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**The interplay of communication and health:
The potential of communication technologies to
promote health behaviour change in school-based
nutrition interventions with children**

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**Universidade Lusófona – Centro Universitário de Lisboa
Escola de Comunicação, Arquitectura, Artes e Tecnologias da Informação**

Lisboa

2023

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promote health in school-based nutrition
interventions with children**

Tese defendida em provas públicas para obtenção do Grau de Doutora em Ciências da Comunicação no Curso de Doutoramento em Ciências da Comunicação, conferido pela Universidade Lusófona – Centro Universitário de Lisboa, no dia 24 de Julho de 2023, perante o júri, nomeado pelo Despacho de Nomeação n.º: 312/2023, de 11 de julho de 2023, com a seguinte composição:

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Versão final

Universidade Lusófona – Centro Universitário de Lisboa

Escola de Comunicação, Arquitectura, Artes e Tecnologias da Informação

Lisboa

2023

Communication is at the heart of who we are as human beings.

Intervention efforts to change behaviours are communicative acts.

Rajiv N Rimal & Maria K Lapinski (2009)

Dedication page

Acima de todas as pessoas que contribuíram para o meu percurso pessoal, profissional e académico, dedico este trabalho ao meu pai, a pessoa que sempre acreditou em mim, que me criou e educou. Sei que ele estaria orgulhoso de mim.

Above all the people who contributed to my personal, professional, and academic journey, I dedicate this work to my father, the person who always believed in me, who raised and educated me. I know he would be proud of me.

Acknowledgment

Starting with my professional acknowledgements, I would like to honourably express my gratitude to Professor Manuel José Damásio, my supervisor, former line-manager and principal researcher in most researcher projects I participated. He has been an inspiration from the first day I started collaborating with him. An immense thanks for his invaluable guidance, his solid trust, his passionate spirit for research, his enthusiastic personality for this field and all the challenges he pushed me through that contributed to my professional development. I am immensely grateful for the time we worked together.

I am also extremely grateful to the Portuguese Science Foundation (FCT – Fundação para a Ciência e Tecnologia) for funding my PhD, for believing in my research skills and in my research project, when all of this was in its embryonic state. It is an honour to have been supported by this prestigious institution.

Additionally, this journey would not have been possible without the support of Matthew Davies, who has always supported me improving my English and has, in fact, proof-read this whole thesis. I am very grateful for his patience, strong support and availability. Furthermore, I would like to extend my sincere thanks to my colleagues, from my time in the University to my current time at the European Agency, and especially I would like to mention Daniel Cardoso, Pedro Rosa, Conceição Costa, Inês Teixeira-Botelho, Patrícia Dias, Diogo Morais.

My personal acknowledgements go to my family, in particular to my partner Ricardo, my son Lourenço, my sister Joana and my nephew António and my aunt Maria Augusta. Without their continuous support and full confidence in me I would not have been able to conduct this work. Furthermore, I am also grateful to all my other family members who raised me, inspired me and sparked in me the interest in knowing more, the curiosity to research, the strength to fight for my goals and for who I am and what I believe, the humbleness to be grateful and the love for what I do and who I am – my father, my mother, my aunts, my grandmothers and my grandfathers.

Resumo

Esta dissertação foi desenvolvida no âmbito da comunicação em saúde, focando-se no potencial da comunicação e das suas tecnologias para promover a mudança de comportamentos de saúde em intervenções escolares na área da nutrição. A comunicação em saúde é um campo científico relevante que resulta da interseção entre o campo da saúde e da comunicação, destacando o papel fundamental da comunicação nas intervenções em saúde.

Esta dissertação progrediu em três fases, incluindo cinco estudos no total, que evoluíram de uma abordagem teórica e exploratória para uma abordagem pragmática e empírica. A primeira fase é teórica e inclui dois estudos – 1) uma perspectiva integrativa dos modelos de mudança de comportamento em saúde e 2) uma revisão sistemática da literatura de intervenções de comunicação em saúde no contexto escolar. A segunda fase do projeto aplica uma abordagem exploratória incluindo dois estudos – 3) um inquérito online a pais sobre hábitos alimentares e intervenções de saúde que fazem uso de tecnologias de comunicação e 4) a análise da cobertura noticiosa nacional sobre alimentação nas escolas. A terceira fase centrou-se numa metodologia empírica e incluiu uma intervenção em saúde em contexto escolar sobre nutrição, com crianças dos 9 aos 12 anos.

Os estudos desenvolvidos nesta dissertação são complementares e contribuem para a compreensão teórica e empírica aprofundada do papel da comunicação e do potencial das suas tecnologias em intervenções de promoção da saúde.

Palavras-chave: comunicação em saúde, intervenção em saúde, tecnologias da comunicação, mudança de comportamento em saúde, nutrição.

Abstract

This dissertation was developed within the scope of the health communication, focusing on the potential of communication and technologies to promote health behaviour change in school-based nutrition interventions. Health communication is a prominent scientific field that results from the intersection of health and communication, emphasising the key role of communication in health interventions.

This dissertation evolved in three stages, including five studies in total, that progress from a theoretical exploratory to a practical empirical approach. The **first stage** is theoretical and includes two studies – 1) an integrative perspective of health behaviour change models and 2) a systematic literature review of school-based health communication interventions. The **second stage** applies an exploratory approach and includes two studies – 3) an online survey with parents on nutrition habits and health interventions using communication technologies and 4) an analysis of news coverage about nutrition at schools. The **third stage** focused on an empirical methodology, conducting a school-based health intervention on healthy nutrition with children aged 9 to 12.

These studies are complementary and contribute to a thorough theoretical and empirical understanding of the role of communication and the potential of communication technologies in health promotion interventions.

Keywords: health communication, health interventions, communication technologies, health behaviour change, nutrition.

Abbreviation list

ACP	Assertiveness, Clear language, Positivity Model
BC	Behaviour Change
DGS	Directorate-General of Health of Portugal (Direção Geral da Saúde)
DGE	Directorate General of Education of Portugal (Direção Geral da Educação)
ELM	Elaboration Likelihood Model
EU	European Union
F	Fruit
FCT	Foundation for Science and Technology (Portugal)
F&V	Fruit and vegetables
HAPA	Health Action Process Approach
HBM	Health Belief Model
ICA	International Communication Association
IPTV	Internet Protocol Television
OECD	Organisation for Economic Co-operation and Development
PNPAS	National Programme for the Promotion of Healthy Eating (Programa Nacional de Promoção da Alimentação Saudável)
SCT	Socio-Cognitive Theory
SD	Standard deviation
SLT	Social Learning Theory
SMS	Short message service
SSB	Sugar sweetened beverages
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
TTM	Transtheoretical Model
UK	United Kingdom
US	United States
V	Vegetables
WoS	Web of Science
WHO	World Health Organisation

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Introduction

Introduction

Topic and scientific relevance

This dissertation was developed within the scope of the health communication, focusing on the potential of communication, communication strategies and technologies, to promote health behaviour change in nutrition, with children.

