habits, and lack of perceived risk of the negative implications of obesity were identified as primary causes of obesity. This is consistent with evidence warning that poor diets and insufficient physical activity are the main drivers of obesity (Harrison et al., 2011) and with the findings of Pereira et al., (2019) stressing the positive influence of self-regulation toward healthy eating on children's weight. The current finding is also consistent with prior research showing that the perceived risk of obesity plays a central role in weight management (Alm et al., 2008).

In general, children showed awareness of their personal responsibility while making efforts to control and change some obesogenic behaviors; for example, very few children attributed obesity to genetics (i.e., *internal, stable and uncontrollable* causes). Interestingly, the latter result differs from Amiri et al. (2011) data with adolescents indicating genetics as a prominent category explaining obesity. These authors concluded that this attribution likely contributes to feelings of lack of control towards own weight and health. Thus, the data may suggest the importance of intervening early in life before the transition to adolescence. This phase is characterized by more stable and less malleable attitudes than childhood, and adolescents are more resistant to change (Pearl & Lebowitz, 2014).

Children's awareness of their personal responsibility toward obesity causes could also result from their exposure to public health and marketing campaigns (Pearl & Lebowitz, 2014; Puhl et al., 2013). To illustrate, news on television and social media have consistently stressed the need for individual behavioral changes rather than system-level solutions (e.g., food industry) to face obesity (Barry et al., 2011). The risks of focusing primarily on solutions at an individual level are manifold; for example, children may experience shame and discouragement when they fail to change their obesogenic behaviors or maintain

healthy ones (Simpson et al., 2019). As Pearl and Lebowitz (2014) warn, educators should be attentive to the high prejudice and blame children may experience as a consequence of failure in the accomplishment of healthy behaviors (both towards themselves and others; e.g. Throsby, 2007).

1.5.2. Unexpected findings

In the current study, the number of children attributing obesity to parent-related enablers (i.e., *external, unstable and controllable* causes) was low. This finding is consistent with those from Magalhães et al., (2022), reporting few perceived parent-related barriers to healthy eating in a community sample. Nevertheless, we found interesting data while analyzing results by BMI. Children with unhealthy body weight/obesity appear to place greater emphasis on the role parents may play than their counterparts with healthy body weight did. This is consistent with the study by Brogan et al. (2019), showing that children with obesity perceive the influence of parents as one of the causes of obesity. Thus, data suggest that some children with unhealthy body weight/obesity are prone to believe that the causes of obesity are not self-related, and although it is possible to change them, the control pertains to their parents who, in many cases, have unhealthy body weight/obesity (Lazzeri et al., 2011; Raynor et al., 2011).

1.5.3. Differences by children's BMI

Children with unhealthy body weight/obesity also seem to attribute obesity more often to *external, stable, and uncontrollable* causes (e.g., proximity to food outlets) than their counterparts with healthy body weight do. These attributions may indicate that the former believe that the causes of obesity are nonrelated to their behavior, will remain over time, and, importantly, there is nothing they or close others can do to change them (Almeida et al., 2008; Weiner, 1982, 2012). Children may be making these attributions to protect their self-esteem and avoid the sense of blame that an awareness of personal responsibility could entail (Branscombe & Wann, 1994; Pearl & Lebowitz, 2014); however, these approaches to obesity could translate into passive acceptance of their circumstances and resistance to interventions (Almeida et al., 2008; Amiri et al., 2011).

We also learned that children with healthy body weight mentioned *internal, stable, and controllable* causes of obesity (i.e., habits formed and food preferences) more often than their counterparts with unhealthy body weight/obesity did. This finding is important because children making these attributions could be prone to blaming their peers for their obesogenic behaviors and voicing expectations that these behaviors would maintain over time (Weiner, 2012). Importantly, efforts to blame peers for their unhealthy behaviors are not aligned with the chronic disease model that views obesity as caused by an agent (e.g., food, genetics, environmental factors) affecting the host (e.g. children) and

producing a disease (e.g. obesity) (Bray et al., 2017). These beliefs could lead to stigmatization and social prejudice towards individuals with unhealthy body weight/obesity (Datar et al., 2004; Trainer et al., 2022).

1.5.4. Emerging enablers

We believe our data also add to the literature by emphasizing two new enablers of obesity (i.e., food industrialization and lifestyle) that could be related to the increasing development of industries and society (e.g. Datar et al., 2014). Current new data are aligned with warnings from the WHO highlighting that health maintenance is particularly relevant amidst the context of increased production and availability of processed foods, rapid urbanization, and changes in people's lifestyles likely to lead to an increase in unhealthy dietary patterns (WHO, 2020).

1.5.5. Implications for practice

The present study provides contributions to practice by supporting prior evidence indicating that the design of interventions on a particular topic should match the perceptions of the target population on that topic (Ingoldsby, 2010; Nitsch et al., 2016). In general, data suggest that children could benefit from behavior change interventions addressing constructs emerging in the more prominent category of our results, such as promoting healthy behaviors through self-regulation training (Pereira et al., 2018, Magalhães et al., 2020). A study by Daniel et al. (2015) showed that developing self-regulation strategies may help children with unhealthy body weight/obesity to deal with food temptations by reducing delay discounting, i.e., disregarding larger future rewards (e.g., good health) in favor of smaller immediate rewards (e.g., eat processed food). In fact, children with training in self-regulation strategies are expected to proactively develop and maintain healthy habits despite the reported external influences (e.g., the proximity of food outlets) (Rosário et al., 2017). In our study, children identified lack of perceived risk as a cause of obesity. This important finding could help educators set up brief interventions to improve children's awareness of the consequences of obesity while promoting positive attitudes about the benefits of healthy behaviors (Pereira et al., 2021).

Additionally, as our data suggest, when targeting obesity, educators could consider teaching children about the chronic disease model of obesity by striking a balance between factors focused on promoting healthy eating and physical activity and those out of children's control. This approach is likely to help children failing to achieve healthy behavior goals overcome their sense of blame and actively engage in interventions (Branscombe & Wann, 1994; Pearl & Lebowitz, 2014). Moreover, by mentioning enablers that are out of children's control, educators prevent the propagation of stigmatizing messages

and attitudes towards individuals with obesity, likely to lead to social prejudice (Barry et al., 2011; Throsby, 2007).

Current data suggest that children with unhealthy body weight/obesity and children with healthy body weight understand the causes of obesity distinctively. Thus, these subgroups of children may also differ on the psychological mechanisms underlying the perceived causes of obesity (e.g., acceptance of their circumstances vs. willingness to change) (Almeida et al., 2008; Braet et al., 2012). Nevertheless, literature has highlighted the benefits of considering the different characteristics of a group of children as an approach to designing tailored strategies and interventions (Braet et al., 2012). For example, present results suggest that children with unhealthy body weight/obesity, when compared with counterparts, may be more resistant to change and need further help to understand the internal causes of obesity better. Moreover, these children may also benefit most from interventions targeting children-plus-parents. In fact, Baghurst and Eichmann (2014) found that interventions targeting both children and parents had increased effectiveness in changing obesity-related behaviors. During childhood, parents have a prominent role in their children's education; for example, while influencing their eating behavior (Scaglioni et al., 2018). However, as mentioned in the present results, due to the ongoing lifestyle changes, many parents do not have time to cook meals at home and may end up providing children with unhealthy foods from restaurants. Therefore, interventions focused on healthy eating habits targeting children-plus-parents are expected to help parents with time constraints (e.g., working parents) while providing training on strategies for planning healthy meals (Dahl et al., 2023). Conversely to children with unhealthy weight/obesity, children with healthy body weight may benefit from interventions aiming to promote healthy behaviors to prevent the risks of developing obesity in the future.

Lastly, our study supports the need to acknowledge the rapid advances and changes in the food industry and lifestyle (Harrison et al., 2011). Accordingly, future interventions could consider new potential contributors to obesity to keep pace with rapid advances in food-related topics, and interventions should be complemented with policy actions.

1.5.6. Limitations and future research

Limitations of this study include the methodology adopted for data collection. Even though the vignette with an open-ended question is likely to capture the diversity of children's perceptions, most answers consisted of a few sentences, which may have prevented participants from conveying a full picture of their understanding of obesity causes. Future studies could consider using interviews to capture children's perceptions further. Additionally, difficulties in reaching parents through schools were an obstacle to data

collection (e.g., parents' low availability to engage in research). This obstacle might help explain why we did not have access to BMI information for 42% of the children. Moreover, although we have followed the work of Goodman et al. (2000), showing that they correctly classified 96% of adolescents' weight status through parental self-reported height and weight data, parents' reports of their child's height and weight may have led to inaccurate answers and error in the BMI calculation. Future studies could consider collecting BMI data via objective measures. Finally, children in the present study were enrolled in an intervention promoting healthy eating, which might lead to a sampling bias. Children that accepted to participate in the intervention could have built perceptions about the causes of obesity distinct from those who did not accept to participate in the intervention (e.g., children with common knowledge may understand the causes of obesity as external, stable, and uncontrollable, which may lead to resistance to interventions; Almeida et al., 2008; Amiri et al., 2011). Thus, future research should consider analyzing the causal attributions of a totally naïve sample.

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Chapter 2

The mediator and/or moderator role of complexity of knowledge about healthy eating and self-regulated behavior on the relation between family's income and children's obesity[6]

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2. The mediator and/or moderator role of complexity of knowledge about healthy eating and self-regulated behavior on the relation between family's income and children's obesity

Abstract

Childhood obesity rates have been increasing over the years and is considered one of the most serious public health problems of the century. Low socioeconomic status has been associated with a higher body mass index. However, the pathways underlying this complex relationship are poorly understood. This study aimed to evaluate the possible mediation and/or moderation of complexity of knowledge about healthy eating, and self-regulation processes towards healthy eating, in the association between family's income and weight of elementary school age children. The results showed that complexity of knowledge does not mediate the relationship between socioeconomic status and weight. Still, whenever the levels of complexity of knowledge and self-regulation are high, there is a moderation of complexity of knowledge on the relationship between family's income and weight, conditioned by self-regulation scores. These promising findings support the idea that knowledge about healthy eating in isolation could be insufficient for practicing a healthy diet and underline the relevance of combining transmission of knowledge with training in specific competences (e.g., self-regulation strategies). Considering that complexity of knowledge about healthy eating and self-regulation strategies are interrelated and can be both improved, future preventive interventions could consider incorporating both in their design to mitigate childhood obesity.

Keywords: Elementary school age, BMI Z-scores, Complexity of knowledge about healthy eating, Family's income, Self-regulation, SOLO taxonomy

2.1. Introduction

Obesity is considered a chronic, relapsing progressive, and growing epidemic disease [1][7]. In fact, obesity prevalence has been increasing to alarming levels. According to the World Health Organization [2], obesity rates went up three times worldwide since 1975. Concerning childhood obesity, the scenario is as daunting and, thus, considered one of the most serious public health challenges of the 21st century [3]. For example, data from Portugal shows that 28.5% of children between the ages of 2 and 10 are overweight, with 12.7% being obese [4]. Along with health problems, there are psychological, social, and

[7] References for this article are described in accordance with the journal's request, i.e., following the Multidisciplinary Digital Publishing Institute style.

economic consequences associated with child and adult obesity [5-9]. Regarding health, there are many problems strongly related to childhood obesity, such as new onset of asthma, cardiovascular diseases, type 2 diabetes, and certain types of cancer [7,8]. Additionally, over an extensive period, childhood obesity is associated with increased risk of adult obesity and increased morbidity and mortality in adult life [7]. Regarding psychological and social consequences, obesity is associated with low self-esteem, behavioral problems, and social isolation [8]. Furthermore, obesity also has an impact on the economy. For example, obese adults spend annually $US 3508 more in medical costs than those who maintain a healthy weight [5] and is estimated that around 7% of national health budgets across the EU are spent on diseases linked to obesity each year [6].

Finding solutions to this scenario requires understanding its etiology. Obesity and overweightness are the results of a combination of multiple factors, such as genetic, environmental, and individual [10–12]. Although there are many elements contributing to childhood obesity, research shows that most cases are associated with non-genetic and modifiable factors, such as eating habits and physical activity [13,14]. However, for children in low-income families, eating habits do not seem easily modifiable. In fact, parents with low socioeconomic status (SES) are less likely to purchase healthy food or to demonstrate healthy dietary behaviors [15]. The limited financial resources and the high cost of healthier diets may contribute to this shortness of healthy food purchases [16,17]. In fact, fats and sweets provide dietary energy at significantly low expense, whereas eating vegetables and fruit leads to an increase in dietary costs [18]. Conversely, families with high SES, in addition to fewer budget restrictions to purchase healthy food, show more effective parental investments in child's health. Additionally, they tend to be integrated into school and community environments that promote physical exercise and healthy eating practices [19,20]. Consequently, there is a negative relationship between SES and obesity that seems to be associated with children's eating habits and influenced by food parental practices at home, i.e., low SES is associated with higher body mass index (BMI) and this relationship is likely to strengthen over time [21–26].

Concurrently, research shows that parents with low SES have lower nutritional knowledge (e.g., understanding the health benefits such as disease prevention) than parents with higher SES, and parents' nutritional knowledge directly predicts children's knowledge about nutrition [27]. Thus, children from low SES households whose parents possess low nutritional knowledge are likely to have low nutritional knowledge themselves. Research shows that a lack of knowledge about what is healthy to eat is a major challenge in nutritional education [28,29]. To illustrate, 70% of EU individuals believe their diets are already healthy and do not know how to evaluate their own diet appropriately in terms of fat, fibers, fruits,

and vegetable intake [29]. Furthermore, studies show positive associations between nutritional knowledge and likelihood of healthy food consumption, indicating that nutritional knowledge is necessary for making healthy food choices [30,31].

Considering this evidence, it comes as no surprise that most of the interventions to tackle obesity and overweightness have focused on transmitting knowledge about healthy eating. For example, interventions emphasize the increased consumption of vegetables and fruits and the regular practice of physical exercise to decrease the likelihood of becoming obese [32]. However, despite the considerable investment in knowledge-based interventions and programs for children, in a wide range of settings, there has been no substantial improvement in healthy eating, and childhood obesity does not seem to be reverting [33,34]. In fact, a metanalysis with several interventions showed heterogeneity on nonsignificant improvements in healthy eating regardless of the modality of the intervention (e.g., cognitive vs. non-cognitive, healthy eating only vs. combined lifestyle intervention), with an exception for interventions with reinforcement [33]. A possible underlying cause for the ineffectiveness of these interventions is that research shows that beliefs about healthy eating (e.g., think that broccolis is good) have a stronger influence on eating behavior than declarative knowledge [35]. That is, by itself knowledge about healthy eating is not a guaranty of healthy food choices.

A recent systematic review suggests that, among other aspects, using self-regulation strategies in the implementation of a healthy diet may be key for individuals to adopt healthy eating habits [36]. Self-regulation comprises processes that allow individuals to proactively control the personal, behavioral, and environmental influences that impact human behavior [37]. For instance, various studies have shown that the extent to which people engage in planning behaviors to reach a goal is associated with healthy or unhealthy food intake [38]. Hence, understanding the role of self-regulation in behavior change and the adoption of healthy eating habits may be key to develop and design effective programs [39].

Most studies on factors that contribute to obesity prevention evaluate variables in isolation. However, an examination of combinations of factors may be required to improve a comprehensive understanding of the complex obesity prevention phenomenon [36]. All things considered, the main aim of the present study was to evaluate the possible mediational and/ or moderation effects of complexity of knowledge about healthy eating (KHE) and self-regulation (SR) processes towards healthy eating in the association between family's income and BMI Z-scores of elementary school age children (see Figure 4). Elementary school students were chosen as participants of this study as previous research has suggested that this age is the ideal stage to discuss, learn, and enact behavior change, including in healthy eating

domain [40–42]. Considering the aim of contributing to understanding how reverting the increasing rate of childhood obesity, participants of the present study had a weight range between healthy and obese (BMI Z-scores). This methodological option allowed to understand how KHE and SR may contribute to decrease obesity and promote a healthy BMI on elementary school age children.

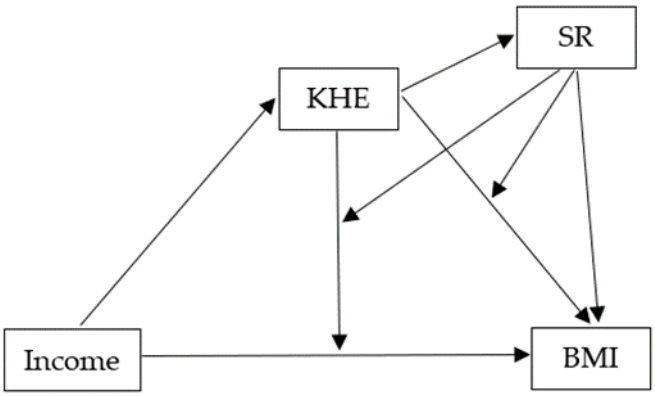


Figure 4 - Conceptual Model of mediational and moderator role of the complexity of knowledge about healthy eating (KHE) on the relation of family's income and BMI Z-scores, and the mediator/moderator role of self-regulation (SR) in the KHE and BMI Z-scores relationship.

Grounded on previous research, a mediation-moderation model (Figure 4) was set with the following hypothesis:

H1. There is a statistically significant relationship between Family's Income and BMI. The higher the Family's Income the more likely they are in the healthy BMI range, and the lower the Family's Income the more likely the children are overweight and obese.

H2. The relationship between Family's Income and BMI is mediated by KHE. It is expected that the higher the Family's Income the better their KHE, and the more children in the healthy BMI range.

H3. The relationship between KHE and BMI maybe mediated by SR. That is, the more complex the participants' KHE, the higher their SR and the higher their SR, the more the proximity with a healthy BMI range. This means that the effect of more complexity of knowledge about healthy eating on children's BMI is likely to occur when they self-regulate their food intake behaviors.

H4. Moreover, besides the mediation effect, the relationship between KHE and BMI is possibly moderated by SR. It is expected that the intensity and direction of the relationship between KHE and BMI are conditioned by the SR scores. It is expected this relation to be more intense when SR scores are higher.

H5. The relationship between Family's Income and BMI is moderated by KHE. The magnitude of this relationship is significantly different for distinct KHE scores.

H6. The relationship between Family's Income and BMI is moderated by KHE and this moderation effect is conditioned by the SR scores.

2.2. Materials and Methods

2.2.1. Participants

The participants were selected from five schools in the North of Portugal. This study appertains to a large research project (CEICSH 032/2019) counting with 744 students from the 5th and 6th grades and their parents. Participants had already agreed to participate and provided written informed consent. Of the initial pool of participants, 445 (59%) had to be excluded of the present study due to: 1) at baseline parents did not provide all the necessary information for BMI Z-scores calculation (e.g., date of birth of their child, weight), 2) students did not complete all the measures collected (e.g., did not answer to the open-ended question). Additionally, 4 (1.3%) participants were excluded due to their BMI Z-score being > – 1*SD* (e.g., thinness). Considering the aims of the present study, i.e., contribute to understanding how to mitigate overweightness and obesity and promote healthy weight, these participants were excluded as they do not provide information helpful to attain these goals. Thus, the final sample was composed of 295 students who were healthy weight, overweight (> + 1*SD*), and obesity (> + 2*SD*).

2.2.2. Instruments

2.2.2.1. BMI Z-Scores

To evaluate children's BMI, the Z-score classification system was used [43]. The Z-score system expresses the anthropometric value as a number of standard deviations below or above the reference mean or median value. This is widely recognized as the best system for analysis and presentation of anthropometric data because of its advantages compared to the other methods (e.g., percentiles) [44]. For example, the Z-score scale is linear and therefore a fixed interval of Z-scores has a fixed height difference in cm, or weight difference in kg, for all children of the same age, which makes results comparable across ages groups and indicators.

In the present study, parents/caregivers were asked about their child's height, weight, and date of birth. To calculate children's Z-scores according to children's height, weight, gender, and age in months, the WHO *AnthroPlus* software was used. The classification through z-scores for five-19 years is: Obesity: > + 2*SD* (coded for the current study as 1), Overweight: > + 1*SD* (coded as 2), Healthy range

weight: between +1 *SD* and – 1 *SD* (coded as 3), Thinness: between – 1*SD* and – 2*SD* and Severe thinness: > – 2*SD*.

2.2.2.2. Family's Income

Income is a simple indicator that aims to capture one's ability to purchase desired resources [45]. Specifically, financial resources have an important influence on food purchases [16,17].

To evaluate the family's income, students' School Social Action Level was requested. In Portugal, the School Social Action corresponds to the following three levels of family income (i.e., sum of the income of the whole household members): A, corresponds to a family's income of up to 3050.32 € per year, B, corresponds to a family's income of up to 6100.64 € per year, and C, corresponds to a family's income of up to 9150.96 € per year. An income superior to this last value corresponds to a family that does not have School Social Action, is considered a high income [46]. It should be considered that the Portuguese minimum wage in 2019 is 600 € per month and that a worker who earns the minimum wage has a gross remuneration of 8400 € per year [47]. Accordingly, in the present study Family's Income was classified as 1 = extremely very low income, 2 = very low income, 3 = low income, 4 = medium to high income.

2.2.2.3. Complexity of Knowledge about Healthy Eating

To evaluate the complexity of knowledge about healthy eating, the open-ended format question "What is healthy eating?" was presented to the participants. An open-ended question format allows to reduce the likelihood of biased responses by the participants and is better suited to capture participants' knowledge, diversity of conceptions, and beliefs about a topic compared with closed-format questions [48].

Responses to the question were classified through the Structure of the Observed Learning Outcome (SOLO) Taxonomy [49]. SOLO Taxonomy evaluates the complexity/quality of an answer's structure about a concept (comprehension complexity). The five levels represent the five different possible ways for an individual to structure an answer (from incompetence to expertise) and is applicable to any subject area. In fact, it is a powerful tool for qualitative assessment of the point at which children are currently in in their understanding of a concept.

In the present study, to classify the responses of the participants to the open question, researchers developed a codebook for each level of complexity of the SOLO taxonomy (see Table 2). This codebook addressing each level of the SOLO taxonomy was developed by taking the writing samples produced by the participants who did not enter in the final sample of the present study (see Participants section). For example, Biggs and Collis [49] describe the unistructural level as "the learner focuses on

the relevant domain and picks one aspect to work with". On the present research codebook, the relevant domain is healthy eating, and one aspect could be not to drink sugary drinks.

Table 2 - SOLO coding criteria applied to complexity of knowledge about healthy eating.

Level	Name	Descriptors	Examples
1	Prestructural	1. reveals lack of effort and engagement; 2. does not understand the question; 3. repeats the question; 4. mentions something irrelevant; 5. wrong answers.	"I don´t know"; "It is to eat healthy things".
2	Unistructural	1. reveals minimum effort; 2. the answer is correct, but it only focuses on one aspect.	"It is to have balanced eating habits"; "It is not to eat chocolate".
3	Multistructural	1. knows some content; 2. describes, make lists; 3. more aspects are perceivable, however not correlated; 4. connects sentences using "and", "also"; 5. answers in which two or more elements are mentioned and connected, however this correlation is wrongfully made.	"It is to always drink water, not to drink too many sodas and not to eat too much candy"; "It is to eat vegetables and fruits because they are carbohydrates".
4	Relational	1. applies knowledge, recognizes these applications; 2. connects concepts in a way that the whole text has a coherent and meaningful structure; 3. gives an explanation, justifies.	"It is to eat food that is good for your health, like lettuce, tomatoes, kale..."; "It is not to eat too much candy or sugar, as we could get diabetes."

5	Extended Abstract	1. reflects, evaluates, formulates; 2. takes into consideration all the relevant information (and may also consider information which is not part of the task) and its connections, lists them and deducts a hypothesis that may be applied to a different situation; 3. there is generalization.	"It is to eat soup, fruit, and vegetables every day, not to eat too much candy (although sometimes it is allowed), not to consume sparkling beverages... if we don't follow a healthy diet, we may suffer serious consequences in our growth. Healthy eating is very important".

Next, prior to the coding of the participants' responses, two researchers trained the coding scheme as follows: (i) researchers first discussed the distinguishing features of each of the codebook levels, (ii) researchers practiced together applying the scale to a series of open-ended answers that varied in terms of their complexity until agreed on coding, (iii) each researcher independently scored 10 open-ended answers during practice, compared scores and resolved any differences through discussion, (iv) training continued until they assigned scores that differed by no more than 1 open-ended answer on ten consecutive ones. Once the criteria were met, one researcher scored all of the open-ended answers written by the participants in this study and the other researcher independently scored 25% of those open-ended answers. Interrater reliability between the two researchers was 0.947.

2.2.2.4. Self-Regulation Processes towards Healthy Eating Questionnaire

An adapted version of the Self-Regulation for Health Scale [50] was used to evaluate the self-regulation processes towards healthy eating that participants are guided by. The recorded internal consistency was of 0.77, value which has been obtained using Cronbach's Alpha coefficient on the present study. The scale has nine statements regarding the participants' self-regulation towards healthy eating (e.g., I pay attention to information on healthy eating, I apply that knowledge on a daily basis). Responses are scored from 1 (never) to 5 (always) on a Likert-like scale and summed to create a composite score from nine to 45, with higher scores implying more self-regulation.

2.2.3. Procedure

The present study is part of a research project that has been approved by the University of Minho Ethics Committee for Research in Social and Human Sciences (CEICSH) (CEICSH 032/2019). CEICSH considered that the project complies with the requirements for good practice in human research in accordance with national and international standards governing research in social and human sciences, including the Declaration of Helsinki. Additionally, consent to conduct the study was obtained from the Portuguese Ministry of Education. Prior to data collection, written informed consent from children and parents/caregivers were requested. To protect confidentiality and anonymity of the data, codes were assigned to identify the participants.

Data collection took place in a regular class. Students were invited by a research assistant to fill in the previously mentioned instruments and the research assistant highlighted the need to complete the task individually. Children took approximately 25 min to complete the questionnaires.

2.2.4. Statistical Analysis

The statistical examination of the mediation-moderation model (see Figure 4) was approached as follows. First, descriptive analyses (mean, standard deviation, skewness, and kurtosis) and Pearson correlations were conducted. Secondly, to analyze the hypothesis, several regression analyses were done using PROCESS from SPSS 22 [51]. Mediation, moderation, and conditional analysis were conducted. The effect sizes were calculated using Cohen's (1988) d statistic ($d < 0.20$ = non-significant, $d \geq 0.20$ and d < 0.50 = small effect, $d \geq 0.50$ and $d < 0.80$ = medium effect, $d \geq 0.80$ = large effect).

2.3. Results

In the present study participated 295 students with ages comprised between 9 and 14 years ($M = 10.89$, $SD = 0.849$), of which 54.8% were female.

2.3.1. Descriptive Statistics

Table 3 presents descriptive statistics and the Pearson correlation matrix. Skewness and kurtosis data indicate that the variables follow a normal distribution. Moreover, statistically significant relationships were found between Family's Income and BMI (the higher the Family's Income the more proximal BMI will be to the healthy weight range), between Family's Income and KHE (the higher the Family's Income the more the complexity of knowledge about healthy eating), and between KHE and SR (the higher the KHE the higher the scores on SR). The remaining correlations were not statistically significant (e.g., SR and Family's Income).

Table 3 - Descriptive statistics and Pearson correlation matrix[8].

	Income	BMI	KHE	SR
Family's Income	–			
Body Mass Index (BMI)	.115*	–		
Complexity of Knowledge about Healthy Eating (KHE)	.173**	.106	–	
Self-Regulation (SR)	-.014	-.008	.191**	–
M	2.970	2.448	2.920	3.824
SD	1.215	0.709	0.721	0.623
Asimetria	-0.569	-0.895	-0.360	-0.534
Kurtosis	-1.349	-0.506	1.292	0.065
Mínimum	1	1	1	1
Máximum	4	3	5	5

2.3.2. Mediation, Moderation and Conditional Analysis

The current research examines a set of models to explain the relationships between the Family's Income and their children's BMI Z-scores (from now onwards just BMI). First, the mediation processes were examined as follows: (i) analyze how the Family's Income affects their children's BMI. To this purpose, the role of KHE as mediator in the relationship between Family's Income and BMI was analyzed. Moreover, (ii) it was also analyzed the mediator role of SR between KHE and BMI. Additionally, the moderator role of KHE and SR (i.e., the boundary conditions for an association between two variables) was investigated. In fact, it was studied (iii) how the relationship between Family's Income and BMI was moderated by KHE, and (iv) how the relationship between KHE and BMI was moderated by SR. In this process, (v) both the indirect as well as the interactive effects (i.e., conditional process analysis, or second stage moderation model [52]) were analyzed. Specifically, it was addressed how the relation between

[8] Family's Income (1 = extremely very low income; 2 = very low income; 3 = low income; 4 = medium to high income); BMI (1 = obesity; 2 = overweight; 3 = healthy weight range); KHE (1 = prestructural; 2 = unistructural; 3 = multistructural; 4 = relational; 5 = extended abstract); SR (1 = very low SR; 2 = low SR; 3 = moderate SR; 4 = high SR; 5 = very high SR). * $p < 0.05$. ** $p < 0.01$.

Family's Income and BMI was mediated by KHE and, at the same time, how the relationship between KHE and BMI was moderated by SR. Finally, (vi) it was analyzed how the potential moderator role of KHE could be conditioned by SR (this last step aimed to answer the following question: Is the effect of Family's Income on BMI Z-scores affected by the scores of KHE, but only for certain scores of SR?).

In general, data gathered from the fit of the models do not confirm the hypothesis set. However, findings support, despite marginally, the first hypothesis (i.e., there is a statistically significant relationship between Family's Income and BMI: $b = 0.0580$, $p = 0.0898$, Model 1, Table 4). The second hypothesis was not confirmed, data indicates that the indirect effect of Family's Income on BMI trough KHE, was not statistically significant ($b = 0.0090$, $p = 0.1912$). The no relationship found between KHE and BMI ($b = 0.0877$, $p = 0.1280$, see Model 1, Table 4) may help explain the latter. Findings allow us to conclude that KHE is not mediating the relationship between Family's Income and BMI.

To further understand the absence of direct effect of KHE on BMI we set the third hypothesis, to examine whether this effect could be not direct, but indirect through SR. Data do not support the third hypothesis, i.e., no indirect effect of KHE on BMI was found (note that the relation between SR and BMI is not statistically significant, $b = -0.0333$, $p = 0.6192$). Still, data also show that by including SR in the model the direct effect of KHE on BMI is significant ($b = 0.1101$, $p = 0.0501$, see Model 2 in Table 4). In sum, data indicate that KHE mediates the effect of Family's Income on BMI when SR is included in the model (see Model 2 in Table 4).

Table 4 presents data from the fit of the six models tested to address the hypotheses raised.

Table 4 - Results of the Mediation, Moderation, and Conditional Process Analysis[9].

Model	Description of Model	Effects	Coeff.	SE	t	$p <$	d
1	Mediation Model: Effect of Family's Income on BMI mediated by KHE	Income → KHE	.1027	.0339	3.0281	.0027	0.36
		KHE → BMI	.0877	.0575	1.5261	.1280	–
		Income → BMI	.0580	.0341	1.7022	.0898	0.20

[9] Family's Income (Income), Body Mass Index (BMI), Complexity of Knowledge about Healthy Eating (KHE), Self-Regulation (SR)

2	Mediation Model: Effect of KHE on BMI mediated by SR	KHE → SR	.1652	.0493	3.3532	**.0009**	0.40
		SR → BMI	-.0333	.0669	-0.4975	.6192	–
		KHE → BMI	.1101	.0579	1.9015	**.0501**	0.22
3	Moderation Model: Effect of Family's Income on BMI moderated by KHE	KHE → BMI	-.0453	.1515	-0.2992	.7650	–
		Income → BMI	-.0781	.1475	-0.5294	.5969	–
		KHE x Income → BMI	.0464	.0489	0.9488	.3435	–
4	Moderation Model: Effect of KHE on BMI moderated by SR	SR → BMI	-.0404	.2264	-0.1784	.8585	–
		KHE → BMI	.1006	.2949	0.3412	.7332	–
		SR x KHE → BMI	.0025	.0776	0.0328	.9739	–
5	Second Stage Moderation Model: Effect of Family's Income on BMI mediated by KHE and the effect of KHE on BMI moderated by SR	Income → KHE	.1027	.0339	3.0281	**.0027**	0.36
		KHE → BMI	.0307	.2969	0.1034	.9177	–
		Income → BMI	.0581	.0344	1.6877	**.0925**	0.20
		SR → BMI	-.0737	.2266	-0.3255	.7450	–
		SR x KHE → BMI	.0165	.0778	0.2123	.8321	–
6	Moderation-Moderated Model: Effect of Family's Income on BMI conditioned by the	KHE → BMI	.9227	1.8376	0.0735	.9414	–
		Income → BMI	.8770	.6772	1.4640	.1443	–
		SR → BMI	.5955	.5016	1.1873	.2361	–

interaction of KHE and SR	Income x KHE →BMI	-.3580	.2378	-1.5055	.1333	–
	Income x SR → BMI	-.2554	.1848	-1.3771	.1696	–
	KHE x SR → BMI	-.2757	.1818	-1.5167	.1304	–
	Income x KHE x SR → BMI	.1061	.0630	1.6840	.0933	0.20

The inclusion of SR improved the model, so the next step was to analyze the role of this variable as a moderator of the effect of KHE on BMI (hypothesis 4). The aim was to examine whether the strength or direction of this relationship was conditioned by the scores of SR (see Model 4, Table 4). It was hypothesized that the higher the scores of SR the more intense the relationship between KHE and BMI would be. Data from the first stage moderation model (see Model 4, Table 4) (b = 0.0025, p = 0.9739) and from the second stage moderation model (see Model 5, Table 4) (b = 0.0165, p = 0.8321) indicates that SR is not moderating the effect of KHE on BMI.

In sum, considering current data from the fit of the six models presented thus far, SR is not mediating nor moderating the effect of KHE on BMI, but when included in the model as a potential mediator, KHE partially mediates the effect of Family's Income on BMI. Note that, besides analyzing the mediator role of KHE in the relationship between Family's Income and BMI, it was also investigated the moderator role of KHE on this relationship (see Model 3, Table 4). At that stage, it was hypothesized that the magnitude of the relationship between Family's Income and BMI varies depending on the scores of KHE (hypothesis 5). Data indicates that the relationship between Family's Income and BMI is not conditioned by the students' level of complexity of knowledge on healthy eating (KHE x Income = 0.0464, p = 0.3435, see Model 3 Table 4), thus the increment on the explained variance of BMI due to the inclusion of KHE as moderator was not statistically significant (R^2 change = 0.0030). However, when analyzing the conditional effect of Family's Income on BMI at the values of KHE, data indicates that for higher scores on KHE the effect of Family's Income on BMI is marginally statistically significant (b = 0.0909, p = 0.0624).

Considering the aforementioned findings, a new model (Model 6 Table 4) was set to investigate whether the absence of moderation of KHE (for low and medium scores) on the effect of Family's Income on BMI could be related to the moderator effect of SR (hypothesis 6). It was hypothesized that the

relationship between Family's Income and BMI is moderated by KHE when this moderation effect is conditioned by the scores of SR (see Model 6, Table 4). The results of the model fit have partially confirmed this hypothesis. Table 5 shows that the interaction (Income x KHE x SR) is marginally significant ($b = 0.1061$, $p = 0.0933$) and significantly increments the explained variance of BMI (R^2 change = 0.0094, $F(1,291) = 2.8358$, $p = 0.0933$). However, the effect of Family's Income on BMI is only statistically significant for KHE and SR high scores (see, Table 5). Additionally, data show that for low SR, the effect of Family's Income on BMI does not vary irrespective of the KHE scores, and also that the higher the SR and the KHE scores, the stronger the effect of Family's Income on BMI.

Table 5 - Conditional effect of socioeconomic status of family on student' Body Mass Index at values of the moderators SR (Self-Regulation) and KHE (Complexity of Knowledge about Healthy Eating).

Self-Regulation	Complexity of Knowledge about Healthy Eating	Effect	SE	t	$p <$	d
3.2005	2.1954	.0218	.0571	0.3827	.7023	—
3.2005	2.9164	.0084	.0531	0.1592	.8736	—
3.2005	3.6374	-.0050	.0785	-0.0630	.9498	—
3.8241	2.1954	.0084	.0530	0.1581	.8745	—
3.8241	2.9164	.0427	.0354	1.2062	.2287	—
3.8241	3.6374	.0770	.0510	1.5088	.1324	—
4.4477	2.1954	-.0051	.0780	-0.0650	.9482	—
4.4477	2.9164	.0769	.0490	1.5698	.1175	—
4.4477	3.6374	.1589	.0628	2.5291	**.0120**	0.30

2.4. Discussion

Childhood obesity is one of the most serious public health challenges of the 21st century [3]. The etiology of obesity and overweightness is complex and multifactorial, being the result of a combination of genetic, environmental, and individual factors [10–12]. To decrease this worrying scenario, it is important to deepen the knowledge of how modifiable factors influence obesity and overweightness, especially among

children from families with low income. Literature has been stressing the importance of knowledge about healthy eating and self-regulation, but data on this topic is limited. Thus, the present study aimed to understand the mediation and/or moderation role of complexity of Knowledge about Healthy Eating (KHE) and Self-Regulation (SR) on the relationship between Family's Income and their children's BMI Z-scores (BMI).

First, results showed that there is a relationship between Family's Income and BMI. Higher Family's Income is associated with a BMI more proximal to the healthy weight range and lower Family's Income is associated with overweightness and obesity. This promising finding is consistent with previous research. Studies have shown that there is a negative relationship between SES and obesity [21–23]. In fact, a systematic review concluded that low SES, including low income, is the only factor that has so far witnessed consistent evidence for unhealthy eating and risk of overweightness and obesity [36].