Health communication is a multidisciplinary field that uses communication to foster and guide behaviours, policies and practices that advance the health and well-being of people (Society for Health Communication, 2017).

To communicate is at the core of human nature. To communicate about health, and with the aim to promote health, is the essence of health communication. Health Communication is a growing field that intersects the scientific domains of communication and health by transferring, advancing and applying communication knowledge, strategy, theory, techniques, technologies to enhance health and to inform and guide policy decisions about health (Society for Health Communication, 2017; Freimuth, Linnan and Potter, 2000; Maibach & Holtgrave, 1995; Schiavo, 2013). This field has been recognised as significant for promoting individual and public health (Thomas, 2006; Hornik, 2008; Rimal & Lapinski, 2009), indicating the central role of communication in health promotion and health interventions.

Intervention efforts that focus on changing behaviours are, above all, communicative acts (Rimal & Lapinski, 2009). Perceiving health interventions as communicative acts, guide us to reflect on the channels used to disseminate the health message, the audience that is the target of the message, the source of the message, how the language used can impact the reception of the message, as well as, how both individual traits and macro socio-cultural levels can influence the meaning, understanding and appropriation of the message (Rimal & Lapinski, 2009).

On the other side, nowadays more than ever, discourses about health are no longer limited to health institutions and treatment contexts (Tsang & Hui, 2016) and there is a high amount of information available from several sources through various channels, from health professionals, to specialists, public and private institutions, or patient consumer groups (Espanha, 2008). Prevention practices are a central part of the discourse and talking about health is an everyday activity in diverse social and cultural contexts. In the media, for instance, health information has become increasingly regular (Araújo, 2017; Lopes et

al.2012, Espanha, 2008; Cardoso et al., 2005). Not only it is common for health institutions to be mediated and serve as official sources of content production (Araújo, 2017; Lopes et al.2012), but also the individual, families or communities have been embedded in the discourse as actors of content creation and sharing, encouraging the individual to be responsible for his own health, to be informed and to have an active role in his daily health management (Espanha, 2008, Cardoso,et al., 2005).

To re-think strategic communication in health education and health promotion campaigns, and to improve health professionals' effective communication skills in the healthcare context, has a great potential to enhance the reach, understanding and impact of a health message (Thomas, 2006). Efficient communication can progress health outcomes by improving the effectiveness of health promotion campaigns. Simultaneously, new technologies bring new opportunities to the forefront and new tools to support the delivery of health interventions in innovative engaging ways.

This dissertation focuses on the potential of communication and new technologies to delivery school-based health interventions aimed at promoting a healthy nutrition. These interventions aim to foster health behaviour change in nutrition, for instance, to promote the intake of fruits and vegetables, whole grains, lean protein, low-fat food, or reduce the intake of sugar-sweetened beverages, sweets, salty food, or processed foods.

Health behaviour change (BC) is a central area in health communication. BC theories are concerned with the psychological and structural determinants, processes and causes of human behavior (Glanz et al., 2005; Avis, 2016). The crossing of these theories with the field of communication and health offers us useful knowledge and strategies to plan more effective health-related communication interventions. These interventions are grounded on the premise that many health conditions, namely chronic diseases, are a result of risky behaviours and less healthy choices throughout life. And, more importantly, that these unhealthy behaviours can be modifiable and, in addition, health-enhancing behaviours can be adopted, thus preventing future health problems.

Promoting a willingness to change, to make health-enhancing choices and change pre-established behaviours, are crucial matters that call for research to promote health and support a more sustainable healthcare system. It is crucial to include scientific knowledge from BC theories and models and from communication sciences in the planning and implementation of health interventions that aim to effectively promote health. Evidence indicates that theory-based health interventions are more effective than interventions that do not follow theory (Cane, O'Connor & Michie, 2012; Painter et al., 2008; Noar & Zimmerman, 2005). Science-based, innovative and promising approaches to health behaviour change are

crucially necessary. New and original health communication interventions, with an effective power to promote health BC, represent an actual and great public health challenge in recent years.

The present dissertation deals with school-based health communication interventions to promote healthy nutrition. The school environment can be a strategic setting when working with children and developing interventions aiming to assist children in having healthier behaviors (Whittemore, Jeon & Grey, 2013; Fertman & Allenworth, 2010; Moore et al, 2009). School-based obesity and healthy nutrition interventions have proliferated in the last decades (Whittemore, Jeon & Grey, 2013) pointing out the school context as one of the most successful settings to work with this audience.

Furthermore, obesity and unhealthy nutrition habits represent a current serious public health concern, with the numbers of obese and overweight children rising globally (WHO, 2021). Overweight and obese children, as well as children with a regular unhealthy diet, are more likely to develop serious health problems at younger ages (Lobstein et al., 2004; Oude Luttikhuis et al., 2009; Sahoo et al., 2015), such as the so-called non-communicable diseases (or chronic diseases), for instance, cardiovascular diseases, musculoskeletal disorders, type 2 diabetes, some types of cancers, respiratory diseases, hypertension, hyperlipidemia, liver and renal diseases (Bandini et al. 2005; WHO-4COSI, 2021; Sahoo et al., 2015; Van Cleave, Gortmaker & Perrin, 2010; Chen, 2010).

In turn, nutrition is a topic that affects not only the individuals, but the society and its institutions. On the one hand, access to food and food quality are key issues of human development and, on the other hand, it has also profound implications in public health and the well-being of people (Santos et al., 2013). In a world of demographic growth, rapidly changing habits, sedentary lifestyles, growing scarcity of resources, economic and political instabilities, the pandemic, the increase of chronic diseases, the future of nutrition, and how to best communicate about food and eating habits, poses extraordinary challenges to science, technology, public policies and other diverse domains (Santos et al., 2013). How to best communicate information about health, namely about nutrition, and promote a healthy lifestyle based on a healthy diet and habits, in particular, to children, is a challenge that calls for research, for an amazing ability for innovation and adaptation to fast-changing environments, and a strong commitment for action.

Research motivation

This dissertation is a result of personal preferences and professional choices and experiences. Around 14 years ago I joined the Centre for Applied Communication Culture and New Technologies (CICANT), at Lusofona University, as a research assistant with a research grant from the Foundation for Science and Technology (FCT). My path into communication sciences was just starting, and I could not have imagined how far it would take me. I was new to this field, but I had my academic and professional experience in psychology and health, and my passion for research and for data analysis. I was introduced to many interesting topics within communication and participated in many national and international research projects. It was when I was involved in a research project in health communication that I found my place in communication sciences. The health communication field allows me to combine the best of two worlds and bring my skills and enthusiasm about both health and communication into one place.