Second, data shows that in the present study KHE does not serve as a mediator of the effect of Family's Income on BMI (see Model 1 in Table 4). In fact, KHE is related to Family's Income but not to BMI. This result allows us to conclude that it cannot be argued that, by itself, a greater or lesser complexity of knowledge about healthy eating is a crucial variable for the control of obesity. Research shows that parents with low SES have lower nutrition knowledge, and that parent's low nutrition knowledge predicts five and six years-old children's low nutrition knowledge [27]. However, current data alerts to the fact that providing knowledge about healthy eating in isolation could be insufficient to improve healthy eating and revert overweightness and obesity. For example, previous studies show that whereas information about healthy diet is available to consumers, it is often regarded as complicated and difficult to implement, even if consumers have apprehended the knowledge conveyed [36]. Altogether, our findings may help understand why, despite the considerable investment in interventions and programs, there has been no substantial improvement in healthy eating and obesity does not seem to be reverting [33,34].

Third, it was explored the mediating and moderating role of SR. The rationale for analyzing this step was that the effect (weak or strong) of the complexity of knowledge on children's BMI could be related to the level of SR. For example, children with high complexity of knowledge about healthy eating but with low SR competences to follow a healthy diet could show overweightness as well as children with low complexity of knowledge, but strong SR competences. Surprisingly, results show that SR does not mediate nor moderate the relationship between KHE and BMI (see Model 2 and 4 in Table 4). Instead, data shows that the conditional effect of KHE on the Family's Income relationship with BMI was, in turn, conditioned by the levels of SR (see Model 6 in Table 4). Current results showed that moderation only occurs for high

levels of KHE and SR. This promising finding may contribute to further understand the complex relationship between Family's Income and BMI. Data indicates that Family's Income influences BMI whenever the levels of KHE and SR are high (i.e., children from high Family's Income can be obese if they do not have deep complexity of knowledge about healthy eating and do not display self-regulated behaviors, and children from low Family's Income can have healthy weight range if they have deep complexity of knowledge about healthy eating and self-regulate their health behaviors). All considered, these promising findings support the idea that knowledge about healthy eating in isolation could be insufficient for practicing a healthy diet [36]. The formula for mitigating childhood obesity does not seem to be the promotion of a single factor in isolation, i.e., neither promoting knowledge in isolation is enough, nor promoting self-regulation in isolation is enough. Instead, it seems that the promotion of knowledge about healthy eating combined with self-regulation strategies may be a promising approach for supporting healthy eating behaviors.

Thus, the design of future interventions may wish to focus not only on transmitting knowledge on healthy eating habits but combining it with the training on self-regulated strategies related to healthy eating behaviors. For example, design programs with hands-on activities to exercise PLEE (planning, execution, evaluation) logic in meal preparation or to practice choice and control skills towards food purchase is likely to promote healthy eating behaviors [37,39,53]. We believe that the promising findings of the present study could be used in educational settings in different ways: (a) through curricular infusion - teachers may use their classes as opportunities to embed self-regulation strategies into their curricula and work the contents simultaneously. For example, when teaching the food wheel in the Sciences discipline, teachers can use activities of meal planning. In doing so, teachers meet the curricular goals while promoting reflection about how children can use the declarative knowledge to make healthier choices. Thus, children do not receive information about healthy eating passively but are expected to reflect on the process [37]. (b) through school-based programs—school administrators may organize educational interventions running outside school hours to transmit knowledge about healthy eating and promote self-regulated strategies. Moreover, interventions based on the promotion of knowledge about healthy eating combined with self-regulation strategies could also be used to train parents. Parents play an important role in transmitting knowledge to their children and parent support is an important facilitator in healthy eating [27,54,55]. For example, the family could influence children's early-life experiences with various tastes and flavors [55]. Thus, it is important that parents provide their children accurate knowledge and opportunities to use self-regulation strategies at home.

As our data suggest, it is important to work "healthy food choices" at the individual level. However, individuals' daily lives and their more or less healthy eating habits are influenced and shaped by economic and social policies, and social norms and developmental agendas that must also be acknowledged [56,57]. The outcomes of the current research are expected to be used by advocacy groups comprised of children, parents, teachers, and the health community to advocate for the importance of launching policies on healthy eating habits. In fact, to promote healthy eating habits and facilitate individual healthy food choices, we need to consider social determinants of health and use multiple strategies. For example, prior literature highlights the importance of promoting children's health by supporting policies that restrict aggressive marketing encouraging sedentary activities, energy-dense, and nutrient-poor foods, and unhealthy beverages [56,57]. Advocacy groups for healthy eating habits could consider working with the governmental agencies and food companies to help set environmental and structural changes likely to facilitate individual healthy choices (e.g., improve health literacy, encourage low-cost price leadership models, advertise healthy choices as optimal choices). The work done by these advocacy groups over the individual and social determinants of health is expected to generate public debate on this issue and, hopefully, help flourish innovative obesity prevention strategies.

Although the present research entails an advancement in the understanding of the moderating effect of KHE and SR in the relationship between Family's Income and BMI, some limitations of the study and suggestions for future research should be addressed. Despite the effect of Family's Income on BMI being statistically significant, the effect size is minimal. One explanation for that could be the measurement of the variables: (i) the information for the BMI Z-scores calculation was provided by the parents, instead of being measured directly by the researchers. This could add self-report bias, i.e., instead of report children's actual weight/height, parents may report the last values that they remember or values more proximal to the normative standards, (ii) Family's Income could not be considered a continuous variable because, although the first three levels could be continuous, the fourth level is something else, being that more income intervals could be considered in the fourth category (e.g., 9000 to 12000 €, 12000–15000 €), (iii) the use of Family's Income instead of compound variable to define socioeconomic status, iv) knowledge about healthy eating could also be defined in many different ways. In the present study, the SOLO taxonomy allowed to transform qualitative data into a continuous quantitative variable to make possible run mediation and moderation models [51]. However, while measuring the complexity of knowledge we may have lost content information. Future research could consider analyzing knowledge using a different methodological approach (e.g., thematic analysis to the open-ended question). Another limitation of the study refers to its design. Due to the cross-sectional nature

of the study, a causal relationship regarding associations between the variables could not be established [51]. Future research should consider a longitudinal design to provide a methodological advantage to infer the causal relationship between the variables. Moreover, despite promising, the effect sizes of the present study results are small. Finally, although it is not possible to guarantee the generalization of the present findings, current data were collected in five Portuguese public schools from different environments (e.g., rural, urban). This variety of settings allows a wide range of socioeconomic and cultural backgrounds. Consistently, different factors that influence overweightness and obesity have been studied for decades, but the impact of these determinants on actual eating behavior has been shown to be small to medium [36]. In fact, many studies on factors likely to influence healthy eating and obesity focus on one or two factors in isolation, while insight in particular combinations of factors may be required to improve a comprehensive understanding of the drivers of healthy eating [36]. For example, future research could consider studying the role of variables such as self-efficacy and attitudes towards healthy eating and use complex analysis designs combining mediation and moderation effects conjointly. Thus, it seems important to continue studying the relationships between different modifiable variables in order to understand how to design preventive interventions to decrease this worldwide complex problem.

2.5. Conclusions

Overall, the results of the present study contribute to the existing literature, shedding light on the complex relationships between Family's Income and BMI. To further understand this relationship, we tested the mediational role of KHE, but results were not statistically significant. Further analysis testing a moderation role of KHE on the relationship between Family's Income and BMI showed positive results when this moderation effect is conditioned by the scores of SR. These findings are expected to provide an important reference to the design of future preventive interventions on eating behaviors. Considering that knowledge about healthy eating and self-regulation strategies are interrelated and can be improved, interventions could consider incorporating both in their design. Finally, future research could consider study other possible mediators/moderators that may have a significant influence on the relationship between Family's Income and BMI of children. For example, motivational variables related to volition (strengthen children will follow a healthy diet) but also metacognitive variables related with children awareness of the pros and cons of following a healthy diet.

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Chapter 3

Food availability, motivational-related factors, and food consumption: A path model study with children[10]

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3. Food availability, motivational-related factors, and food consumption: A path model study with children

Abstract

The promotion of children's healthy eating is a key public health priority. However, children's food consumption is a complex phenomenon with several contributing factors, and there is a call to continue developing comprehensive models with several variables acting simultaneously. The present study aimed to examine the role different motivational-related variables (e.g., self-regulation, self-efficacy) may play in children's consumption of healthy and unhealthy foods. To address this goal, data were collected in a sample of 242 fifth and sixth graders with access to both healthy and unhealthy foods at home. A path model was conducted to analyze networks of relationships between motivational-related variables and children's healthy and unhealthy eating. The gender variable was included as a covariate to control its effect. The data showed that self-regulation for healthy eating mediates the relationship between the predictor variables (i.e., knowledge, attitude, and self-efficacy) and the type of food consumption (healthy and unhealthy). Current data contribute to understanding the complexity behind food consumption by providing a comprehensive model with motivational-related factors associated with both healthy and unhealthy eating. The present findings are likely to help inform the development of early preventive interventions focused on the promotion of healthy eating.

Keywords: Food consumption, Healthy eating, Motivational-related factors, Food availability, Self-regulation, Self-efficacy, Children, Path model

3.1. Introduction

Promoting children's healthy eating is a key public health priority to prevent chronic diseases (e.g., obesity, diabetes) and maintain health, well-being, and school performance [1–3][11]. To help achieve this public health goal, international organizations have been establishing eating guidelines for children, advocating the intake of five pieces of fruits and vegetables (F/V) per day and the limitation of fat and sugar consumption [1,2]. However, there is extensive evidence that children are not meeting the recommendations and are instead consuming large amounts of energy-dense foods, fat, and sugar, and low amounts of F/V [1,3–5]. Particularly, it seems that boys have unhealthier diets when compared with girls [5–7].

[11] References for this article are described in accordance with the journal's request, i.e., following the Multidisciplinary Digital Publishing Institute style.

To find additional solutions for this unhealthy eating scenario, predictors of children's food consumption have been a major research target over the past few decades. Many variables have been studied, including variables that are external and not amenable to be changed by the individual (e.g., food economy–high prices of F/V) and child-related variables that are amenable to be changed by the individual (e.g., nutritional knowledge) [8–10]. Although it is well established that external variables greatly affect children's food consumption, exclusively relying on them to predict food consumption does not account for the agential role of the child. In fact, by considering only the influence of external variables on individuals' eating behaviors, the individuals' efforts to develop adaptive competences and skills for adopting and maintaining healthy eating behaviors are not considered (e.g., choosing a healthy snack by themselves alongside the external constraints) [11,12].

Drawing on this premise, researchers are increasingly giving attention to the role of child-related factors, especially motivational-related ones, on children's food consumption [13,14]. For example, regarding child-related factors, studies in the literature have been extensively investigating the relationship between nutritional knowledge and children's food consumption. While some studies have shown no relationship between nutritional knowledge and children's dietary practices, most research has emphasized that nutritional knowledge seems to be necessary, or at least important, for making healthy food choices [9,10,15]. As a matter of fact, knowledgeable individuals seem to be 25 times more likely to consume adequate amounts of F/V daily than unknowledgeable ones [16]. Concerning the specific case of motivational-related factors, the role of self-efficacy on children's food consumption is also well established. In fact, the literature suggests that high self-efficacy regarding eating behaviors is associated with a high consumption of F/V and low consumption of fat, whereas low self-efficacy is associated with unhealthy eating patterns [17,18]. Furthermore, researchers have also been studying the role that children's attitudes and perceptions toward healthy eating play on food consumption. Actually, healthy eating seems more likely to be adopted by children who think and reflect on the long-term benefits of healthy foods [19]. Moreover, research shows that attitudes about healthy eating (e.g., thinking that broccoli is good for health) have a stronger influence on eating behavior than declarative knowledge about food [20].

Although the research acknowledges the role played by these child-related factors on children's food consumption, little is known about the factors and mechanisms underlying these relationships. A systematic review suggested that, among other factors, using self-regulation (SR) strategies may be key for individuals to adopt healthy eating behaviors [14]. For example, adolescents who frequently use SR

strategies (e.g., putting chips out of reach when watching television, setting goals about how many candies a day one can have) consume fewer unhealthy foods [21]. In addition, improvements in SR are associated with an increase in F/V consumption [22]. This may be explained by the use of SR allowing individuals to proactively take control of the personal, behavioral, and environmental influences that impact human behavior, including eating [23]. Thus, it is possible that self-regulation may help in understanding the mechanisms likely explaining the relationship between knowledge, self-efficacy, and attitudes toward healthy eating and children's food consumption. In fact, a recent study showed that knowledge about healthy eating only influenced children's weight when the children with knowledge on healthy eating also used SR strategies. [13]. Furthermore, research shows that children and adolescents with a high self-efficacy were prone to using a diverse spectrum of SR strategies [24]. Moreover, recent research [25] conducted structural equation modeling to examine the role of a set of variables (i.e., nutrition-related self-efficacy, intentions to eat F/V, behavioral strategies, outcome expectations, outcome expectancies, situation, and social support) on adolescents' reported consumption of F/V. Findings indicated that adolescents' intentions to eat F/V mediated the relationship between self-efficacy, social support, and outcome expectancies and F/V consumption behavior. This could be due to the fact that children need to have confidence and mastery of their ability, i.e., self-efficacy, to implement SR strategies to control the personal and external influences on behavior [26,27]. Lastly, it seems that attitudes also affect the use of SR strategies. For example, when individuals understand the utility of using SR strategies to achieve their self-set goals, they are more likely to use them and achieve success [28].

Taking this information all together and grounding on previous research of child-related factors (especially motivational-related ones) that may contribute to children's food consumption, the present study aimed to improve our understanding of the following aspects: (i) the mediator role played by SR toward healthy eating in the relationship between the predictor variables (i.e., declarative knowledge, self-efficacy, and attitudes toward healthy eating) and the (un)healthy food consumption of elementary-school children; and (ii) the role played by gender in the relationship between SR and children's food consumption. Children were chosen as participants in this study because the formation of habits and behaviors occurs during childhood [29]. Moreover, as habits developed during childhood are likely to persist through adulthood, it is important to intervene before challenges arise [30].

The present paper's novelty arises from its investigation of the extent to which the collected data support a complex net of relations among multiple children-related factors, especially motivational-related ones, expected to help explain children's food consumption. Although recent studies in the literature have

started investigating motivational-related factors as important drivers of children's (un)healthy eating, little investigation has been performed on how factors interact with each other (i.e., research tends to evaluate one or two factors in isolation) [17]. Examining only separate elements risks not understanding the real contribution of each factor to the phenomenon [31]. Thus, analyzing all the variables' relationships within the same model is expected to contribute to a more comprehensive understanding of the role played by these variables on the control an individual may possess in the complex phenomenon of food consumption [13,14]. Learning the relationships between factors using a path model is expected to provide valuable information on the process and help design multidimensional preventive interventions aiming to promote healthy eating. Toward this goal, a mediation model (Figure 5) was devised with the following hypothesis:

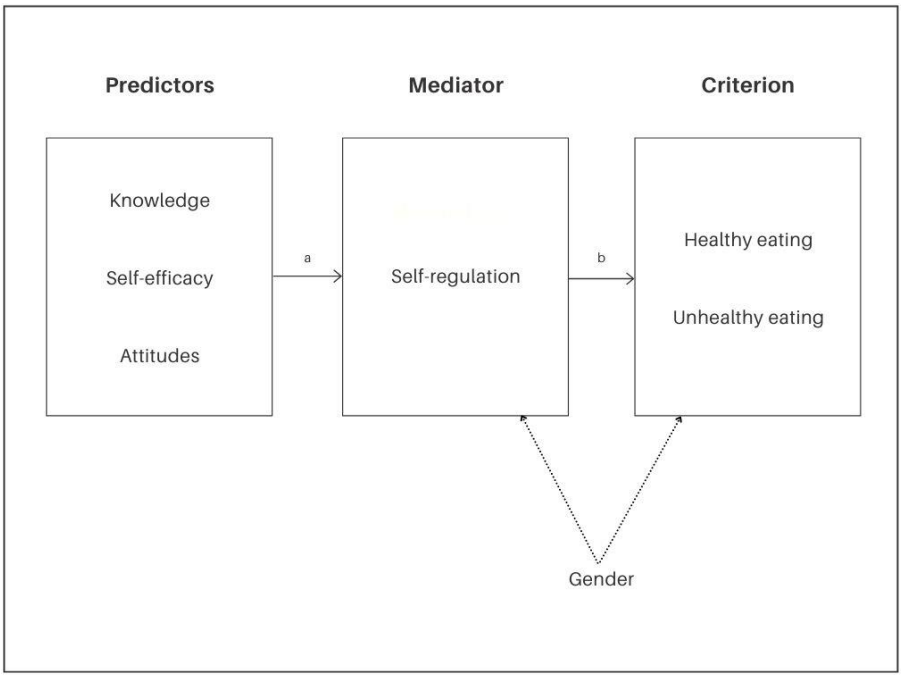


Figure 5 - Explanatory model of the mediational role of the self-regulation processes toward healthy eating on the relationship between the predictor factors (i.e., declarative knowledge about healthy eating, self-efficacy processes toward heathy eating, and attitudes and perceptions on healthy eating) and the food consumption criterion variables (healthy and unhealthy eating)[12].

The current model hypothesized that the predictor variables (i.e., declarative knowledge about healthy eating, self-efficacy processes toward heathy eating, and attitudes and perceptions on healthy eating) are indirectly related to children's food consumption (i.e., healthy, and unhealthy eating) through their relationship with self-regulation processes toward healthy eating. The latter association is expected to be: (i) positive for healthy eating: the higher the self-efficacy, attitudes, and knowledge scores, the higher the use of SR strategies, and the higher the likelihood of children's healthy food consumption; and

[12] Coefficients a and b are expected to be statistically significant; gender was treated as a covariate to statistically control its effect.

(ii) negative for unhealthy eating: the lower the self-efficacy, attitudes, and knowledge scores, the lower the use of SR strategies, and the higher the likelihood of children's unhealthy food consumption.

3.2. Materials and Methods

3.2.1. Study Context

The study took place in five public schools in the North of Portugal from different settings/contexts (e.g., rural, urban). In addition, the children attending the schools enrolled are likely to come from a wide range of socioeconomic and cultural backgrounds. Importantly, children from varied socioeconomic and cultural backgrounds are expected to have distinct resources and opportunities to make food choices. Considering the aim of the present study, i.e., to contribute to the understanding of how child-related factors influence children's food consumption, only children with food availability at home were recruited. The reason for this inclusion criteria was that children without food availability are limited in their ability to control their food choices (e.g., if they do not have fruit at home, the likelihood of choosing to eat fruit at lunch decreases). In fact, while analyzing individuals' choices, researchers cannot disregard the role that food availability at home might play [14,32,33]. Research shows that having a limited variety of foods available at home may inhibit a child's ability to choose and, consequently, affect the quality of their food consumption [32,33]. Specifically, the likelihood of selecting a healthy or unhealthy snack is lower when the availability of these types of food is scarce [34]. Therefore, following the literature's warnings, the present study comprised children from diverse socioeconomic and cultural backgrounds with access to both healthy (i.e., F/V) and unhealthy (i.e., candies and refrigerants, and fats and fast-food) foods at home.