This dissertation is also a result of my application for a FCT Doctorate Grant. To receive a grant to work on my PhD was a privilege that I am proud of and that allowed me to focus on my own research interests. This dissertation is the final product of my Doctorate path, but in fact, it is much more than that. It is the result of a developing and growing process as a researcher and as a person.

I strongly believe that communication sciences and health fields benefit from each other, and that health promotion campaigns and health literacy programs with an effective communication strategy play a relevant role in creating healthy and empowered individuals, families, communities.

Changing behaviours that affect health via communication interventions represents a current practical and intellectual challenge that truly captured my attention. Moreover, health BC theories are so immersed in psychology studies that it reminded me of my first passion in research, to understand human behaviour, motivations, and intentions.

Moreover, the topic of nutrition has always been present in my life by personal interest. Obesity and unhealthy nutrition are a serious public health problem with so many impacts on society and health. On the other hand, there is also a constant pressure from society and peers on children and youth to have a specific body image and comply with certain visual aspects, not considering what is in fact relevant, such as educating, empowering and informing on how to eat healthy and how to stay healthy throughout life.

Nutrition habits are acquired early in development and tend to last. Therefore, nutrition interventions are critically necessary to approach this topic in schools, with children,

to foster better nutrition and healthier lifestyles in the younger population. Opportunely, the communication field, and in particular new technologies, new media, new creative engaging ways of sharing a message and passing information, might bring the so necessary and longed groundbreaking context to better engage this young audience, and better communicate and promote health throughout life.

Research objective(s)

The main goal of this research is to achieve a deep theoretical and empirical understanding of the role of communication and the potential of communication technologies in health promotion interventions. More specifically, this dissertation focuses on school-based health communication interventions in nutrition and explores the variables that have an impact on changing health-related behaviours, and how communication technologies can support that process and serve as a useful vehicle to stimulate progression and adoption of healthier behaviours. This twofold approach is not only interesting from a scientific perspective, but also has policy and structural implications in health interventions and in the field of communication.

General objectives of this research project include:

- 1) To explore the potential of communication and media technologies within health interventions and how to best communicate about health contents, in particular, nutrition with children, in the school context.
- 2) To explore the variables that have an effect in the different phases of the process of health behaviour change (predictors and moderators), their relationship and how to influence them using communication strategies and technologies.
- 3) To reduce the complexity of health behaviour change models by proposing a complementary integrated approach that would support the planning of future health communication interventions.
- 4) To explore and compare the impact of different communication technologies and communication strategies to promote healthier nutrition habits in school-based health promotion interventions.
- 5) To contribute to the understanding of the role and value of media communication technologies in the field of health, health promotion and health literacy.

The final outcome of the project is an improved understanding on how to better communicate health contents, in particular, nutrition; how to promote health behaviour change; which media communication technologies is more effective to foster the relevant health indicators and promote the desirable change.

Methodology

This project evolved in stages that progress from a more theoretical exploratory to a more practical empirical approach. Each stage included a specific study and method.

The **first stage** of the project is essentially theoretical and includes two studies. The general goal of this stage was to build a base knowledge for the following stages of the project, supporting future decisions, exploring what has been done, addressing gaps, understanding what questions remain unanswered, how to best contribute to the state of the art. Moreover, regarding the research objectives, this stage already intends to contribute the goals 1), 2) and 3) of the aforementioned section, namely: to explore health communication field and the potential of communication and media technologies with school-based health interventions on nutrition; to explore behaviour change process and the variables that have an impact in the different phases; to reduce the complexity of health behavior change models by advancing a complementary view of different models. Two main studies are part of this stage:

The first **study 1) *Rethinking health behaviour change models from an integrated perspective*** constitutes an effort to integrate some of the most central theories in the field of health behaviour change, based also on the most relevant models and theories, aiming to reach an integrated overview. This work emerged from the premise that theory-based health interventions are more effective (Cane, O'Connor & Michie, 2012; Painter et al., 2008), but also that there is a very extensive list of theories and models (more than 80) (Michie et al., 2014; Davis et al., 2014) and a general lack of objective criteria to choose between them. This makes it difficult for researchers, health practitioners and other professionals in the field, to take an informed choice on which theory or model to use to guide their interventions. This study follows a theoretical exploratory methodology and intends to reduce the complexity of choosing between different health BC theories to inform and plan a health intervention, by offering a visual and operational analytical tool. This tool is the final outcome of this study and intends to offer guidance on the relevant model/ theory for

an intervention and the crucial health indicators to address, depending on the stage for which the intervention is planned to act on, and on the type and content of communication.

The second study of the first stage, ***study 2) Systematic literature review and meta-analysis of school-based health interventions on nutrition with children aged 6 to 14***, applied a systematic approach to the problem and reviews school-based health communication interventions on nutrition that used media technologies to deliver the intervention and convey health message(s) related to nutrition. This study mapped existing research on this topic and synthesised the best available evidence on the impact of health promoting programs using media technologies, both qualitatively and quantitatively. A systematic literature review was the method used in this study to review relevant literature using a rigorous and systematic process for both the search strategies and the content found in the literature. This study offered insights on the most used theoretical models of health BC; health indicators, moderators, predictors of behaviour; outcomes and commonly used instruments to measure them; and the most common media technology(ies) used and their effectiveness.

The **second stage of the project** applies an exploratory approach and has as general goal to explore the topic in different perspectives, collecting the views of different stakeholders. Two studies were conducted at this level:

The first study ***3) comprised an online survey with parents of school-aged children on nutrition habits at school and school-based health interventions to promote healthy nutrition*** approaching the topic of nutrition (at school and at home) and how media technologies could support and promote healthy nutrition habits in children. This study applied a descriptive statistical analysis to analyse survey data, offering the view of the family about the topic.

The second study of this stage, ***4) analysis of news about nutrition at schools – an overview of the current situation***, addressed the media communication on health food practices at schools, the current regulations in place and the national and local context of nutrition practices. This study intends to contextualise the topic of nutrition at schools currently, aiming to frame the role and potential of journalistic media to communicate health information, seeking to understand its construction in news' texts and focusing on a social, cultural and political analysis. A content analysis of news coverage was conducted, identifying the main topics discussed, motivations, sources of information, forms of intervention and (media and food) regulations.

The **third stage** of this research project focused on an empirical methodology, conducting a quasi-experimental study that involved a ***5) School-based health intervention***

on healthy nutrition with children aged 9 to 12 years: promoting the increase of fruits and vegetables and the decrease of sugar-sweetened beverages consumption among students. The main goal of this study was to promote the increase of fruits and vegetables (F&V) and the decrease of sugar-sweetened beverages (SSB) consumption among students. The study represents the conclusion of a learning journey and the application of the knowledge acquired and information collected in a local practical situation. The study included a health promotion intervention that compared 3 groups: 1) a control group that received communication materials through oral expository techniques (expositive learning), 2) a treatment group that received the same contents as the control group plus communication materials such as posters, flyers, printed instruments (written and visual materials), and 3) a treatment group that received the same contents as the control group plus game-learning activities (educational online games on the contents approached).

Structure of the thesis

The structure of this dissertation follows the main sections of a scientific research study, including a literature review section, methods section, data analysis, results, discussion and conclusions sections. Furthermore, the structure is also organised according to the stages and studies aforementioned, namely in the sections – methods, data analysis, results and discussion. In these sections, the contents are organised per stage and study, following the order of the studies mentioned above. The literature review and the conclusions are broad sections that focus on the work conducted overall, not isolating stages/ studies, but addressing all studies together from a holistic complementary perspective. The following table (Table 1) provides an overview of this thesis structure.

Table 1: Structure of the thesis

Introduction	Topic and scientific relevance Research motivation Research objective(s) Methods Structure of the thesis
Section I. Literature review	Health communication Health behaviour change models Communication in school-based nutrition interventions
Section II. Method	Research Problem Research questions and hypothesis Research design

	Methods: Stage 1: - Study 1 - Study 2 Stage 2: - Study 3 - Study 4 Stage 3: - Study 5
Section III. Data analysis and results	Stage 1: - Study 1 - Study 2 Stage 2: - Study 3 - Study 4 Stage 3: - Study 5
Section IV. Discussion	Stage 1: - Study 1 - Study 2 Stage 2: - Study 3 - Study 4 Stage 3: - Study 5
Conclusions	Conclusions Implications for theory and practice and future directions

Source: Own elaboration

Considering this organization, the reader can choose between reading the dissertation following the pages order (from the beginning to the end), reading each main section, or reading the literature review and the methods and then opting by reading each study separately (starting with study 1, study 2, study 3, study 4 and study 5), searching for each component in the main sections (methods, data analysis and results and discussion).

For a general overview, the stages and studies included in this thesis are the following (Table 2), and should be read in order (from 1 to 5).

Table 2. Stages and studies in this thesis

Stage 1	Study 1	Rethinking health behaviour change models from an integrated perspective
	Study 2	Systematic literature review and meta-analysis of school-based health interventions on nutrition with children aged 6 to 14
Stage 2	Study 3	online survey with parents of school-aged children on nutrition habits at school and school-based health interventions to promote healthy nutrition

	Study 4	analysis of news about nutrition at schools – an overview of the current situation
Stage 3	Study 5	School-based health intervention on healthy nutrition with children aged 9 to 12 years: promoting the increase of fruits and vegetables and the decrease of sugar-sweetened beverages consumption among students

Source: Own elaboration

I. Literature review

I. Literature review

1. Health communication

1.1. The role of communication in health interventions

Health communication is an ever more prominent field that results from the intersection of the scientific fields of health and communication. The combination of these fields was not random or occasional, but rather reflects the need of applying communication into health interventions and actions (Rogers, 1994), aiming to better foster, reinforce and guide behaviours, policies and practices that advance the health and well-being of people (Society for Health Communication, 2017).

Communication is a key element and plays a vital role in influencing, supporting and empowering both individuals, communities, practitioners and policymakers to adopt and maintain health behaviours, at micro-individual or macro-ecological levels (Shiavo, 2014). The intersection of communication and health is essentially achieved by transferring, advancing and applying communication knowledge, strategy, theory, techniques and technologies into public health practices (health promotion and disease prevention) with the goal of enhancing health outcomes, informing and guiding policy decisions about health (Society for Health Communication, 2017; Freimuth, Linnan and Potter, 2000; Maibach & Holtgrave, 1995; Schiavo, 2013). This field has been recognised as significant for promoting individual and public health (Thomas, 2006; Hornik et al., 2008; Rimal & Lapinski, 2009), pointing out the prominent role of communication in health promotion and health interventions.

While in its roots, health communication may have been perceived as a skill or a tool to address a problem (Parrot & Kreuter, 2011). However, nowadays, health communication is a much-needed science that brings evidence-based indicators and orientations on how best to plan, implement and communicate health content to different audiences in an era of pandemics, epidemics, chronic diseases and global health threats (Shiavo, 2014). Health communication can improve healthcare quality and safety, increase the effectiveness of health interventions, improve the health information infrastructure, promote health knowledge, skills and behaviours, facilitate decision-making processes in health and foster health care, both within the community and the individual (Healthy People, 2020). The scope

of health communication includes both health promotion, disease prevention and treatment, health risk perception, health-related policy, quality of life and life expectancy.

There is a broad agreement in the definition of health communication, although several definitions have been offered in the literature over the years, reflecting the actual status and incredible growth of this field. Nowadays, health communication is considered as the science of applying communication knowledge and technologies to better inform, influence and motivate audiences about health contents with the final goal of improving health. Health communication is seen as a process that promotes health by empowering audiences to be active actors in their own health, to engage and motivate them for a healthier and safer lifestyle, to be informed about their choices and about health benefits and risks, to guide them in the path to health BC, and to support them to sustain a healthy behaviour (Ratzan, 1994, Bernhard, 2004; Thomas, 2006). Various health topics can be addressed within health communication interventions, from nutrition, to oral health, mental health, sexual health, chronic diseases, pregnancy, screening and prevention habits, vaccination, sanitary habits, smoking, substance abuse, violence, injury prevention, among many others related to health promotion, disease prevention, health policies.

Several definitions of health communication have been suggested by different authors along the development of this field. The following table (Table 3) presents some of the most used definitions, considering that citing all existing definitions is not possible due to the current extensive number of definitions that exist.