3.2.2. Participants and Procedure

The present study is part of a research project that has been approved by the University of Minho Ethics Committee for Research in Social and Human Sciences (CEICSH) (CEICSH032/2019). CEICSH confirmed that the project complies with the requirements for good practice in human research, being in accordance with national and international standards governing research in social and human sciences, including the Declaration of Helsinki. Additionally, consent to conduct the study was obtained from the Portuguese Ministry of Education.

Prior to data collection, children and caregivers were informed by the research assistants about the aims of the study and were assured of the confidentiality of the data. Children and caregivers' written informed consent agreements were requested in 5th and 6th-grade classes from the five schools participating in the study. During this phase, participants who met the food availability inclusion criteria

were selected (i.e., children who declared having both healthy and unhealthy foods at home; see the instruments and measures section for more details on food availability assessment). Thus, 244 elementary school students met the inclusion criteria (i.e., consent to participate and have food availability at home) and took part in the data collection. Data collection took place in regular classes between January and February 2018. Students were invited by a research assistant to fill in the instruments and were asked to complete the task by themselves. Children took approximately 40 min to complete the questionnaires; each child fulfilled the instruments at their own pace and was supported by the research assistant with any item found to be unclear. From the initial pool of participants, 2 (0.82%) had to be excluded due to the lack of completion of all the measures collected (e.g., did not answer to the SR scale). The above data collection procedure is presented in Figure 6. Thus, the final sample was composed of 242 children aged between 9 and 12 (M = 11; SD = 0.797). Of these participants, 107 (44.2%) were female.

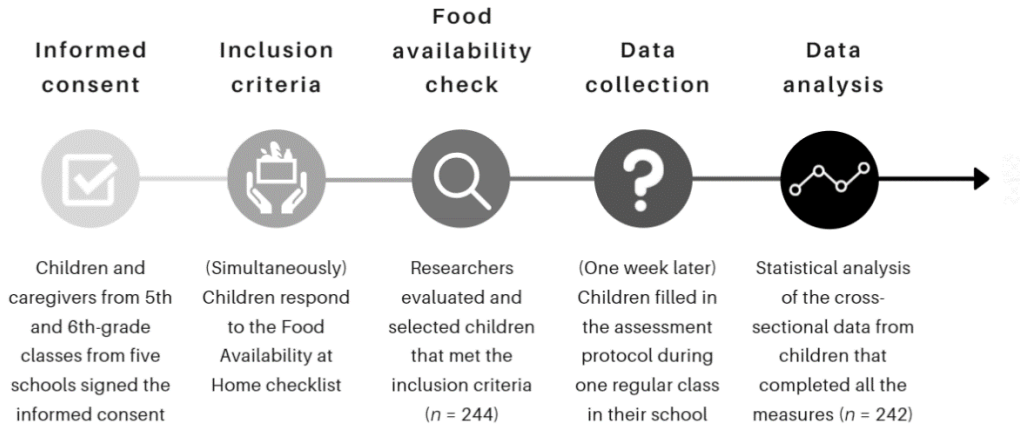


Figure 6 - Timeline of the data collection procedure.

3.2.3. Instruments and Measures

3.2.3.1. Personal Data

Participants were asked about their gender, age, and school grade.

3.2.3.2. Food Availability at Home

To assess food availability at home, a checklist comprised of eight food groups was used [5]. The checklist consisted of eight images (i.e., cereals, derivatives, and tubers; vegetables; fruits; legumes; dairy products; meat, fish, and eggs; candies and soda; fats and fast food), and children were asked to circle the groups of foods they had available at home. For the purposes of the current study, children only met

the food availability inclusion criteria when they reported access to both healthy (i.e., vegetables and fruits) and unhealthy (i.e., candies and refrigerants, and fats and fast-food) food groups.

3.2.3.3. Self-Regulation Processes toward Healthy Eating Questionnaire

To evaluate the SR processes toward healthy eating, the Self-Regulation Processes towards Healthy Eating Questionnaire [13] was used. The scale consisted of nine statements regarding the participants' use of SR strategies toward healthy eating (e.g., I plan my meals. I think about what I am going to eat and what it takes to prepare my meal; (for example, after waking up, I think about what I will eat for breakfast and what I need to prepare it)). Responses to the individual items were scored from 1 (never) to 5 (always) on a Likert-like scale and summed to create a composite score that ranged from 9 to 45, with higher scores implying more SR. The reliability of the scale is good (α = 0.788; ω = 0.792).

3.2.3.4. Self-Efficacy Processes toward Healthy Eating Questionnaire

To evaluate self-efficacy processes toward healthy eating, an adapted version of the Self-Efficacy for Health Scale (Mattos et al., 2018) was used. This adapted scale consisted of twenty statements regarding situations where the participants were asked to evaluate their confidence about being able to choose a healthy option (e.g., Eat fruit at breakfast). Responses to the individual items were scored from 1 (cannot do at all) to 4 (highly certain can do) on a Likert-like scale and summed to create a composite score that ranged from 20 to 80, with higher scores implying more self-efficacy. The reliability of the scale is good (α = 0.832; ω = 0.835).

3.2.3.5. Students' Attitudes and Perceptions on Healthy Eating Questionnaire

To evaluate the participants' attitudes and perceptions about healthy eating, an adapted version of the Students' Attitudes and Perceptions on the Health Instrument [35] was used. The present instrument consisted of 17 statements about students' attitudes and perceptions about the importance of healthy eating (e.g., Eating fruit and vegetables will help me to grow up; I think fruit is tasty). Responses to the individual items were scored as true or false, and the answers marked to be true were summed to create a composite score that ranged from 0 to 17, with higher scores implying more positive attitudes and perceptions toward healthy eating. The reliability of the scale is moderate (KR-20 = 0.626).

3.2.3.6. Declarative Knowledge about Healthy Eating Questionnaire

To evaluate the participants' declarative knowledge about healthy eating, an adapted version of the Declarative Knowledge about Healthy Eating Questionnaire [36], initially developed for assessing declarative knowledge about health in general (e.g., healthy eating, oral health), was used. The final scale consisted of 10 statements about healthy eating (e.g., It is necessary to eat fruits and vegetables, but not

every day). The answers to the individual items were scored as being true or false; the correct answers were summed to create a composite score that ranged from 0 to 10, with higher scores meaning more declarative knowledge about healthy eating. The reliability of the scale is moderate (KR-20 = 0.547).

3.2.3.7. Previous Day Food Intake Questionnaire (PDFIQ)

The Previous Day Food Intake Questionnaire [37] is a visual instrument used to assess the foods children had eaten during different meals throughout the previous day (i.e., breakfast, mid-morning snack, lunch, afternoon snack, dinner, and before-bed snack). The scale consisted of six images, one for each meal, illustrated with 21 individual foods and some food groups, specifically: dry beans, rice, milk, coffee with milk, chocolate milk, cheese, yogurt, beef or poultry, pasta, bread or crackers, French fries, pizza or hamburger, leafy vegetables, starchy vegetables, vegetable soup, fruits, sweets, chips, fish/sea foods, soft drinks, and fruit juices [37]. For each image of a meal, children were asked to circle the foods that they had eaten during the previous day for the corresponding meal. The instrument's reliability in evaluating the foods consumed was 70.2% and was 96.2% for foods not consumed. For the present study, responses for each image were scored based on the frequency at which these foods were consumed throughout the day, i.e., in how many meals had the children consumed fruit and vegetables, and in how many meals had the children consumed fast-food, soda, and candies. The reliability of the scale is moderate for healthy (KR-20 = 0.673) and unhealthy food intake (KR-20 = 0.619).

3.2.4. Data Analysis

The data were analyzed in three stages. First, we analyzed the statistical properties of the variables included in the path model (means, typical deviations, asymmetry, kurtosis), as well as the correlation matrix and the missing values (the percentage of missing values in the final sample was low, about 0.80%). Secondly, the healthy and unhealthy eating path models were fit with the AMOS 22 program in SPSS [38], using the robust maximum likelihood (ML). In this model, the gender variable was included as a covariate in order to statistically control its effect on the explanation of the variability of the dependent variables (i.e., SR, healthy and unhealthy eating). In fact, the literature shows that girls use more SR strategies than boys and that boys eat unhealthier than girls, regarding the amount of fruit and vegetable intake [5,7,39]. Model fit was evaluated using $\chi 2$, $\chi 2/df$, the adjusted goodness-of-fit index (AGFI), the comparative fit index (CFI), the root-mean-square error of approximation (RMSEA), and the standardized root-mean-square residual (SRMR). There is evidence of a good fit when $\chi 2$ has $p > 0.05$, $\chi 2/df < 5$, AGFI ≥ 0.90, CFI ≥ 0.95, and RMSEA and SRMR ≤ 0.05. Finally, a multiple-group analysis was conducted to

verify whether the fit model was invariant for the sex variable. The effect size of the regression coefficients was calculated using Cohen's [40] d statistic.

3.3. Results

3.3.1. Descriptive Statistics

Descriptive data are presented in Table 6. Most of the correlations are statistically significant. It is particularly striking that there is no relationship between healthy and unhealthy eating. The predictor variables (i.e., knowledge, attitudes, self-efficacy, and self-regulation) show a normal distribution. Self-regulation, self-efficacy, knowledge, and attitudes are positively associated with healthy eating and negatively with unhealthy eating. The correlations indicate that healthy eating tends to be associated with more positive attitudes, more self-efficacy, and the use of SR strategies for healthy eating. Conversely, unhealthy consumption is associated with more negative attitudes, less knowledge, less self-efficacy, and fewer SR strategies. Finally, despite girls reporting more healthy eating consumption than boys (i.e., positive correlation between gender and healthy eating. Note that boys are coded with zero and girls with one), no relationship between gender and unhealthy consumption was found.

Table 6 - Pearson correlations, mean, standard deviation, skewness, and kurtosis of observed measures (N = 242)[13].

	Gender	Self-Regulation	Self-Efficacy	Knowledge	Attitude	Healthy Eating	Unhealthy Eating
Gender	–						
Self-Regulation	0.310**	–					
Self-Efficacy	0.271**	0.539**	–				
Knowledge	0.226**	0.223**	0.253**	–			
Attitudes	0.153*	0.332**	0.345**	0.192 **	–		
Healthy Eating	0.138*	0.264**	0.199**	0.091	0.163 *	–	

[13] Sex (0 = boys; 1 = girls), Self-Regulation (9 = min.; 45 = max.), Self-Efficacy (20 = min.; 80 = max.), Knowledge (0 = min.; 10 = max.), Attitudes (0 = min.; 17 = max.), Healthy and Unhealthy eating (0 = min.; 6 = max.). * $p < 0.05$; ** $p < 0.01$.

Unhealthy Eating	−0.008	−0.150*	−0.164*	−0.187 **	−0.183 **	0.028	–
M	0.44	32.39	66.47	8.31	12.29	2.19	1.96
SD	0.50	5.99	8.02	1.64	2.42	1.62	1.62
Skew	0.23	−0.83	−1.45	−0.98	−0.54	0.47	0.65
Kurt	−1.96	1.04	4.26	0.36	−0.25	−0.46	−0.46

3.3.2. Explanatory Model of Food Consumption (Healthy and Unhealthy Eating Models)

While the healthy eating model presents an excellent fit ($\chi2(3) = 2.128$; $p = 0.546$; $\chi2/df = 0.709$; AGFI = 0.980; CFI = 0.999; RMSEA = 0.001; SRMR = 0.018), the unhealthy eating model fit is just acceptable ($\chi2(3) = 11.835$; $p = 0.008$; $\chi2/df = 3.945$; AGFI = 0.890; CFI = 0.951; RMSEA = 0.111; SRMR = 0.044). Table 7 presents the standardized regression coefficients for healthy and unhealthy eating models (direct and indirect effects). According to Table 7, in both the healthy and unhealthy eating path models, there is a significant positive relationship between attitudes and self-regulation, self-efficacy and self-regulation, and gender and self-regulation. The relationship between knowledge and self-regulation and between gender and (un)health was not significant. Moreover, self-regulation positively influenced children's healthy eating and negatively influenced children's unhealthy eating. For indirect effects, the data showed that attitudes and self-efficacy positively explained healthy eating through self-regulation. Regarding unhealthy eating, only self-efficacy negatively explained children's food consumption through self-regulation.

Table 7 - Standardized regression coefficients of the explanatory model of food consumption (N = 242)[14].

	SRW	*SE*	*T*-Value	*p*-Value	*Cohen' d*
Direct Effects					
Healthy Eating Path Model					
Knowledge ⟶ Self-Regulation	0.049	0.201	0.886	0.375	—

[14] SRW (Standardized Regression Weights); S.E. (Standardized Errors); ⟶ (Direction of relationship); ↔ (Direction of relationship); SR (Self-Regulation).

Attitudes → Self-Regulation	0.149	0.139	2.655	0.008	0.346
Self-Efficacy → Self-Regulation	0.432	0.043	7.447	<0.001	1.091
Self-Regulation → Healthy Eating	0.244	0.018	3.746	<0.001	0.496
Gender → Self-Regulation	0.160	0.664	2.897	0.004	0.379
Gender → Healthy Eating	0.062	0.212	0.945	0.344	—
Knowledge ↔ Attitudes	0.192	0.260	2.933	0.003	0.384
Knowledge ↔ Self-Efficacy	0.253	0.872	3.811	<0.001	0.505
Attitudes ↔ Self-Efficacy	0.345	1.318	5.066	<0.001	0.689
Unhealthy Eating Path Model					
Knowledge → Self-Regulation	0.049	0.201	0.886	0.375	—
Attitudes → Self-Regulation	0.149	0.139	2.655	0.008	0.346
Self-Efficacy → Self-Regulation	0.432	0.043	7.447	<0.001	1.091
Self-Regulation → Unhealthy Eating	−0.164	0.018	−2.443	0.015	0.318
Gender → Self-Regulation	0.160	0.664	2.897	0.004	0.379
Gender → Unhealthy Eating	0.043	0.217	0.637	0.524	—
Knowledge ↔ Attitudes	0.192	0.260	2.933	0.003	0.384
Knowledge ↔ Self-Efficacy	0.253	0.872	3.811	<0.001	0.505
Attitudes ↔ Self-Efficacy	0.345	1.318	5.066	<0.001	0.689
Indirect Effects					
Healthy Eating Path Model					
Knowledge → SR → Healthy Eating	0.012	0.014	0.865	0.387	—
Attitudes → SR → Healthy Eating	0.036	0.017	2.195	0.028	0.285
Self-Efficacy → SR → Healthy Eating	0.106	0.031	3.431	0.001	0.452

Unhealthy Path Model					
Knowledge → SR → Unhealthy Eating	−0.008	0.010	−0.836	0.403	—
Attitudes → SR → Unhealthy Eating	−0.024	0.013	−1.813	0.070	—
Self-Efficacy → SR → Unhealthy Eating	−0.071	0.030	−2.352	0.019	0.306

Figure 7 presents the principal results. The relevance of controlling the gender variable has been validated. Specifically, gender did not directly affect the type of food consumption (neither healthy nor unhealthy), but rather indirectly through its effect on SR (see Figure 7).

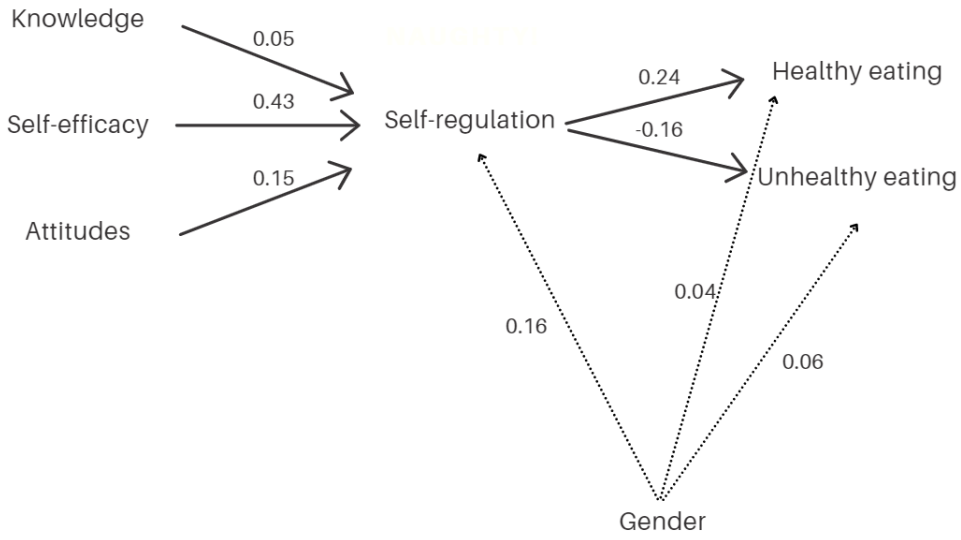


Figure 7 - Principal results of the food consumption model.

Our main hypothesis was that SR for eating behaviors plays a mediating role between self-efficacy, attitude, and knowledge on healthy and unhealthy eating. The data obtained confirm this hypothesis only partially. SR for healthy eating is positively associated with healthy eating (b = 0.244, p < 0.001) and negatively with unhealthy eating (b = - 0.164, p < 0.01). Moreover, SR for eating behaviors is positively predicted by children's self-efficacy (b = 0.432, p < 0.001) and their positive attitude (b = 0.149, p < 0.01), but not by their level of knowledge toward healthy eating (b = 0.049, p = 0.375). However, considering the indirect effects (see Table 7), the SR mediation hypothesis is confirmed only for some relationships. Specifically, considering the healthy food model, the SR mediation was statistically significant for the effects of attitude (b = 0.036, p < 0.05) and self-efficacy (b = 0.106, p < 0.001), but not for knowledge (b = 0.012, p > 0.05). Regarding the unhealthy food model, only the SR mediation for self-efficacy was statistically significant (b = 0.071, p < 0.05). It should also be noted that a total mediation

effect was found in cases where the mediation effect was significant; that is, the effect of the independent variables on eating behavior — healthy or unhealthy — was entirely through SR (note that there are no statistically significant direct effects of knowledge, self-efficacy, or attitude on eating behavior). However, the effect sizes of such mediation effects are small (note that only the mediation of the effect of self-efficacy on healthy eating is close to medium: $d = 0.452$).

Finally, 34.3% of the variance of SR for eating behaviors is explained by the predictor variables, but healthy and unhealthy eating are barely explained (7.3% and 2.4%, respectively).