Table 3. Health communication definitions

Primary reference	Definition
Society for Health Communication (2017)	“Health communication is the science and art of using communication to advance the health and well-being of people and populations.” “Health communication is a multidisciplinary field of study and practice that applies communication evidence, strategy, theory, and creativity to promote behaviors, policies, and practices that advance the health and well-being of people and populations.”
Tsang & Hui (2016, p.65)	“Health communication (...) is about how to create a communicative context for achieving a diversity of health-related purposes.” “Health communication is also widely used in community empowerment.”
Shiavo (2014, p.9)	“Health communication (...) is concerned with reaching different populations and groups to exchange health-related information, ideas, and methods in order to influence, engage, empower, and support individuals, communities, health care professionals, patients, policymakers,

	organizations, special groups and the public , so that they will champion, introduce, adopt, or sustain a health or social behavior, practice, or policy that will ultimately improve individual, community, and public health outcomes. "
Kreps (2012, p.253)	"One of the most important, and largely unrecognized, dimensions of effective health communication relates to how engaging the communication is. "
Food and Agriculture Organization of the United Nations (2011)	"Communication processes are central to broader empowerment practices through which people are able to arrive at their own understanding of issues, to consider and discuss ideas, to negotiate, and to engage in public debates at community and national levels."
Krenn & Limaye (2009, p.136)	"(...) strategies that are collaboratively and strategically designed, implemented, and evaluated that can help to improve health in a significant and lasting way. Positive results are achieved by empowering people to change their behavior and by facilitating social change. The field of health communication has evolved into what may be called the " strategic era ," which is characterized by utilizing many different channels of communication, multiple stakeholders , and an increased emphasis on evaluation and evidence-based programming. "
Thomas (2006, p.2)	"Health communication encompasses the study and use of communication strategies to inform and influence individual and community knowledge, attitudes and practices (KAP) with regard to health and healthcare." "(...) the role of health communication has expanded. Community-centered prevention (...) emphasizes the empowerment of individuals and communities to effect change on multiple levels." "The field represents the interface between communication and health and is increasingly recognized as a necessary element for improving both personal and public health."
Muturi (2005, p.78 and p.81)	"The goal of health communication is to increase knowledge and understanding of health-related issues and to improve the health status of the intended audience." "Communication empowers people by providing them with knowledge and understanding about specific health problems and interventions."
Bernhard (2004, p.2051)	"Public health communication is the scientific development, strategic dissemination, and critical evaluation of relevant, accurate, accessible, and understandable health information communicated to and from intended audiences to advance the health of the public ".
Centers for Disease Control and Prevention (2001)	"Health communication is the study and use of communication strategies to inform and influence individual and community decisions that enhance health . Health communication considers a variety of channels to deliver its targeted or tailored messages to specific segments among varied audiences, including individuals, communities, health professionals, special groups, and decision makers."
Freimuth, Linnan,	Health communication is a " means to disease prevention through behavior

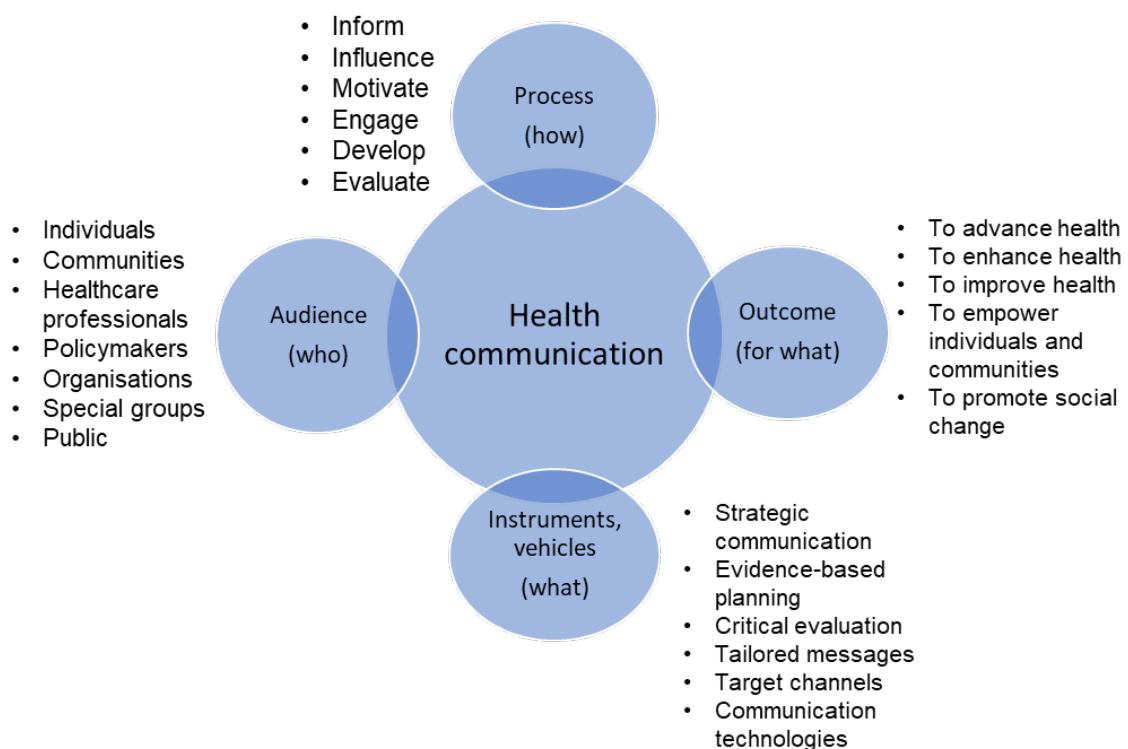
& Potter (2000, p.337).	modification.” It is “the study and use of methods to inform and influence individual and community decisions that enhance health. ”
Kreps, Bonaguro & Query (1998, p.1)	Health communication “examines the pragmatic influences of human communication on the provision of health care and the promotion of public health (...) and is often used to enhance the quality of health care delivery and health promotion. ”
Maibach and Holtgrave (1995, p.219)	“Health communication is the use of communication techniques and technologies to (positively) influence individuals, populations, and organizations for the purpose of promoting conditions conducive to human and environmental health. ”
Rogers (1994; p.209)	Health communication is a “ response to the growing pragmatic and policy interest in health promotion and disease prevention. The academic field of study has been driven by the needs and problems of public health. ”
Ratzan (1994, p. 361)	“The art and technique of informing, influencing and motivating individual, institutional, and public audiences about important health issues. Its scope includes disease prevention, health promotion, health care policy, and business, as well as enhancement of the quality of life and health of individuals within the community”.

Source: Own elaboration, based on the sources identified.

While further analysing the definitions organised in the table (with the support of NVIVO12), it is possible to identify the processes of health communication (how health communication is accomplished), the outcomes (what is the goal of health communication), who it is for (target audiences) and what (techniques, instruments) it may apply to accomplish that goal. In general, health communication is defined as a process of informing, influencing, motivating, engaging, developing, evaluating and sustaining health behaviours. The final outcome of health communication is to enhance, improve and advance health, to promote social change and to empower individuals and communities to act in a way that promote their health, their quality of life. The target audience of health communication is broad, encompassing individuals, communities, health professionals, policymakers, organisations, special groups and the general public. Health communication is for everyone and anyone, regardless of age, sex, socio-economical level, education level, ethnicity, or race. However, the way it is designed and the instruments that it applies to deliver information should be targeted and tailored according to the intended audience. For instance, recent definitions state that health communication uses strategic communication and

strategic dissemination (being currently in a 'strategic' era), applies evidence-based planning, implementation, and critical evaluation (it is currently a science), and uses tailored messages and target channels to better communicate health contents (adapted to the target audience and to the health contents it is promoting) to better motivate, influence and engage. The following figure shows the components discussed here (Figure 1).