3.4. Discussion

The present study analyzed the reported food consumption behavior of children from the 5th and 6th grades with food availability at home. A path model was tested to investigate how the self-regulation of healthy eating mediates the effect of child-related variables (i.e., knowledge, self-efficacy, and attitudes) on food consumption. Finally, gender was controlled due to its potential effect on SR and the intake of healthy and/or unhealthy food.

Overall, the hypothesized mediation model was partially confirmed, i.e., some motivational-related factors are related to children's (un)healthy food consumption through the strategies that children use to self-regulate their eating.

The direct effects of the present model showed that attitudes and self-efficacy toward healthy eating were positively associated with self-regulation toward healthy eating, i.e., children who think positively about healthy eating and feel capable of making healthy food choices are more likely to self-regulate their eating behaviors. Woods et al. [25] also found that self-efficacy can lead to an increase in behavioral strategies (e.g., tracking food consumption, planning meals) aimed toward fruit and vegetable consumption. Moreover, in the current model, self-efficacy showed a positive effect on SR stronger than that found for attitudes about healthy eating. This finding emphasizes the prominent role children's beliefs about their capability to perform a task play in carrying out that task [26,27,41,42]. Thus, it seems necessary to promote children's sense of confidence in their ability to use SR strategies for healthy eating to promote their adherence to healthy eating. Interestingly, there is no association between declarative knowledge about healthy eating and SR for healthy eating.

Still, regarding the direct effects of the model, SR toward healthy eating was positively associated with children's food consumption, i.e., high SR strategies are associated with healthier food choices, and poor SR strategies are associated with unhealthier food choices. These findings are consistent with

previous research showing that SR behaviors may play a relevant role in developing a healthy diet [13,14]. This stresses the importance of the child's agent role in managing and activating personal resources to make healthy food choices (e.g., plan a healthy school lunch box).

A detailed analysis of the indirect effects (mediational hypothesis) indicates that the effects of self-efficacy and attitudes toward healthy eating are fully mediated by SR. The former exhibited a medium effect size while the latter showed a small effect size. In fact, the more positive the attitude toward and the self-efficacy for healthy eating, the higher the SR and the healthier the eating choices made. Conversely, the effect of self-efficacy for healthy eating on the consumption of unhealthy food is negative. Importantly, the stronger the self-efficacy, the higher the protective effect on the consumption of unhealthy food. This effect is similar regarding attitudes about healthy eating, but the impact is marginally significant. These indirect effects emphasize the idea that food consumption is a complex phenomenon with a network of relationships between several contributing factors [14,25]. Interestingly, SR for healthy eating does not mediate the effect of knowledge on healthy food consumption. This relevant finding supports prior evidence suggesting that solely conveying knowledge about healthy eating is insufficient to influence healthy food choices being made [13].

Lastly, gender did not directly impact food consumption but instead showed an indirect impact through SR. Girls in the present sample reported more self-regulation behaviors than boys, which in turn may lead to girls consuming more healthy foods and less unhealthy ones than boys. These data help in understanding the mechanisms underlying the gender differences regarding food consumption found in previous studies [5,7].

The current study's promising results sustain the idea that multidimensional interventions and actions are needed to promote eating behavior changes, rather than interventions focused on a single factor in isolation [14]. Grounded on present data, we believe that motivational-related factors are key in the promotion of healthy eating, but also that their impact on children's food consumption is lower than expected. Therefore, the design of future research and interventions might consider: (a) promoting SR toward healthy eating (e.g., hands-on activities about meal planning) [23,36,43]; (b) boosting feelings of self-efficacy toward healthy eating (e.g., group interventions where children discuss their experiences in making (un)healthy choices with their peers, reinforcing the feasibility of success) [44]; (c) promoting positive attitudes toward healthy eating (e.g., illustrating that increasing fruit and vegetable consumption is important not only to maintain a healthy weight, but also to protect against chronic diseases) [45]; (d)

improving the explained variance of food consumption by considering the inclusion of social-related variables in the path model (e.g., peer pressure on food consumption [46]).

Additionally, it is important to use current outcomes to inform the activities of groups comprised of children, parents, teachers, and the health community in the future and advocate for the importance of launching policies promoting children's agency toward healthy eating. Advocacy groups for healthy eating could consider working with governmental agencies and food companies to help set environmental and structural changes likely to facilitate children's healthy choices (e.g., training for parents on healthy meal preparation, delivering media marketing messages encouraging healthy food choices, or lowering prices for healthy foods). Although the present research advances the understanding of how motivational-related factors may contribute to children's food consumption, the findings should be taken cautiously. For example, no association between declarative knowledge about healthy eating and SR for healthy eating was found. This important finding is expected to provide further insight to school administrators and healthcare regulatory agencies on the limited or small-to-medium-sized effects of healthy food campaigns [14,47,48], as well as suggestions for future interventions (e.g., include self-efficacy and attitudes toward healthy eating). Moreover, despite the effect of SR on food consumption being statistically significant, the amount of explained variance is small. The following reflections could shed light on current findings. Participants are elementary school children declaring access to both healthy and unhealthy foods at home. This is a strength of the present study, as it ensures the exclusion of children that would not have the possibility to make choices regarding their eating habits, due to lack of accessibility; yet, due to their early age, the participants may still lack autonomy in their food choices. For example, some parents set limits, rules, or restrictions regarding food consumption [49]; moreover, children could eat some of their meals at school and may purchase (un)healthy items in the cafeteria [50]. In sum, current data show that children's SR may play a limited role in their food choices, and there is a need to include other variables in the model to increment the explained variance of (un)healthy food consumption (e.g., external factors such as parental styles and school cafeteria vending options) [51,52]. At this age, although motivational-related factors seem to play an important role in food consumption, external factors could also play a key role in food choices, and therefore need to be added to the model.

Moreover, a few limitations must be acknowledged. First, the self-reported nature of the measures used in the research may have led to socially desirable or inaccurate responses. Despite the reliability and validity of the measures, future research could consider combining self-reported with alternative measures, such as objective observational ones (e.g., children sending photos of the meals). Second, the

data are cross-sectional. Future research could consider a longitudinal design to examine whether changes in any of the motivational-related factors predict actual behavior changes. Finally, although it is not possible to guarantee the generalization of the present findings, current data were collected in five public schools from different settings/contexts (e.g., rural, urban). This variety of settings ensured a wide range of socioeconomic and cultural backgrounds.

3.5. Conclusions

Overall, the results of the present study contribute to the existing literature, shedding light on the role of motivational-related factors on children's food consumption. To further understand the etiology of (un)healthy food consumption from a motivational perspective, we evaluated the mediating role of self-regulation on the relationship between knowledge, self-efficacy, and attitudes toward healthy eating and children's reported food consumption. The present results showed that self-efficacy and attitudes indirectly explain both healthy and unhealthy eating through self-regulation strategies. These findings are expected to help inform the design of future multidimensional interventions promoting healthy eating behaviors. For example, educators could consider instigating feelings of self-efficacy while encouraging the use of self-regulation strategies toward food choices. The study of a complex net of relationships among multiple motivational-related factors within the same model is an advantage of the present research. All considered, it is important to continue examining the complex relationships between different modifiable variables and their relationships with external factors (i.e., proximal and distal factors such as family meal climate and proximity to food outlets, respectively) to understand how to better-design preventive interventions likely to promote children's healthy eating and, consequently, decrease childhood overweightness and obesity-related problems. Future research could consider the study of other motivational-related variables that may significantly influence children's food consumption, for example, how parental styles and school vending options may impact children's autonomy to choose and control their eating behaviors. Moreover, to address some limitations of the present study, future research could consider using observational measures and longitudinal designs.

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Chapter 4

Extending prior research on the effect of motivational-related factors on children's eating behavior: A path model of child-clan-community relationships[15]

[15] This article is under review.

4. Extending prior research on the effect of motivational-related factors on children's eating behavior: A path model of child-clan-community relationships

Abstract

Research has highlighted the role of self-regulation in eating behavior; however, prior research has shown mixed results. A recent study investigated the relationship between motivational-related factors (i.e., attitudes and perceptions towards healthy eating, self-efficacy for healthy eating) and children's eating behavior. It concluded that self-regulation explained a small amount of the variance in the model. Aiming to investigate further the role of self-regulation on children's healthy eating behavior, the current study extended the latter model by adding four new variables from the clan- and community-level environments (i.e., parent's healthy eating behavior, parent's self-regulation, parental feeding styles, and peer pressure). A cross-sectional survey was conducted with a sample of 273 parent-child dyads. Results indicated that children's self-regulation mediates the relationship between variables from the child- (e.g., children's attitudes and perceptions towards healthy eating), clan- (e.g., parent's self-regulation towards healthy eating), and community-level (e.g., positive, and negative peer pressure), and children's healthy eating. Compared with the previous model, the current one explained an additional 4.7% of the children's self-regulation variance and 17.7% of the children's healthy eating behavior variance. Results suggested that, for this age group, variables from the community-level (e.g., positive peer pressure) significantly influence children's eating behavior more than those from the clan-level (e.g., prompting and encouragement feeding practices). The present study highlights the utility of the extended model for understanding the predictive effects of children's eating behavior and provides new insights into the promotion of children's healthy eating efforts within a context of a supportive social network.

Keywords: Children, Healthy eating behavior, Self-regulation, Parents, Peer pressure

4.1. Introduction

Eating behavior influences children's health and development to a large extent (1-3)[16]. Prior research on eating behavior indicates that promoting healthy eating (HE) early in life is vital to prevent chronic diseases (e.g., obesity, cancer, heart disease) and promote good cognitive functioning (e.g., high academic achievement) throughout the entire lifespan (2-4). Moreover, research suggests that children are likely to maintain their eating behaviors into adulthood (5). Despite the benefits of HE and the efforts of

[16] References for this article are described in accordance with the journal's request, i.e., following the Vancouver style.

researchers, educators, and governmental bodies to promote HE behavior, evidence indicates that many children do not meet the daily food consumption recommendations (6-7). For example, the recent work by Pereira et al. (8) reports that fruit and vegetables (F/V) consumption among a sample of 678 Portuguese elementary school-aged children is below the expected (i.e., below five portions per day). Thus, despite the vast body of knowledge on HE, a better understanding of the factors contributing to children's HE behavior is still a research priority.

Extant findings suggest that children's eating behavior is a highly complex phenomenon, resulting from the interplay of multiple factors, including variables related to the child, their clan (i.e., family), and their community (e.g., peers from school) environments (9-10). The Six-Cs developmental ecological model from Harrison et al. (9) summarizes and organizes these factors into six spheres. In particular: (1) the cell environment, comprised by hereditary and biological factors, such as food allergies (11); (2) the child environment, comprised by children's personal and behavioral factors, such as attitudes towards healthy eating (12); (3) the clan environment, comprised by family characteristics and interactions, such as parental feeding practices (13); (4) the community environment, comprised by children's social world outside the home, such as their school peers (14); (5) the country environment, comprised by national factors, such as policies allowing advertisements focused on unhealthy foods (15); and (6) the cultural environment, comprised by societal factors, such as norms for oversized portions (16). This model provides a relevant theoretical framework for the present study.

Literature has been reporting the crucial role played by the motivational-related factors (i.e., child-level factors), especially SR, in children's HE (e.g., 17); however, individual change is more likely to be facilitated and sustained when the surrounding environment supports healthful food choices (8, 17-18). Accordingly, for the purposes of the current study, we extended a previous model of the effects of motivational-related factors on children's eating behavior (12). Based on the summary of critical environments influencing children's nutrition practices provided by the six-Cs model, we additionally investigated the role of variables from the clan and community environments due to their closeness to the child and amenability to change (9).

4.1.1. Child-level factors and children's eating behavior

Prior research focused on child-level factors explaining children's eating behaviors indicates a growing interest in the role played by self-regulation (SR) in children's HE (19-21). SR comprises processes allowing individuals to control proactively the personal, behavioral, and environmental influences impacting human behavior, including eating (22). Generally, research demonstrates a positive

relationship between the use of SR strategies and HE behavior in all age groups (10, 12, 23, 24). For example, a study from Luszczynska et al. (25) shows that improvements in the use of SR strategies (e.g., action planning, barrier identification) among adolescents tends to increase their F/V consumption. Recently, Pereira et al. (12) conducted an empirical study to understand the potential mediating role of elementary-school children SR towards HE in the relationship between child-level variables (i.e., declarative knowledge, self-efficacy, and attitudes towards HE) and eating behavior. Overall, the path model data confirmed the hypothesized mediation model. Specifically, attitudes and self-efficacy towards HE were positively associated with SR towards HE (i.e., children who think positively about HE and feel capable of making healthy food choices are likely to self-regulate their eating behaviors and, consequently, eat healthy). However, data indicated that SR towards HE played a modest role (i.e., small effect size) in children's eating behavior. The latter suggests that there may be other factors explaining this relationship.

4.1.2. Clan-level environment and children's eating behavior

Research has been showing that parents/caregivers influence children's food consumption in diverse ways. For example, parents' eating behavior, parents' use of SR strategies, and parental feeding styles are factors likely to influence children's eating behavior (26-27). There is evidence that parent's eating behavior is paramount in the development of children's eating behavior through role-modeling (28-30). For example, Sleddens et al. (31) reports that parents who regularly eat F/V influence their children to eat healthy while exposing them to a large variety of healthy foods. Additionally, Johnson (32) found that parents' eating behavior is also likely to influence children's SR. For example, children with mothers who self-report high levels of dieting or impulsive eating develop less SR strategies towards eating behavior (32). Literature reports that parents can be role models for their children not only through their eating behavior but also through their use of SR strategies. For example, Germann et al. (33) found that children whose parents use SR strategies for weight control (e.g., monitoring) are likely to use the same SR strategies to control their weight. However, little is known regarding the role of parents' SR on children's use of SR strategies for eating behavior and, consequently, on children's HE. Research in clinical and educational contexts, for example, shows an association between parent behavioral and emotional SR and child SR (34). These findings raise the possibility of a similar intergenerational communication of SR occurring in the HE context.

Finally, research highlights that parental feeding styles – parents' general approach to socialize the child towards food and eating – are expected to shape children's eating behavior. For example, controlling feeding styles, such as restriction and pressure to eat (e.g., limiting access to desserts, forcing

to eat vegetables), are generally associated with poor SR development and overeating during meals (35-36). Similarly, instrumental (e.g., using food as reward) and emotional (e.g., using food to temper children's emotions) feeding practices are positively associated with children's consumption of unhealthy snacks and negatively with the consumption of fruit (37). A possible explanation is that these parental practices provide children with few opportunities to develop SR skills and practice food choices autonomously (38). In contrast, literature shows that prompting and encouragement feeding practices (e.g., convey clear standards without being intrusive, i.e., children are encouraged to eat healthy foods but are also given some choices about eating options) are likely to help children develop their ability to self-regulate food consumption and are associated with HE behavior (26, 39).

4.1.3. Community-level environment and children's eating behavior

The community-level environment comprises factors likely to affect the relationship between SR and children's eating behavior, such as peer pressure. At this developmental stage, peer pressure begins to play a significant role in children's eating behavior due to concerns about social status and acceptance at school (40-41). Children tend to choose food that is appreciated by their peers as a strategy to be accepted by them. For example, choosing healthy foods is associated with an unpopular status, and often marginalization; moreover, there is the perception that children from the dominant social status in school eat the "big brand" junk food (40). Peers' pressure may prevent children from eating healthy; which may explain the need to promote SR strategies among children and adolescents to enable them to follow HE behaviors, especially in the presence of peers (19).

4.1.4. The present study

Recently, researchers have been showing a growing interest in further understanding the role of SR in children's eating behavior (19, 21, 42). Most of the previous findings have indicated SR as an essential variable for children's HE, with high SR values predicting high consumption of F/V (25, 43). However, the study of Pereira et al. (12) found that children's SR plays a statistically significant but limited role in their HE. Drawing on this evidence, we aim to understand further whether the role of SR in explaining children's HE variance is limited or, despite the relevance of the motivational-related factors, particularly SR, there is the need to consider variables from the surrounding environment of the children (i.e., clan- and community-level variables) to increase the explained variance of children's HE. Therefore, the current study extended the original model of Pereira et al. (12) by following a multi-reporter approach trough parent-child dyads, and adding variables from the clan- (i.e., parent's HE behavior, parent's SR toward HE, parental feeding styles) and community-level (i.e., peer pressure to eat healthy or unhealthy food).

Children's HE is a complex phenomenon, and clan- and community-level factors are expected to play an essential role in shaping children's eating behaviors (e.g., 9-10). Based on these premises, following an holistic approach to the phenomenon, the present study aims to investigate the potential mediator role played by SR in the relationship between child-level factors (i.e., declarative knowledge about HE, self-efficacy for HE, attitudes and perceptions towards HE), clan-level factors (i.e., parent's HE behavior, parent's SR toward HE, parental feeding styles), and community-level factors (i.e., peer pressure to eat healthy or unhealthy food), and children's eating behavior.

This paper also adds to the literature by investigating the extent to which data support a complex net of relationships among multiple factors within the same model. Prior research has been focused on the individual (i.e., child-level) and environmental (i.e., clan- and community-level) predictors of children's eating behavior, still analyzed independently. To the best of our knowledge, no study has simultaneously examined how environmental factors interact with each other and with individual ones (e.g., SR) (12, 31). Analyzing the unique role of each variable may prevent understanding the weight of the contribution of each factor against the other ones (39). Finally, there are a few investigations examining the relationship between clan-level factors and children's eating behavior (e.g., 45-46); however, studies using a multi-reporter approach (i.e., parents and children reports) are limited. Therefore, learning the relationships between child-, clan-, and community-level factors using a path model is expected to provide valuable information on the phenomenon and help design multidimensional preventive interventions aiming to promote children's HE. Towards this goal, a mediation model (see Figure 8) was devised with the following hypothesis:

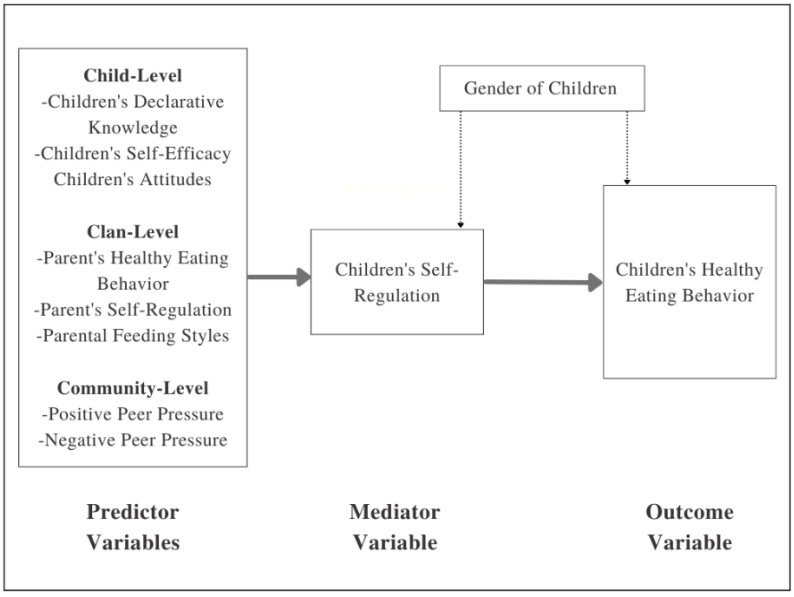


Figure 8 - Explanatory model of children's healthy eating behavior.