Figure 1. Health communication



Source: Own elaboration based on the identified definitions.

A word and text analysis (using NVIVO12 software) of the aforementioned definitions created the following word cloud (Figure 2). Although the words “health communication is” were deleted from the definitions to avoid influencing the frequency it is used, health and communication are still the most common words used to define this concept, many times referring to the process (communication) and to the outcome (health). In the word cloud, it is possible to identify the target audience of health communication (most commonly mentioned) - the community, individuals and the public. The actions (verbs) most

fields as journalism, mass-media, new media, informatics, psychology, sociology, anthropology, economics, biology, pharmacology, medicine, public health, epidemiology (Kreps, 2020).

There were different starting points, milestones and reasons that led to the development of this field. Communication sciences is a field that developed from embedding other fields and adopting theories and methodologies from other social sciences with the aim of answering communication research problems. Therefore, the intersection with healthcare studies and the growing interest in health was a natural path (Kreps, Bonaguro & Query, 1998). Other fields from social sciences, such as psychology or sociology, were also crossing research with the field of healthcare, encouraging communication scholars to study the role of communication in health promotion, disease prevention and therapeutic relationship. Literature on persuasion (Hovland, Janis, & Kelley, 1953), social influence, social learning theory and media effects theories (Bandura, 1986), diffusion of innovations (Rogers, 1983), communication in therapeutic relationship (Reusch, 1952), mass-media influence (Bauer & Bauer, 1960), among others stressed the relevance of studying communication in the health context. Moreover, there was an increased interest in understanding and sophisticating health promotion and disease prevention interventions, and communication theories and practices seemed to be the key to solving the needs and problems of current public health challenges (Rogers, 1994).

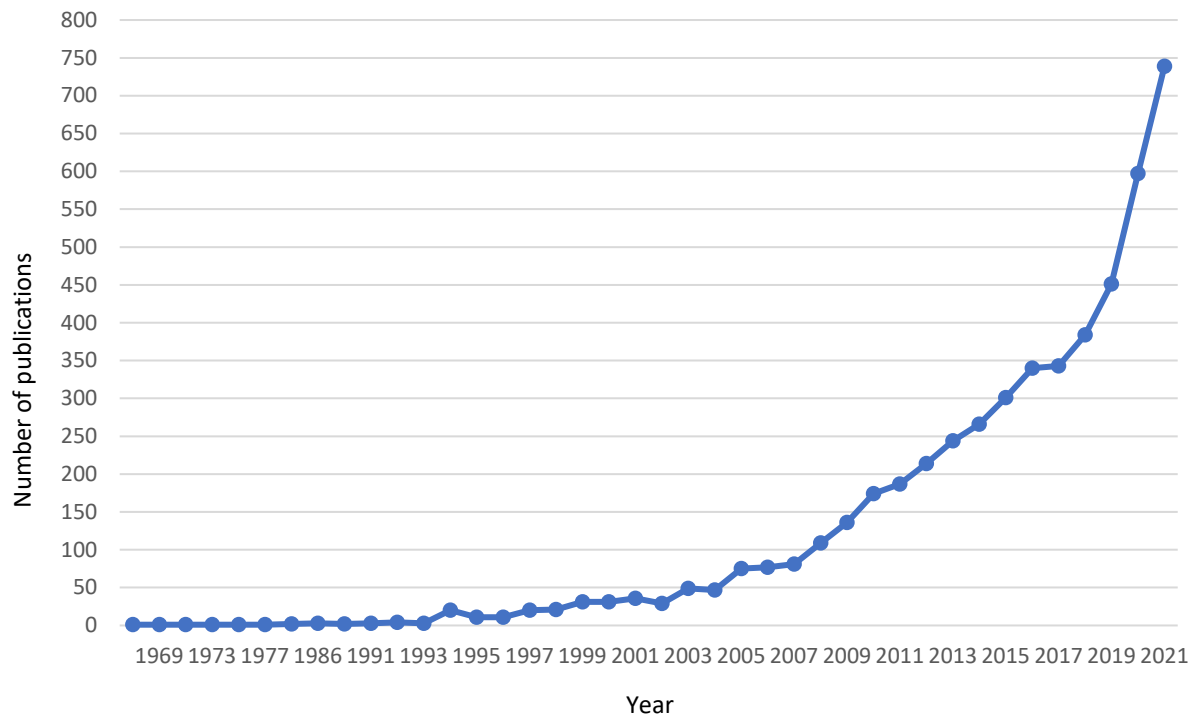
One of the best examples of an early milestone in health communication was the first funded research project in health communication that originated the Stanford Heart Disease Prevention Program in the 70s (Kreps, Bonaguro & Query, 1998; Rogers, 1994), in which cardiologists collaborated with communication scholars, developing a powerful health promotion campaign. In the 80s, there was a growing interest in health promotion and disease prevention campaigns, partially due to the advent of AIDS (Rogers, 1994), which originated large-scale funding for research in health communication, both from public and private sectors. As a result, and as a factor of development by itself, several research centres and universities started to focus on health communication, opening new positions, developing new research projects and training future generations of health communication experts. With relatively stable funding opportunities, the legitimization of the field, and the recognised potential of health communication as an applied science and methodological area with promising results, new centres for research and new research projects in health communication flourished around the world (Rogers, 1994).

Another milestone in this field was the Health Communication working group at the International Communication Association (ICA) in 1975 (Kreps, Bonaguro & Query, 1998;

Rogers, 1994). This step represented a significant moment for the field and marked its future path, offering an academic context to group interested scholars and to discuss new ideas and accomplishments, also legitimating the topic of health in communication research (Kreps, Bonaguro & Query, 1998). Moreover, in 1997, the American Public Health Association recognised health communication as a discipline within the fields of public health education and health promotion (Society for Health Communication, 1997). Later, other organisations, conferences, associations, scientific journals emerged, such as the Commission for Health Communication (in the Speech Communication Association), the Health Communication Newsletter, Medical Communication Conference, Society for Health Communication, Health Communication journal (by Teresa Thompson launched in 1989), the Journal of Health Communication (by Scott Ratzan, in 1996), health communication webpages with information on programs, literature, universities that lectured health communication, and several books on health communication were written and published. The health communication field is still growing towards a more effective and advanced research, incorporating the role of culture and new innovative dimensions and tools, such as new technologies, multiple communication levels, channels, contexts and influences, having as a final goal to improve health, to empower citizens and communities, and to impact the macro-socio-ecological level.

An analysis of the scientific field of health communication in the Web of Science (WoS) database depicts a consistent and steadily growing interest trend of scholars in this field. In the following image (Figure 3), one can observe an incubator period from 1994 to 2007, and a steady growth period since 2007 until today, counting in total 5 047 publications that included health communication in the title, from 1967 to 2021 (in the Science Citation Index Expanded and Social Sciences Citation Index).

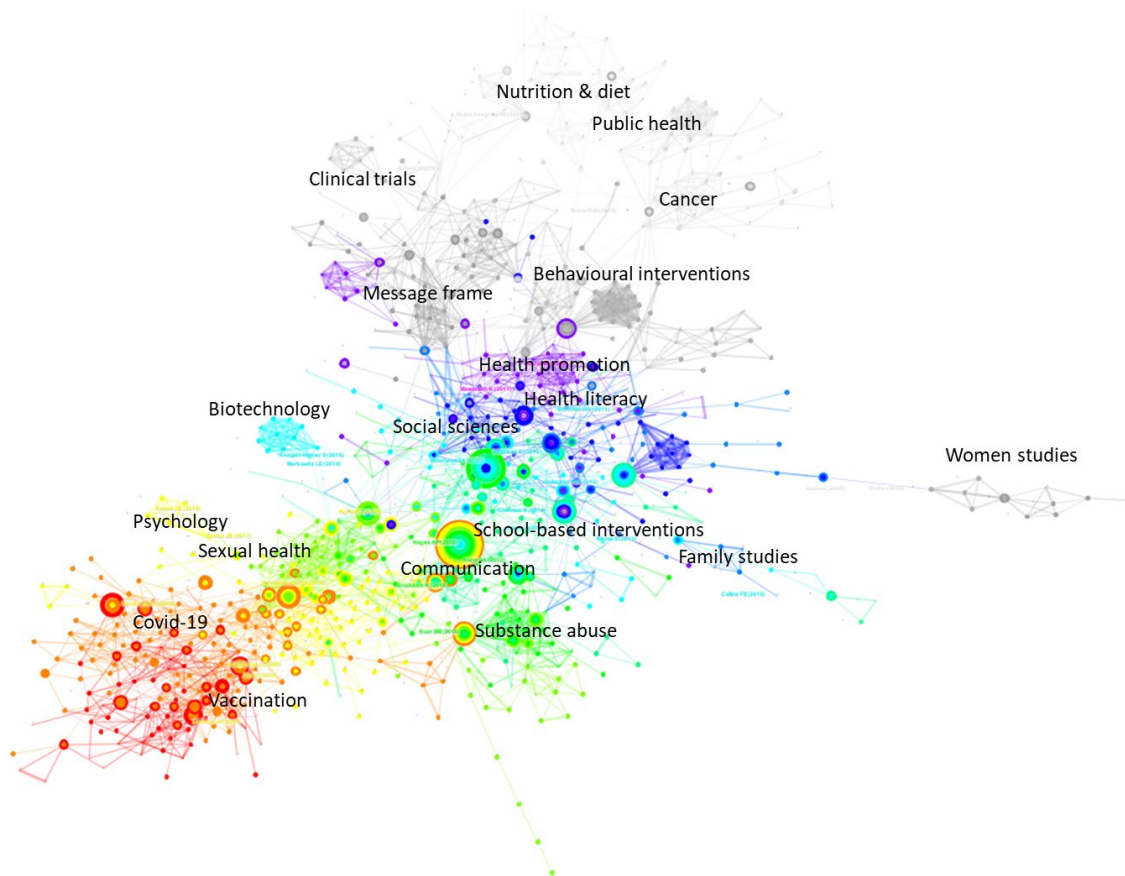
Figure 3. Number of scientific papers published per year in health communication



Source: Own elaboration with Excel.

On a scientometrics analysis of the field of health communication, and applying a cluster technique to document co-citation, it was possible to reach an analysis of thematic publications that are interconnected, reaching a network visualisation map based on citation patterns, as shown in the following figure (Figure 4) and elaborated with CiteSpace software (Chen, 2006; Chen, 2017). This analysis was conducted with the same data extracted from WoS, though focusing on the growing period only (from 2007 to 2021), including a total 4 566 scientific papers. The analysis applied a cluster technique to group similar groups, while less similar groups are placed further away in the map. The mapping of the health communication field offers a structured overview of how the field is organized, supporting the understanding of the field from a more abstract perspective to a more concrete and objective one, allowing one to see which themes, studies, areas, disciplines are part of the field and how they relate to each other within an interconnected network. The clusters' names were created based on a combination between title, keywords and abstracts used in each article (supported by the software). The following image shows the visual map achieved with 19 clusters (Figure 4).

Figure 4. Visualisation of main themes in the field of health communication



Source: Own elaboration with CiteSpace software

The image depicts health promotion, health literacy, social sciences, school-based interventions and communication in the heart of this scientific field. Moreover, it is also possible to find a cluster based on nutrition and diet, very close to the public health cluster. These data indicate that health promotion using school-based interventions focused on communication strategies and approaching nutrition elements, as the present dissertation, are an intrinsic core part of this scientific field.

1.3. Health literacy as a way for health communication – empowering and participatory processes to promote health

Health literacy is a concept inherently related with health communication. While health communication is the field that studies how to apply communication knowledge into health promotion and disease prevention contexts, health literacy is the skill to obtain, process, understand and apply health information to make appropriate health decisions (Ratzan & Parker, 2000). The final goal of communicating health information is to improve individual and community health literacy, which is the ability to make sound health decisions

in the context of everyday life (Kickbush, Wait & Maag, 2005; Sorensen et al., 2012). The way health communication empowers individuals and communities to take control of their health, to be active actors, to have the ability to seek and understand health information, to make informed decisions, reduce health risks and increase quality of life is mainly by promoting health literacy (Zarcadoolas, Pleasant & Geer, 2006). Therefore, communication is a powerful tool to promote change namely, to improve health literacy of communities and individuals.