H1. There is a statistically significant and positive relationship between child-level factors and children's HE behavior. The higher the children's knowledge about HE, the higher their perceived competence to eat healthy, and the more positive their attitude towards HE, the more likely children are to eat healthy (12). This relationship is totally mediated by children's SR: the more positive the child-level factors towards HE, the more likely children are to use SR strategies towards HE, and the more likely children are to eat healthy.

H2. There is a statistically significant and positive relationship between clan-level factors and children's HE behavior. The healthier the parents' eating behavior, the more the parents use SR strategies, and the more the parental feeding style is focused on prompting and encouraging healthy eating, the more likely children are to eat healthy (30, 34, 39). This relationship is totally mediated by children's SR: the more positive the parents-level factors towards HE, the more likely children are to use SR strategies towards HE and to eat healthy (27).

H3. There is a statistically significant relationship between community-level factors and children's eating behavior; this relationship is totally mediated by children's SR. Specifically, the greater the peer pressure for HE, the greater the use of SR strategies, and the more likely children are to eat healthy (19, 40). Contrarily, the greater the peer pressure for unhealthy eating, the less their use of SR strategies, and the less likely children are to eat healthy.

4.2. Materials and Methods

4.2.1. Study Context

The current study took place in four public schools in the North of Portugal, and participants were children from the fifth and sixth grades (typically 10-11 years old). According to the Portuguese education system, the second cycle of basic education comprises the fifth and sixth grades (typically 10-11 years old) (46). Children who finish the first cycle of education (i.e., first to the fourth grades; typically, six-nine years old) transit to the second cycle and to a new school (i.e., usually comprising students from the fifth to nineth grades). Portuguese children enrolled in the fifth and sixth grades are expected to develop autonomy and responsibility to cope with the new school challenges (e.g., interaction with a team of 10 to 12 teachers delivering distinct subjects instead of one head teacher per class, and with older children).

4.2.2. Participants and Procedure

The present study is part of a research project approved by the Ethics Committee of the University. The project complies with the requirements for good practice in human research, in accordance with national and international standards governing research in social and human sciences, including the Declaration

of Helsinki. Additionally, consent to conduct the study was obtained from the Portuguese Ministry of Education.

The measurement protocol of the current study followed a multi-reporter (i.e., children and parents/caregivers) approach. The research team invited 544 dyads (i.e., children and their parents/caregivers) to participate in this study. Prior to data collection, these dyads were informed about the aims of the study and assured of the confidentiality of the data. Written informed assents and consents from children and parents/caregivers, respectively, were requested, and all accepted to participate. From these, 271 (49.82%) were excluded due to the following reasons: i) the parent, the child, or both, did not complete the assessment protocol (e.g., left questionnaires blank); ii) one of the elements of the dyad did not attend the data collection session. Thus, the final sample consisted of 273 children aged between eight and 13 (M = 10.48; SD = .70), and 273 parents/caregivers aged between 20 and 57 (M = 40.84; SD = 5.63). Table 8 presents details about the participants.

Data collection took place between October 2021 and June 2022, in an in-presence (children) and remote (parents/caregivers) fashion. The former took place in regular classes and children took approximately 20 minutes to complete the questionnaires. Simultaneously, an online self-reported questionnaire constructed on Qualtrics Survey Software© 2021 (47) was shared with one of the children's parents/caregivers via e-mail or WhatsApp. Parents/caregivers took approximately 20 minutes to fill in the survey. To protect confidentiality and anonymity of the data, codes were assigned to match the participants (e.g., pair the child's questionnaire with the parent/caregiver's one).

Table 8 - Participants' characterization.

	Children (n = 273)		Parents/Caregivers (n = 273)	
Characteristic	n	(%)	n	(%)
Gender				
Male	134	49.1	34	12.5
Female	139	50.9	239	87.5
Grade				
Fifth	176	64.5	-	-

Sixth	97	35.5	-	-
Kinship				
Mother	-	-	235	86.1
Father	-	-	33	12.1
Sister	-	-	3	1.1
Grandmother	-	-	2	.7
Education level				
Basic education	-	-.	108	39.7
Secondary education	-	-	106	39.0
Undergraduate degree	-	-	48	17.6
Graduate degree	-	-	10	3.6

4.2.3. Instruments and Measures

4.2.3.1. Personal Data

Children were asked about their gender, age, grade, and school. Parents were asked about their gender, age, kinship, and educational level.

4.2.3.2. Children's Healthy Eating Behavior

To evaluate children's HE behavior, children answered three items about their F/V consumption from the *Healthy Eating and Physical Activity Behavior Recall Questionnaire for Children* (HEPABRQ-C) (48) (see Supporting Information section). Responses to the items were summed to create a composite score ranging from 0 to 10, with higher scores implying healthier eating behaviors. Current reliability is good (α = 0.645; ω = 0.691).

4.2.3.3. Children's Self-Regulation Processes towards Healthy Eating

Children filled out the *Self-Regulation Processes towards Healthy Eating Questionnaire* (20). The scale consisted of nine items regarding the participants' use of SR strategies towards HE (e.g., I plan my meals. I think about what I am going to eat and what it takes to prepare my meal - for example, after waking up, I think about what I will eat for breakfast and what I need to prepare it) (see Supporting Information

section). All items were responded to in a 5-point Likert-type scale from 1 "never" to 5 "always". Responses were summed to create a composite score ranging from 9 to 45, with higher scores implying more SR. For the current study, the reliability data is very good (α = 0.843; ω = 0.834).

4.2.3.4. Declarative Knowledge about Healthy Eating

To evaluate children's declarative knowledge about HE, an adapted version of the *Knowledge of Healthy Eating Questionnaire* (49) was used. The present scale consisted of 10 statements and participants had to rate their agreement regarding each one (e.g., "our meal should contain varied and colorful foods") (see Supporting Information section). In the present study, responses to the individual items were scored as true or false, and the correct answers were summed to create a composite score ranging from 0 to 10, with higher scores implying more declarative knowledge about HE. Current reliability data is good (KR-20 = 0.678).

4.2.3.5. Attitudes and Perceptions towards Healthy Eating

To evaluate children's attitudes and perceptions towards HE, an adapted version of the *Students' Attitudes and Perceptions on Healthy Eating Questionnaire* (12) was used. The present scale comprises 16 statements about students' attitudes and perceptions on the importance of HE (e.g., eating fruit and vegetables will help me to grow up) (see Supporting Information). In the present study, responses followed a 5-point Likert-type scale from 1 "totally disagree" to 5 "totally agree". Responses were summed to create a composite score ranging from 16 to 80, with higher scores implying more positive attitudes and perceptions toward HE. Current reliability data is very good (α = 0.856; ω = 0.843).

4.2.3.6. Self-efficacy for Healthy Eating

To evaluate children's self-efficacy beliefs regarding HE behavior, an adapted version of the *Healthy Eating and Physical Activity Self-Efficacy Questionnaire for Children* (48) was used. The present scale comprises seven statements regarding the degree to which children believe that they can eat healthy or handle a situation in which it can be hard to eat healthy (e.g., I will say no when my friends offer me junk food or food that is not healthy) (see Supporting Information section). In the present study, responses followed a 5-point Likert-type scale from 1 "I am sure I cannot do this" to 5 "I am sure I can do this". Responses were summed to create a composite score ranging from 7 to 35, with higher scores implying higher self-efficacy beliefs towards healthy eating behavior. Current reliability data is very good (α = 0.725; ω = 0.719).

4.2.3.7. Parent's Healthy Eating Behavior

Parents/caregivers filled out the same scale as children, i.e., the three items from the *Healthy Eating and Physical Activity Behavior Recall Questionnaire for Children* (HEPABRQ-C) (48) (see Supporting Information section). Current reliability data for parents is good (α = 0.512; ω = 0.532).

4.2.3.8. Parent's Self-Regulation Processes toward Healthy Eating

Parents/caregivers filled out the same scale as children, i.e., the *Self-Regulation Processes towards Healthy Eating Questionnaire* (20) (see Supporting Information section). The current reliability data for parents is very good (α = 0.83; ω = 0.760).

4.2.3.9. Parental Feeding Styles

Parents filled out an adapted version of the *Portuguese Parental Feeding Style Questionnaire* (50-51). The present questionnaire consists of four scales: emotional, instrumental, prompting and encouragement, and control feeding style; parent's responses followed a 5-point Likert-type scale from 1 "I never do" to 5 "I always do" (see Supporting Information section). Note, for each scale, higher scores reflect better the corresponding parental feeding style. The emotional feeding scale comprises five items (e.g., I give my child something to eat to make him feel better when he is upset). Responses were summed to create a composite score ranging from five to 25. The current reliability data is very good (α = 0.880; ω = 0.887). The instrumental feeding scale comprises four items (e.g., I reward my child with something to eat when she is well-behaved). The composite score of the parent's responses ranged from four to 20, and the current reliability data is good (α = 0.684; ω = 0.676). The prompting and encouragement to eat scale comprises six items (e.g., I praise my child if she tries a new food). The composite score ranged from six to 30, and the current reliability data is very good (α = 0.750; ω = 0.729). Finally, the control towards eating scale comprises four items (e.g., I decide how many snacks my child should have). The composite score ranged from four to 20; and the current reliability data is good (α = 0.684; ω = 0.695).

4.2.3.10. Peer Pressure

To evaluate food peer pressure, children answered to the open-ended question "The last time I had money to eat, what did I buy?". The codification into healthy or unhealthy followed the guidelines of healthy school snacks from the Portuguese general direction of health and education (52). Responses were coded for positive and negative peer pressure. Responses mentioning healthy food items (e.g., fruit, yogurt) were coded as "1" for positive peer pressure, and responses including unhealthy food items (e.g., lollipops, pastry cake) were coded as "1" for negative peer pressure. The percentage of responses coded as "1"

(positive and negative peer pressure separately) was calculated for each class, with higher scores reflecting more positive or negative food peer pressure to eat healthy or unhealthily, respectively.

4.2.4. Data Analysis

The data was analyzed in several stages. First, as preliminary analyses, the descriptive statistics and the correlations between the variables were calculated to decide the analytical approach best suited to the study goals. We followed Finney and DiStefano's criteria of statistical normality (53), which sets ±2 and ±7 as the limits for skewness and kurtosis, respectively. Second, the missing values were dealt with using the multiple imputation procedure. Third, the path model corresponding to the prediction of HE behavior was adjusted using the statistical program AMOS 24 version (54).

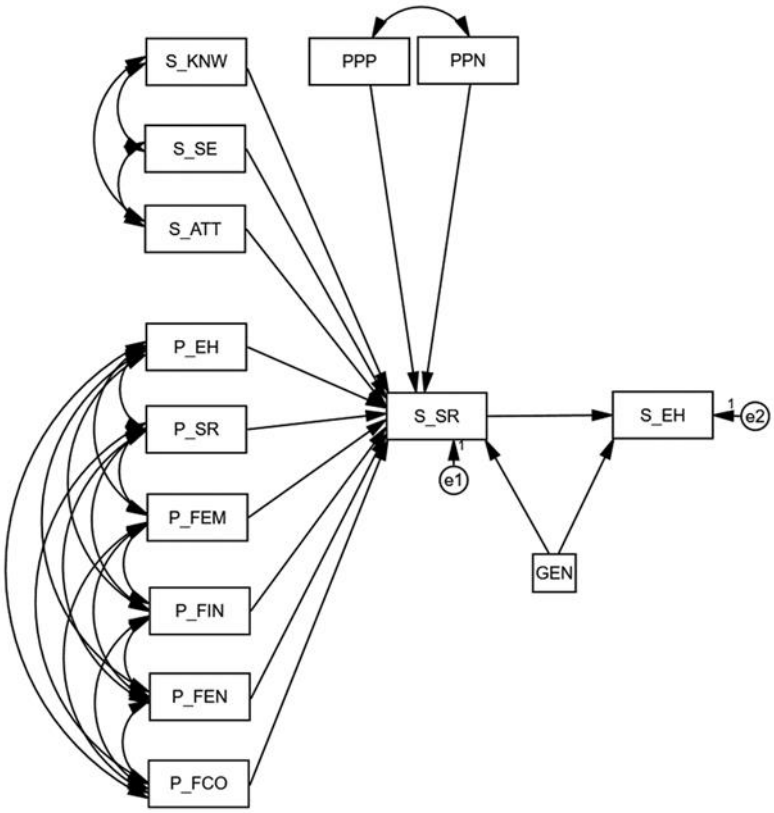


Figure 9 - Path model of child-, clan-, and community-level variables predicting healthy eating of fifth and sixth grade children (Age: M = 10.48; SD = 0.70)[17].

The path model (see Figure 9) was fit, and results were evaluated according to the following criteria: Chi-square, GFI, AGFI, TLI, CFI, RMSEA, and ECVI. While the first six provide us information on the goodness of fit of the theoretical model to the data, ECVI informs us on the extent to which these

[17] Child-level variables: Gender (GEN), Student's Knowledge about Healthy Eating (S_KNW), Student's Self-Efficacy for Healthy Eating (S_SE), Student's Attitude and Perceptions towards Healthy Eating (S_ATT), Student's Self-Regulation Processes towards Healthy Eating (S_SR), Student's Healthy Eating behavior (S_EH); Clan-level variables: Parent's Healthy Eating Behavior (P_EH), Parent's Self-Regulation Processes towards Healthy Eating (P_SR), Parental Feeding Style/Emotional (P_FEM), Parental Feeding Style/Instrumental (P_FIN), Parental Feeding Style/Prompting and Encouragement (P_FEN), Parental Feeding Style/Control (P_FCO); Community-level variables: Positive Peer Pressure (PPP), Negative Peer Pressure (PPN).

results could be replicated in an independent sample. There is evidence of a good fit when qui-square has a $p > .05$, GFI, AGFI and TLI $\geq .90$, CFI $\geq .95$, and RMSEA $\leq .06$. Conversely, data is robust when the ECVI of the selected model is lower than that of the saturated model. Lastly, for the estimation of the size of the observed effects, we used the software provided in Lenhard & Lenhard (55). In the present study, the effect size "*d*" was calculated from the CR test provided by AMOS (CR shows a distribution similar to that of the z test statistic). Then, using Cohen's (56) *d* statistic: $d = 0.20$ small; $d = 0.50$ medium; $d = 0.80$ large.

4.3. Results

4.3.1. Preliminary Analysis

Table 9 shows the descriptive statistics for the variables included in the path model (mean, standard deviation, skewness, and kurtosis) as well as the Spearman correlation matrix. All the variables presented a normal distribution (except knowledge, which comprised values of asymmetry and kurtosis in the limit).

Table 9 - Spearman correlations, mean, standard deviation, skewness, and kurtosis of observed measures (N = 273)[18].

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. S_GEN	1.000													
2. S_KNW	-.139*	1.000												
3. S_SE	-.192**	.235**	1.000											
4. S_ATT	-.100	.198**	.588**	1.000										
5. S_SR	-.110	.138*	.529**	.496**	1.000									
6. S_EH	.000	.104	.387**	.423**	.316**	1.000								
7. P_EH	.047	.028	.111	-.003	.030	.043	1.000							
8. P_SR	-.060	.100	.173**	.105	.212**	.059	.221**	1.000						
9. P_FEM	-.051	.059	-.011	.013	.008	-.042	.052	-.081	1.000					
10. P_FIN	-.044	.012	.030	.030	-.028	-.018	-.100	-.114	.577**	1.000				
11. P_FEN	-.072	.118	.281**	.215**	.146*	.119*	.106	.427**	-.081	-.084	1.000			

[18] Child-level variables: Gender (GEN), Student's Knowledge about Healthy Eating (S_KNW), Student's Self-Efficacy for Healthy Eating (S_SE), Student's Attitude and Perceptions towards Healthy Eating (S_ATT), Student's Self-Regulation Processes towards Healthy Eating (S_SR), Student's Healthy Eating behavior (S_EH); Clan-level variables: Parent's Healthy Eating Behavior (P_EH), Parent's Self-Regulation Processes towards Healthy Eating (P_SR), Parental Feeding Style/Emotional (P_FEM), Parental Feeding Style/Instrumental (P_FIN), Parental Feeding Style/Prompting and Encouragement (P_FEN), Parental Feeding Style/Control (P_FCO); Community-level variables: Positive Peer Pressure (PPP), Negative Peer Pressure (PPN).
* $p < .05$; ** $p < .01$

12. P_FCO	-.083	.110	.244**	.128*	.112	.097	-.020	.213**	-.114	.027	.342**	1.000		
13. G_PPP	-.016	-.046	-.030	-.050	-.141*	-.096	.061	-.088	.073	-.038	.009	-.062	1.000	
14. G_PPN	-.069	.003	-.178**	-.222**	-.213**	-.067	.005	-.029	.010	-.071	-.052	-.038	-.171**	1.000
M	1.49	8.95	24.78	62.99	32.90	6.02	6.09	33.09	7.97	6.22	24.70	15.21	53.11	45.13
SD	0.50	1.49	5.33	9.47	6.59	2.45	1.96	5.24	3.32	2.36	3.42	2.77	20.22	17.22
SKEW	0.03	-2.31	-0.56	-0.86	-0.54	-0.39	-0.07	-0.41	1.50	1.54	-0.59	-0.36	0.46	-0.01
KURT	-2.01	6.79	0.15	2.07	0.11	-0.50	-0.06	0.18	3.02	3.93	0.01	-0.06	-0.48	-0.25

4.3.2. Assessment of path model

The fully mediated model fit was not entirely acceptable ($\chi^2_{(58)}$ = 133.613; p < .001; χ^2/df = 2.304; GFI = .937; AGFI = .887; TLI = .812; CFI = .880; RMSEA = .069 (.054 – .085). The modification indices and the residuals suggested the inclusion of the direct effect of the variable attitudes towards HE on children's eating behavior. This led to a significant improvement in model fit ($\chi^2_{(57)}$ = 98.214; p = .001; χ^2/df = 1.723; GFI = .952; AGFI = .912; TLI = .896; CFI = .935; RMSEA = .052 (.034 – .068). Finally, after estimating the relationship between the measurement errors of two variables of different levels, the model fit was satisfactory ($\chi^2_{(55)}$ = 82.806; p = .009; χ^2/df = 1.506; GFI = .959; AGFI = .922; TLI = .927; CFI = .956; RMSEA = .043 (.022 – .061). Likewise, as the Expected Cross Validation Index (ECVI) value of our model (default model) was lower than the ECVI value of the saturated model (ECVI = 0.672 and ECVI = 0.772, respectively), current data suggests that the model cross-validates across similar-sized samples from the same population. Table 10 provides the estimation of the regression coefficients corresponding to the effects included in the predictive model of children's healthy eating behavior.

Table 10 - Regression coefficients of the Path Model (direct effects)[19].

	RW	*SE*	*SRW*	*T*	*p*	*d*
S_KNW → S_RS	-.347	.212	-.081	-1.635	.102	—
S_SE → S_RS	.563	.076	.458	7.416	<.001	1.005
S_ATT → S_RS	.146	.041	.215	3.572	<.001	0.443
S_ATT → S_EH	.096	.015	.372	6.253	<.001	0.818
S_SR → S_EH	.075	.023	.197	3.305	<.001	0.408
P_EH → S_SR	-.214	.164	-.065	-1.308	.191	—
P_SR → S_SR	.181	.066	.147	2.732	.006	0.335
P_FEM → S_SR	.64	.116	.085	1.408	.159	—

[19] RW (regression weights), SE (standardized errors), SRW (standardized regression weights). Child-level variables: Gender (GEN), Student's Knowledge about Healthy Eating (S_KNW), Student's Self-Efficacy for Healthy Eating (S_SE), Student's Attitude and Perceptions towards Healthy Eating (S_ATT), Student's Self-Regulation Processes towards Healthy Eating (S_SR), Student's Healthy Eating behavior (S_EH); Clan-level variables: Parent's Healthy Eating Behavior (P_EH), Parent's Self-Regulation Processes towards Healthy Eating (P_SR), Parental Feeding Style/Emotional (P_FEM), Parental Feeding Style/Instrumental (P_FIN), Parental Feeding Style/Prompting and Encouragement (P_FEN), Parental Feeding Style/Control (P_FCO); Community-level variables: Positive Peer Pressure (PPP), Negative Peer Pressure (PPN).

P_FIN → S_SR	-.224	.164	-.082	-1.365	.172	—
P_FEN → S_SR	-.159	.103	-.084	-1.540	.123	—
P_FCO → S_SR	-.098	.122	-.042	-0.805	.421	—
PPP → S_SR	-.039	.015	-.124	-2.557	.011	0.313
PPN → S_SR	-.035	.018	-.092	-1.905	.050	0.232
GEN → S_SR	-.389	.611	-.030	-0.637	.524	—
GEN → S_EH	.341	.257	.070	1.325	.185	—

In relation to the hypotheses set, data indicated the following (see Figure 10 for the most relevant relationships found).

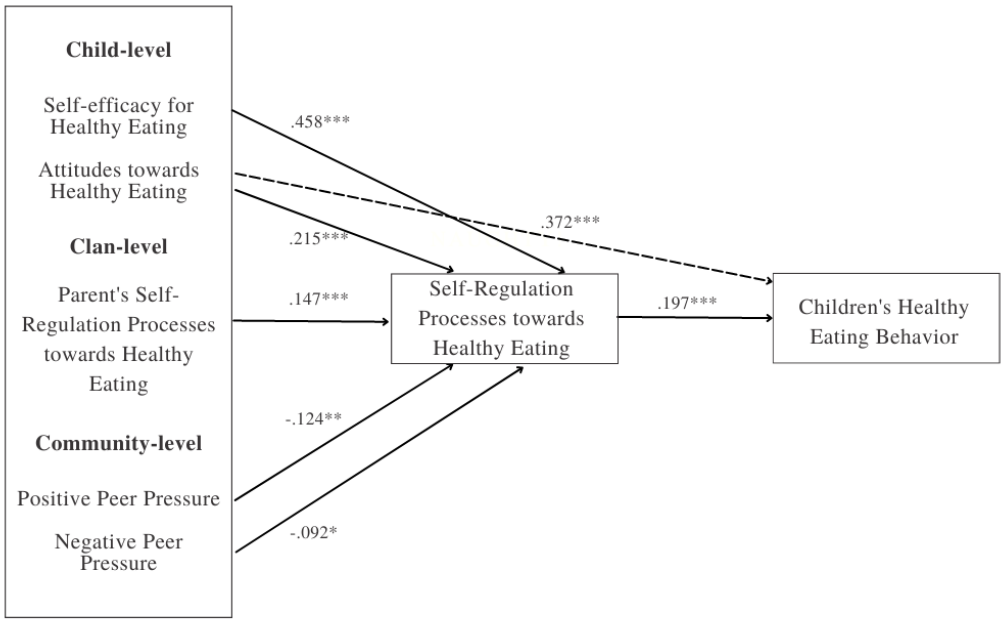


Figure 10 - Statistically significant relationships[20].

First, we hypothesized a fully mediated model (through SR strategies); however, current data support a partially mediated model. Second, the child-level variables, self-efficacy, and attitudes towards HE were significantly, positively, and strongly related to the use of SR strategies (self-efficacy with a large

[20] Solid lines represent indirect effects of the predictors on children's HE through SR; the dashed line represents the direct effect of attitudes on children's HE.

direct size effect: d = 1.005; attitudes with a moderate direct size effect: d = 0.443), and indirectly to children's HE behavior (indirect effects: self-efficacy = .090, p < .001; attitude = .042, p < .01). The variable attitudes and perceptions towards HE was also directly and strongly related to children's HE behavior (d = 0.818). However, the level of declarative knowledge about HE was not related to children's HE behavior. Third, the indirect relationship between peer pressure and children's HE behavior was partially confirmed. The relationship was negative both for positive and negative peer pressure: The greater the peer pressure, the lower the self-regulation (indirect effects: positive peer pressure = -.024, p < .01; negative peer pressure = -.018, p < .05). Fourth, the relationship between clan-level variables and children's use of SR strategies towards HE was not confirmed, except for parent's SR towards HE. Only this variable was directly, significantly, and positively related to the use of SR strategies by children (d = 0.335), and indirectly (.029, p < .01) to children's HE behavior. In addition, a considerable amount of the variance (39%) of SR towards HE was explained by the predictor variables, while 25% of the variance of children's HE behavior was explained by the variables in the model. Finally, the gender of the children was not related to any of the two dependent variables.

4.4. Discussion

The present study aimed to investigate further the role of SR on the children's HE. To that end, we extended a previous model of the effects of motivational-related factors on children's HE (12) by using a multi-reporter approach and including variables from the clan- and community-level. Finally, we fit a path model exploring how children's SR towards HE mediates the effect of child- (i.e., knowledge about HE, self-efficacy for HR, attitudes towards HE), clan- (i.e., parent's HE behavior, parent's SR toward HE, parental feeding styles), and community-level (i.e., peer pressure to eat healthy or unhealthy food) variables on children's HE behavior. Overall, the hypothesized mediation model was partially confirmed.

Data indicated that some of the hypothesized predicting variables are related to children's HE through the strategies used to self-regulate their eating behavior. Concretely, results for child-level variables echo the original model focused on the effects of motivational-related factors on children's HE. Children's SR towards healthy eating mediates the relationship between attitudes and self-efficacy (and not declarative knowledge) with children's HE; this finding is consistent with that of the original model (see 12). However, while in the latter, SR towards HE totally mediated the relationship between attitudes towards HE and children's eating behavior, present results show a direct effect of the children's attitudes towards HE on eating behavior. Specifically, children with more positive attitudes towards HE are more likely to eat healthily than their counterparts are; moreover, this relationship occurs directly, as well as

through the use of SR strategies for HE. This result suggests that there are variables other than SR explaining the relationship between attitudes towards and actual HE. For example, research shows that the neighborhood environment (e.g., proximity to food outlets) may thwart children's intentions to eat healthy (57). Thus, current data suggest that the relationship between children's attitudes towards HE and their eating behavior is likely to be influenced by their use of SR strategies, but also by variables from their surrounding environment (58).

Interestingly, data show that the effect of the variables included (i.e., variables from the clan- and community-level) in this new version of the model added predictive value to children's HE behavior. In fact, the present model added 4.7% to the explained variance of children's SR and 17.7% to the explained variance of children's HE behavior. This finding raises awareness of the need to consider several variables from spheres of the six-Cs model (9) other than the child-level when studying and intervening in children's eating behavior.

Regarding the clan-level, results show that parents who prepare their meals using SR strategies (e.g., planning meals), are more likely to influence their child to use these strategies and, ultimately, to eat healthy. This finding is congruent with prior studies not focused on HE showing a positive association between parent's SR and children's SR (34). Contrary to our expectations, no direct or indirect effects of parents' eating behavior and parental feeding styles on children's HE behavior were found. Current findings do not match those of previous research showing that parents' consumption of F/V and feeding practices focused on prompting and encouragement of HE shape children's HE behavior (31,39). A possible explanation for this mismatch with previous literature could be due to the age group of participants. Most previous research examined the effect of clan-level variables in younger children (i.e., up to eight years old, e.g., 39). For older children, displaying autonomy towards their eating behavior, it is possible that parents' influence through parental feeding practices and parents' eating behavior becomes less prominent (e.g., 62). A recent systematic review from Yee et al. (30) reports that the effects of parents-related variables on HE were found only among younger children. This reflection supports and is substantiated by the results from a qualitative study by Magalhães et al. (60) analyzing children's perceived barriers to HE. Investigating children from the same age group as the present study, these authors reported the clan-level factors (e.g., parent dietary intake) as those with less impact on eating behavior; and surprisingly, the community-level factors (e.g., peer food choices) as those with the greatest influence on children eating behavior.

Consistent with the aforementioned finding, present results showed that peer pressure is related to children's HE behavior through SR. For example, negative peer pressure (i.e., peers' influence to eat unhealthily) is negatively related with children's HE behavior, though with a low regression weight. This result is consistent with data by Ragelienė & Grønhøj (14) showing that children socializing with peers eating unhealthy foods are likely to follow similar unhealthy food choices. Interestingly, contrarily to our initial hypotheses, positive peer pressure negatively influences children's SR. For example, children in classes where most of their peers ate healthily were less likely to use SR strategies for HE. A possible explanation for both results could be that peers may exert a great influence on children's behavior when there is a perceived shared group membership (e.g., school class) (61). In fact, modeling is strongest when there is a desire for affiliation and perceived similarity with the model (62). Thus, it is possible that, in the presence of peers who eat (un)healthy, children reproduce faithfully the eating behaviors of the model to convey a good impression. This reproduction of behaviors translates to few opportunities for developing SR strategies (i.e., proactively control the influences on their behavior), because children do not make their own food choices and act accordingly (38, 63). Note that the regression weight was higher for the relationship between the positive peer pressure (i.e., peers influence to eat healthily) and children's SR.

Finally, the present results suggest that, for children from the fifth and sixth grades, peers' influence become more important than that of parents. The fact that children are more susceptible to peer than parental influence can be explained by the increase in children's autonomy over time, combined with an increase in time spent with peers (59, 64) (see study context section).

Regarding practical implications, this study reinforces the premise that actions aiming to promote children's HE should follow a multidimensional approach. For example, research drawing on the six-Cs model (9) should focus simultaneously on factors from the child-, clan-, and community-level (10). Grounded on present data, the design of interventions on HE should consider including activities to foster children's use of SR strategies, beliefs of self-efficacy, and positive attitudes towards HE (42). Interestingly, attitudes towards HE showed a direct impact on children's eating behavior; while acknowledging this result, educators could consider working with children to address possible wrongful beliefs affecting their attitudes towards HE (e.g., believing that only unhealthy food is tasty) and promote positive ones (e.g., benefits of HE) (65). Prior research shows that videos could be a powerful tool to change children's attitudes (66-68), for example, towards HE. For example, healthy food advertisements could be embedded within popular television programs for families.

The present study results also support the idea that HE outcomes could be strengthened when interventions include social support. For example, there are many reports of interventions promoting children's HE through SR, but only a few are family-based (69-70). The present study suggests that future interventions aimed at improving children's HE could benefit from promoting SR strategies to both children and their parents. Strengthening parent's SR simultaneously with children's SR may lessen the unfavorable effects of peer's pressure on children's eating behavior (59). Additionally, interventions following a class-based approach may also help to overcome the negative effects of peer pressure by equipping children from the same group with strategies to attain HE behavior. Salvy et al. (63) argue that the involvement of the child's peer networks in the intervention efforts is critical for promoting and maintaining positive behavioral health trajectories. In this line of thought, there is a need to advocate for the importance of launching policies promoting social, recreational, and familial strategies to help children adopt and maintain HE within the context of a supportive social network (63).

This study has some limitations that need to be acknowledged. First, data are cross-sectional, which do not allow inferring about causal relationships. Future research could consider a longitudinal design to examine whether changes in any of the predicting variables leads to actual changes in children's SR for or on their eating behavior. Second, it is not possible to guarantee the generalization of the present findings; nevertheless, current data were collected in four public schools from different contexts (e.g., rural, urban). This variety ensures a wide range of socioeconomic and cultural backgrounds. Additionally, the present model should be examined in distinct age groups (e.g., preschool, "early" elementary school, middle school), where the relationships between child-, clan-, and community-level factors, and HE behavior may differ from those reported in the present study (30, 59). We endeavored to account for variables from distinct children's environments; however, other predictors such as the interaction between parent/siblings and perceived social support may have influenced the relationships and should be included in future research. Finally, the self-reported nature of the measures could have led to biased responses preventing to capture the diversity of children's perspectives on the variables examined. For example, the positive role played by the motivational-related variables in the present study suggests the potential value of using qualitative research to grasp the perspectives and experiences of children and their implicit theories about the SR-HE relationship.

In conclusion, the present study extends extant literature on the motivational-related factors' influences over children's HE behavior. First, Pereira et al. (12) have tapped into child-level variables influencing children's eating behavior through SR, but no previous research has simultaneously tested

the predictive effect of these variables together with clan- and community-level ones. Thus, informed by the literature, we extended the Pereira et al. model (12) by incorporating variables from these latter levels in a sample of children from the fifth and sixth grades (see Figure 10). Present results showed relationships between variables from the three sphere levels (i.e., children's attitudes and self-efficacy towards HE, parent's SR, and positive and negative peer pressure) and HE through SR. The central finding that child-level variables are associated with HE through SR lends empirical support to the relevance of the motivational-related factors on children's HE.

Another key conclusion points to the need of incorporating variables from several spheres of the six-Cs model (9) when studying children's eating behavior. In fact, some of the variables included in the present model (e.g., parent's self-regulation processes towards HE) are related with the target outcome, and its inclusion improved the explained variance of the original model. This highlights the complexity of children eating behavior, which is influenced by many factors (e.g., 9). Finally, our study stresses that both parents and peers could influence children eating behavior. However, for children over eight years of age, peers may have greater impact than parents do.

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4.6. Supporting Information

Table 11 - Measures: constructs and items.

Construct	Items
Children's Healthy Eating Behavior	
	On a typical weekday, I usually eat ___ servings of vegetables.
	On a typical weekday, I usually eat ___ colors of vegetables.
	On a typical weekday, I usually eat ___ servings of fruit.
Children's Self-Regulation Processes Towards Healthy Eating	
	I plan my meals. I think about what I am going to eat and what it takes to prepare my meal.
	During the day, at home or elsewhere, I think about what I must change to have a healthy diet.
	I like to think about what I eat to maintain a healthy diet.
	When I get sick or feel unwell, I think about the things I need to do to improve my diet.
	When I receive some guidance on healthy eating, I pay attention to understand what I am being told.
	I try to apply in my daily life the information on healthy eating that I receive at home, at school, at the health center or elsewhere.
	I believe that I am capable of learning what I will be taught about diet and that I will therefore eat healthy.
	I compare what I eat with what I should eat.
	I look for a quiet place to have my meals.

Declarative Knowledge about Healthy Eating	Water does not belong on the food wheel.
	The size of the food wheel portions means nothing.
	Our meal should contain varied and colorful foods.
	Eating healthy is boring.
	It can be fun, eat well and healthy.
	Healthier foods have more sugar, more fat, and more salt.
	The most important meal of the day is the breakfast.
	Carbonated juices (e.g., sodas) should be our choice to accompany main meals.
	Yogurt is a good choice for a school snack.
	It is important to associate healthy eating with physical exercise.
Attitudes and Perceptions towards Healthy Eating	I think that fruit is tasty.
	I like to eat fruit.
	I think that vegetables are tasty.
	I like to eat vegetables.
	I can have more energy if I eat fruit and vegetables.
	I can have more energy if I eat bread, rice, and other cereals.
	I can get sick if I do not eat fruit and vegetables.

	I can get sick if I do not eat meat, fish or eggs.
	Eating fruit and vegetables can help me grow.
	Drinking milk and yogurt, and eating cheese can help me grow.
	I can have healthier skin if I eat fruit and vegetables.
	I can see better if I eat fruit and vegetables.
	I can think better if I eat fish.
	Eating fruit and vegetables can help me get fewer cavities.
	I like to try new foods.
	I think that eating cakes and cookies often is not good for my health.
Self-Efficacy for Healthy Eating	
	I will say no when my friends offer me junk food or food that is not healthy.
	I will eat healthy food even when my friends eat food that is not healthy.
	I will eat healthy foods when I eat out with my family.
	I will eat at least 4 servings of vegetables every day.
	I will eat at least 3 servings of fruits every day.
	I will eat or drink 3 servings of milk, cheese, or yogurt every day.
	I will not drink refrigerants more than once per week.
Parent's Healthy Eating Behavior	On a typical weekday, I usually eat ___ servings of vegetables.
	On a typical weekday, I usually eat ___ colors of vegetables.
	On a typical weekday, I usually eat ___ servings of fruit.

Parent's Self-Regulation Processes towards Healthy Eating

I plan my meals. I think about what I am going to eat and what it takes to prepare my meal.

During the day, at home or elsewhere, I think about what I must change to have a healthy diet.

I like to think about what I eat to maintain a healthy diet.

When I get sick or feel unwell, I think about the things I need to do to improve my diet.

When I receive some guidance on healthy eating, I pay attention to understand what I am being told.

I try to apply in my daily life the information on healthy eating that I receive at home, at work, at the health center or elsewhere.

I believe that I am capable of learning what I will be taught about diet and that I will therefore eat healthy.

I compare what I eat with what I should eat.

I look for a quiet place to have my meals.

Parental Feeding Styles

Emotional Feeding

I give my child something to eat to make him feel better when he is upset.

I give my child something to eat to make her feel better when she is hurt.

I give my child something to eat to make him feel better when he is bored.

	I give my child something to eat to make her feel better when she is worried.
	I give my child something to eat to make him feel better when he is angry.
Instrumental Feeding	
	I promise food to my child, so that he behaves well.
	If my child misbehaves, I will not give her favorite food.
	I use candies to bribe my child to eat the main plate.
	I reward my child with something to eat when she is well-behaved.
Prompting and Encouragement Feeding	
	I encourage my child to eat a variety of foods.
	I present to my child food in an attractive way.
	I encourage my child to taste all the foods I serve at meals.
	I encourage my child to try new foods.
	I encourage my child to enjoy his food.
	I praise my child if she tries a new food.
Control Feeding	
	I decide how many snacks my child should have.
	I decide when it is time for my child to have a snack.
	I decide the time that my child eats the meals.
	I decide what my child eats between meals.

Conclusion

Conclusion

The increased production of processed foods, rapid urbanization, and changes in lifestyle observed in recent decades prevent the promotion of healthier diets and childhood obesity one of the most serious public health challenges of the 21st century (Abarca-Gómez et al., 2017; World Health Organization, 2020). Acknowledging this urgency, several efforts ranging from direct interventions with children to policy actions have been made in an attempt to reverse this scenario (e.g., Nava & Dong, 2022; Verdonschot et al., 2022). Despite the promising results of these initiatives, reports on children's eating patterns and on childhood obesity trends highlight the persistence of unhealthy eating behaviors and the increase of obesity numbers (Abarca-Gómez et al., 2017; Pereira et al., 2021).

The current thesis aimed to contribute to the scientific literature on the topics of healthier eating and childhood obesity and has implications for practice in the domain of this public health challenge with a motivational look at children's eating behavior and childhood obesity. Therefore, this thesis aimed to map motivational-related factors underlying children's healthy eating promotion and childhood obesity prevention by responding to the following overarching research questions: (i) What are children's perceptions of obesity enablers from a causal attribution perspective and how might they influence children's engagement in interventions?; and (ii) What is the role of motivational-related factors in preventing obesity and promoting healthy eating?

Overall, the findings of the four studies conducted indicate that considering the motivational background of children may be key in addressing a healthier eating and, consequently, healthier weight. In fact, the results shed light about some motivational-related factors that could be considered in the design of future actions and interventions to promote healthier diets and prevent childhood obesity, alongside with other important factors from the Six-Cs model (Harrison et al., 2011). Thus, to respond to the present thesis aim and questions, the conclusions regarding the motivational-related factors will be briefly explained and discussed, and implications for practice will be suggested in the upcoming section.

Regarding the children's perceptions of the obesity enablers, the first study [chapter 1] allowed a better understanding of the multiplicity of causal attributions that children give to obesity, from the most prominent (e.g., self-regulation and emotionality) to the least important (e.g., genetic propensity) from their point of view. The findings helped to reflect about the role that causal attributions may play in children's willingness or resistance to engage in interventions and actions to promote healthier diets and prevent childhood obesity and, consequently, in the effectiveness of these initiatives. For example, children who attribute obesity to internal, unstable, and controllable causes (e.g., dietary intake) may be

more predisposed to eating-related behavior changes and present less resistance to interventions than children who attribute obesity to external, stable, and uncontrollable causes (e.g., unhealthful vending options). In fact, the former show awareness of their personal responsibility and understand the possibility of making efforts to control and change some eating-related behaviors, while the latter believe that the causes of obesity are nonrelated to their behavior, will remain over time, and, importantly, there is nothing they, or close others, can do to change them (Almeida et al., 2008; Weiner, 1982, 2012). A fine-grained analysis showed that children with healthy weight mentioned more internal, stable, and controllable causes (e.g., habits formed and food preferences) for obesity than children with overweight and obesity did, while children with overweight and obesity mentioned more external, unstable, and controllable causes (e.g., parent food restrictions) than their counterparts. This may explain why interventions targeting children with overweight or obesity often fail to achieve their goals. Together, the conclusions of this study highlighted the relevance of considering children's causal attributions of obesity before the design of interventions, and the need of tailoring interventions according to children's perceptions. Moreover, the knowledge gathered from this chapter allowed answering to the first research question of the present thesis and inform the subsequent studies.

The multitude of enablers for obesity that emerged from the first chapter served as a guide for the selection of variables for the next three quantitative studies. Therefore, informed by the results from the previous chapter, the second study [chapter 2] was conducted to evaluate the role played by knowledge about healthy eating and by self-regulation towards healthy eating in the relationship between family's income and children's weight. Despite the well-known relationship between socioeconomic status and childhood obesity (Dennis et al., 2022), being born into a poor family does not have to mean living with overweight or obesity, and vice versa. In fact, there are children from families with low income that have healthy weight, and children from families with high income that have unhealthy body weight. The moderation and conditional analysis allowed to identify complex pathways underlying this relationship (i.e., family's income and children's weight). Results revealed that the variable complexity of knowledge about healthy eating just moderates the relationship between family's income and children's BMI when both knowledge and self-regulation towards healthy eating scores are high. This means that children from families with low income can have a healthy weight if they have deep complexity of knowledge about healthy eating and self-regulate their eating behaviors. Thus, the findings of this study suggest that considering motivational-related factors, such as promoting self-regulation for healthy eating, alongside with the promotion of nutritional knowledge, could be key in preventing childhood obesity. The conclusions of this study contributed to answer to the second research question of this thesis, reinforcing previous

literature that stated that conveying nutritional knowledge in isolation could be insufficient for children to reach a healthier diet and weight (Schultz & Danford, 2016). Moreover, this chapter also shed light on the need to further explore the role of other motivational-related factors on children's eating behavior.

The conclusions of the previous study [chapter 2] lead to the third work of this thesis [chapter 3]. In chapter 3 was explored not only the role of knowledge about healthy eating and self-regulation towards healthy eating, but also the role that self-efficacy towards healthy eating and attitudes and perceptions on healthy eating play in children's (un)unhealthy food consumption. In fact, previous research suggested that self-efficacy to exercise control over our own choices and attitudes and perceptions on healthy eating are two motivational-related factors with an important role in the adoption of health-related behaviors, including in the eating domain (Bandura, 2005; Luszczynska et al., 2016; Marty et al., 2018). The results of the third study of this thesis showed that self-regulation towards healthy eating mediates the relationship between self-efficacy towards healthy eating, attitudes and perceptions on healthy eating, and children's eating behavior; however, the variance of children's eating behavior that is explained by these factors is small. Moreover, results also showed that knowledge about healthy eating does not play a significant role on children's (un)healthy eating, reinforcing the idea that motivational-related factors may play a more prominent role on children's eating behavior than nutritional knowledge (Schultz & Danford, 2016). In sum, findings revealed that motivational-related factors could be core aspects to understand children's eating behaviors, while highlighting the relevance of exploring other external variables that could be key in fostering children's motivation to adopt and maintain a healthy diet.

Grounded on the knowledge gathered from the third study [chapter 3], the fourth work of the current thesis [chapter 4] aimed to extend the model from the chapter 3 by adding four new external variables from the clan- and community-level spheres of children's lives (i.e., parent's healthy eating behavior, parent's self-regulation, parental feeding styles, and peer pressure). Despite children who participated in the first study [chapter 1] barely perceived the influence of these variables on obesity, the choice to add them to the model was based on extensive research that has been demonstrating that parents and peers play a relevant role in shaping children's eating behavior (Roberts & Pettigrew, 2013; Sleddens et al., 2010). The results corroborated the findings presented in chapter 3, since in the present model self-regulation towards healthy eating also mediates the relationship between self-efficacy towards healthy eating, attitudes and perceptions on healthy eating, and children's eating behavior. Moreover, adding variables from children's peers and parents improved the previous model, by explaining an additional 4.7% of the children's self-regulation variance and 17.7% of the children's healthy eating

behavior variance. Finally, results also suggested that, at this school level (i.e., 5th and 6th grades), peers significantly influence children's self-regulation and eating behavior more than parents do.

As a whole, these four chapters helped answering the umbrella goal (i.e., mapping motivational-related factors likely to contribute to the promotion of healthy eating in children and, ultimately, prevent childhood obesity) and the two research questions proposed by the current thesis: (i) what are children's perceptions of obesity enablers from a causal attribution perspective and how might they influence children's engagement in interventions?; and (ii) what is the role of motivational-related factors in preventing obesity and promoting healthy eating? There is still a long way to go to address this great public health challenge; nevertheless, in general traits, the implications for practice of this thesis suggest that the design of future interventions to promote healthier diets and prevent childhood obesity must consider children's perspectives on the causes of obesity as a way of overcoming barriers to their engagement and openness to change [chapter 1], and must comprise not only the transmission of nutritional knowledge [chapter 2], but also addressing motivational-related factors [chapter 3] and variables related to their proximal spheres (i.e., parents and peers) [chapter 4]. In the next sections, some more specific implications for practice in the health, educational, and policy fields and future research pathways will be described with the hope of contributing to better face this worldwide problem. The implications for practice and future research suggestions will be organized following the spheres of the Six-CS model (Harrison et al., 2011).

Lessons Learned and Implications for Practice

The knowledge generated by the studies presented in this thesis provides valuable information on how considering the motivational background of children can inform the practice of promoting healthier diets and preventing childhood obesity. Therefore, some lessons learned and implications for practice related to the cell, child, clan, community, country, and culture spheres of children's lives are described. The lessons learned regarding the country and culture sphere will be discussed together, since they are somehow related to and influenced by each other (e.g., media food marketing is related to the acceptance of aggressive marketing of high-energy foods for children, cultural norms for eating out could be influenced by the national food economy).

Lesson number 1: Should we consider the genetic propensity for obesity when working with children?

Considering the results of the first study [chapter 1] showing that, in general, children do not attribute obesity to genetic propensity, the obvious answer could be "no, there is no need to talk about it". On the one hand, this lack of attribution of obesity to causes related to genetic propensity is actually good news,

since a qualitative study indicated that adolescents who attribute obesity to genetic propensity have a feeling of inefficiency towards their weight, which prevent them to engage in healthy lifestyle behaviors (Amiri et al., 2011). However, on the other hand, not considering genetic propensity as one of the causes of obesity is bad news, as it can lead to blaming children with overweight and obesity for their weight and discriminatory attitudes toward them. Based on this premise, the answer to the lesson number 1 question is yes – the genetic propensity for obesity still needs to be considered when working with children to promote healthier diets and preventing childhood obesity. Educators should consider increasing children's awareness of genetic propensity as one (and not as "the one") of the contributors for obesity. This awareness could contribute to children with obesity overcome their sense of blame triggered by the believe that all causes of obesity are self-generated and under their control to change (Branscombe & Wann, 1994; Pearl & Lebowitz, 2014). Moreover, it could diminish the propagation of stigmatizing messages and attitudes towards individuals with obesity by their peers with healthy weight, likely to lead to social prejudice (Barry et al., 2011; Throsby, 2007). In sum, increasing the awareness of genetic propensity as one cause for obesity may contribute to children's engagement in behavior change interventions by decreasing stigmatization and the associated sense of blame.

Lesson Number 2: What are the Motivational-related Factors that Support Children's Healthy Eating?

Considering the set of results from the present thesis, it is clear that considering the motivational background of children could be key in addressing healthy eating promotion and childhood obesity prevention. For example, to increase the likelihood of children's engagement in behavior change, it is important to assess the causal attributions to obesity in the target population before starting to design and deliver an intervention. This approach will make it possible to tailor interventions to children's perceptions and needs (Braet et al., 2012), such as incorporate the use of adapted strategies for those who are resistant to change (i.e., due to attributing obesity to external and/or uncontrollable causes).

Regarding specific motivational-related factors that supports children's healthy eating, the conclusions of chapter 3 and 4 suggest that the design of interventions to promote children's healthy eating should comprise not only the transmission of nutritional knowledge – approach used by many health professionals and educators (e.g., Verdonschot et al., 2022) – but also consider self-regulation training, and the inclusion of features to instigate self-efficacy believes and positive attitudes and perceptions towards healthy eating. These features could include, for example: i) developing hands-on activities with children about meal planning to instigate the use of self-regulation strategies (Pereira et al., 2018); ii) including group discussions, where children share their experiences in making (un)healthy food

choices, reinforcing the possibility of success to boost their feelings of self-efficacy toward healthy eating (Rosário et al., 2019); and ii) increasing children's awareness of the benefits of fruit and vegetables to maintain a healthy weight and protect against chronic diseases as a way to promote positive attitudes and perceptions towards healthy eating (Schultz & Danford, 2016).

Lesson Number 3: How Can Parents Facilitate Children's Adoption of Healthy Eating?

The conclusions of this thesis are in line with the literature stating that the influence that parents exert on the eating behavior of young children (e.g., throughout parental feeding practices) begins to fade as children increase their autonomy (Reicks et al., 2015; Yee et al., 2017). Nevertheless, there are still some actions that parents, as educators, can develop to help children from the age of 10 to foster their motivation to adhere to a healthier diet.

At this age, children strongly influence parent's food purchasing decisions (Turner et al., 2006); however, parents are still primarily responsible for household food purchases and, therefore, have the power to control the food available at home. When unhealthy foods are available at home, children choose those foods despite healthier choices being also available (Pereira et al., 2021). Thus, parents should limit the purchase of unhealthy foods to provide an environment that facilitates children to form the habit of eating healthy foods. Another point in which parents can support children's healthy eating is in modeling their self-regulation towards healthy eating skills through their own self-regulated behaviors (e.g., children are more likely to eat without screens in a family where parents do not bring screens to the table than in a family where parents text during meals). In fact, the results of the fourth study [chapter 4] showed that parent's self-regulation predicts children's self-regulation. Accordingly, parents should be trained to and use self-regulation strategies at home such as planning their meals, looking for a quiet place to eat meals, and adjust their eating behaviors according to the health professionals' recommendations.

Lesson Number 4: What About the Role of School Community?

Alongside with the decrease in the role played by parents in children's food choices as children approach adolescence, there seems to be an increase in the influence of peers on children's eating behavior [see chapter 4]. This aspect is especially relevant considering that children spend an important part of their days at school, learning from classes and activities, and through interacting with their peers. Thus, health professionals and educators should take advantage of the potential of the school community as a context to develop initiatives to promote healthier diets. In fact, previous research suggested that the involvement of the child's peer networks in the intervention efforts is critical for promoting and maintaining positive

behavioral health trajectories (Salvy et al., 2012). Accordingly, interventions following a class-based approach may help to overcome the negative effects of peer pressure by equipping children from the same group with strategies to attain healthy eating behavior.

Considering the first study [chapter 1] results and the literature review made for this thesis, it was also possible to conclude that there are other important school-based initiatives that can largely influence children's eating behavior, such as limiting the unhealthful vending options at the school cafeteria and vending machines in the school hallways (Capacci et al., 2018). Fortunately, in Portugal, since September 2021, schools have been forbidden from selling pastries, bread with sweet filling, charcuterie, crackers and cookies, sugar-sweetened drinks, candies, and other unhealthy foods (Despacho n.º 8127/2021, de 17 de Agosto [Dispatch No. 8127/2021 of August 17, 2021). On the other hand, it has become mandatory that school cafeterias have available bottled water, plain milk, yogurts without added sugars, bread, fruits, and other healthy foods. Thus, despite the work that remains to be done, it is possible to conclude that Portuguese schools are on the right path to becoming an environment that facilitates healthier diets for children, and other countries should follow the same example.

Lesson Number 5: How can Policymakers Respond to the Childhood Obesity Public Health Challenge?

The previous lesson, on the community sphere, already addressed one of the possible initiatives that policymakers can take to help prevent childhood obesity – banning the provision of unhealthy foods and making it mandatory to provide healthy foods in Portuguese schools. Based on the European best practices, other countries should consider following the same initiative of providing healthy foods in the school setting and limiting unhealthy products in the school cafeterias and vending machines (Pineda et al., 2022).

The results of the first three studies of this thesis [chapter 1, 2, and 3] have highlighted the need to reinforce policies supporting children from families with low socioeconomic background in making healthier food choices. Indeed, it is difficult to exhibit self-regulation skills towards healthy eating when food availability is limited. A solution for this challenge could be the creation of social supermarkets, i.e., food outlets located in areas at risk of poverty that sell food, still consumable but no longer of marketable or saleable quality in supermarkets, at reduced prices (Holweg et al., 2010). This initiative have the potential of helping many families, but need further investigation of some cons arguments (e.g., stigma towards people who buy from social supermarkets) (Holweg et al., 2010). Other solutions include, for example, the application of taxes to sugar-sweetened beverages (Nava & Dong, 2022), and the provision

of school meals at zero or reduced cost (FAO et al., 2021). However, the cost benefit of these solutions need to be taken into consideration and discussed.

Limitations and Future Research

As mentioned throughout the conclusion section, the present thesis contributed to the literature with several scientific and practical implications; however, some limitations should be acknowledged and highlighted (i.e., from those already mentioned in the corresponding chapters). First, all studies were conducted with elementary-school children from public schools in the north of Portugal. Despite the efforts made to reach schools from distinct contexts (e.g., rural – Coronado and Castro school grouping, urban – Braga schools) to ensure a variety of socioeconomic and cultural backgrounds, it was not possible to guarantee a fully generalization of the results. Considering the relevant influence played by children's environments (e.g., community) on their food consumption (Dennis et al., 2022; Ragelienė & Grønhøj, 2020), future research should consider replicating the current models with expanded samples from geographic areas with distinct characteristics.

Second, the cross-sectional nature of the data collected in the four chapters does not allow to establish causal relationships between the studied variables. Future studies should consider to further understand these relationships through methodological advances, such as longitudinal and randomized controlled trial (RCT) designs. By using these designs, it is possible to understand whether changes in a predictor variable cause changes in the outcome variables, as well as examine the efficacy of interventions targeting the motivational-related factors studied in this thesis (e.g., self-regulation processes towards healthy eating).

Finally, considering the complexity of the public health challenge addressed in the current thesis (i.e., promotion of healthier diets and prevention of childhood obesity), several variables remained to be studied. Future studies should consider continuing to expand the variables included in the models and the net of relationships between them, to contribute to a comprehensive understanding of the drivers of children's eating behaviors and better inform the design and delivery of interventions aimed at decreasing childhood obesity rates.

Final Remarks

Childhood obesity is a public health challenge, and promoting children's healthy eating is a key priority to address it (Bray et al., 2017; Sahoo et al., 2015). However, despite the numerous efforts undertaken in several domains of action, children's eating behaviors remain far from the recommendations, and the childhood obesity rates are still high (Abarca-Gómez et al., 2017; Pereira et al., 2021). In fact, the

multifactorial etiology of childhood obesity, with new emerging contributors to unhealthy eating behaviors that accompany the evolution of industrialization and people's lifestyle, makes it difficult to develop an intervention that works miracles (Sahoo et al., 2015; World Health Organization, 2020). The conclusions drawn from this thesis highlight the importance of considering the motivational processes underlying children's behaviors related to obesity, especially eating behavior. The motivational processes can be central in supporting children's healthy choices despite the presence of unhealthy external factors. Additionally, conclusions from this thesis also emphasize the need for tailored interventions according to children's perceptions and needs. In fact, children may engage differently in behavior change depending, for example, on their believes about the causes of obesity and on the socioeconomic background of their family. Altogether, these findings are expected to contribute positively to help health professionals, educators, and policymakers in designing actions and interventions able to equip children with the necessary motivational-related skills and stimulate their motivation to deal with the internal and external obstacles that prevent them to follow a healthy diet and maintain a healthy weight. Ultimately, children will be able to become adults with better physical and psychological health, more financial resources, and more positive social lives.

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