Health literacy is the ultimate purpose of health communication. It is the operationalisation of health communication at the grassroot level, at the community level. If health communication is concerned with the message, the communication dimension and the instruments used to deliver health information; health literacy, in turn, is focused on the people who receive the health message(s), their competencies to obtain, process, understand and evaluate health information, and the degree to which they are able to put in practice health information, to use it to their own benefit and to their groups and community's benefit, by making healthy choices and behaving in a way that promotes health. According to Sorensen et al. (2012, p.3) – the European Consortium for Health Literacy Project, *“health literacy is linked to literacy and entails people's knowledge, motivation and competences to access, understand, appraise, and apply health information in order to make judgments and take decisions in everyday life concerning healthcare, disease prevention and health promotion to maintain or improve quality of life during the life course”*. There are numerous definitions of health literacy were developed along the years, showing some lack of consensus in the exact definition and in the conceptual dimensions of health literacy. The study developed by Sorensen et al. (2012) performed a systematic literature review of the different definitions and models aiming to develop an integrated, thorough and comprehensive definition that encompasses the six categories identified when condensing the definitions – competence / skills, action, information, objective, context and time. These efforts originated the definition cited above.

Additionally, a relevant concept in this field is the one of informed, empowered and autonomous patient (Espanha, 2008; Kivits, 2004). With the increase of health information available through different sources and channels, patients have been urged to be more informed about their own health, to be more empowered to take decisions, to be more aware of their medical conditions, and to be more responsible for their own health. Studies have indicated that health literacy mediates the relation between health information and effective healthier choices, reducing health risks and promoting health (Broder & Carvalho, 2019). This stresses the active and responsible role of the individual, who has a high degree of personal agency in managing his own health (Stone, 2015). However, it is important to

consider the impact of interdependencies between the individual and his life context (social, cultural, emotional, beliefs, self-efficacy) on individuals' health literacy, and thus, his health behaviours (Broder & Carvalho, 2019).

The literature has proven the importance of health literacy for both life quality, life expectancy and the financial burden of health systems. Studies indicated that low levels of health literacy are associated with more frequent use of emergency services, more inpatient stays in the hospitals, poor health outcomes, and less health prevention and promotion practices (Espanha & Avila, 2016; DGS, 2019). On the other side, people with higher healthy literacy skills are more likely to make informed decisions about health, promoting their own health and of the ones near them. Several steps can be taken to promote and facilitate health literacy, from communicating clearly, using plain language, offering simple health materials, review health instructions and prescriptions with patients, among others. Health literacy is a public health priority and simultaneously a challenge for the whole society, it is not seen as an individual obligation but as a collective responsibility, a commitment for the society and public institutions, as it reproduces health outcomes, life quality and a more sustainable healthcare system. Increasing health literacy in the population is crucial and a strategic way to optimize the well-being of the population, requiring an integrated approach involving several actors – the population, health professionals and policymakers. In simple terms, health literacy fosters an informed and conscient search for solutions to health problems, promotes healthy and responsible lifestyles and preventive behaviours, promotes critical thinking, autonomy and empowerment (critically and appropriately seek, obtain, and use basic health information and services), ability to communicate effectively, conveying beliefs, ideas and information about health, responsible and proactive citizens (DGS, 2019). One of the central concerns when defining and researching health literacy has been the identification of indicators and determinants that affect health literacy and may have a predictive power. For instance, age, sex, education level, are variables that have been described as having some impact in health literacy (Espanha & Avila, 2016; Berkman et al., 2010; Kutner et al., 2007). However, health literacy should be perceived in a macro ecological perspective, not only focusing on the individual characteristics of each person, but also the health system, the society and the communities where each person is involved in. Therefore, the health system, the quality of the information, the strategies used to share information, to communicate and the skills of health professional are also determinants that have an effect in the level of health literacy. Moreover, social and cultural factors may also work as determinants, for instance the school system and contents taught in school, conceptions and beliefs in the community, technologies available and scientific knowledge and procedures contribute to the level of health literacy (DGS, 2019).

Regarding the situation in Portugal, a health literacy survey has been conducted in 2014, indicating about half of the population as having a low level of general health literacy (11% inadequate and 38% problematic health literacy), and 50% as having a sufficient to excellent level of health literacy (8% excellent which is below the European average) (Espanha, Avila & Mendes, 2016; Espanha & Avila, 2016). A later study, the Health Literacy Population Survey Project, assessed the levels of health literacy in Portugal in 2020/ 2021 and indicated that about 70% of Portuguese people have a medium to high health literacy level (Arriaga et al., 2022). However, the results should be analysed carefully, namely when comparing both studies as some sociodemographic sampling data varies greatly, as well other methodological aspects and survey itself, making it difficult to compare results. For instance, one of the data that stands out is the formal education, the first study reporting 62% for lower secondary education and the second study reporting 16%, while also reporting higher percentages for higher education levels, such as University degrees (26% for the second study, while the first study reports around 15%). These studies call for the need of a methodological approach that allows comparison between results in longitudinal way, along the years. Nevertheless, both studies indicate age (younger ages are more likely to have higher levels of health literacy), gender (male are more likely to have higher levels of health literacy), economic capacity (people with higher economic capacity are more likely to have higher levels of health literacy), education (higher levels of schooling are associated with higher levels of health literacy) as socioeconomic determinants of health literacy.

The level of health literacy of the population is relevant also when talking about children's health and health promotion interventions targeting children. The literature has proven that individuals' health literacy, in particular, parents' health literacy and other close adults, has an impact on children's health (Mackert et al., 2015). Parent's health literacy levels influence their ability to take informed decisions about their children's health, to be their caregiver and manage health conditions, to talk and educate them about health (Buhr & Tanne, 2020). Research indicates that parents with high levels of health literacy are associated with positive health behaviours in children, including nutrition and physical activity behaviours (Buhr & Tanne, 2020). In fact, some studies have proposed that a child health literacy is the sum of the health literacy skills and resources available in their proximal social context (adults, peers, institutions, etc) (Broder & Carvalho, 2019). Therefore, when dealing with children and health promotion interventions, it is important not only to focus on children health literacy skills promotion, but also the strengthening of their parents and close adults and peers' health literacy, as these competencies may improve children's health outcomes and contribute to their health literacy development. Promoting children's health literacy from an early stage is argued to be paramount for their lifelong health and wellbeing.

2. Health behaviour change models

2.1. Theoretical models to promote health behaviour change

This section of the literature review intends to introduce the main assumptions and concepts currently discussed in the field of health BC, and the models that were used to fulfil the research objectives of this dissertation. It is not the aim of this section to fully identify and describe each theory available in the field, as this would culminate in an immensurable work, considering the vast list of health BC theories available in the literature. Instead, central, and significant health BC theories (for this project) will be summarily approached and analysed with the aim of promoting the necessary knowledge for the following sections of this research work.

BC theories analyse psychological and structural determinants, processes, and regulating factors of human behaviour. The intersection of these theories with the field of communication and health offers useful knowledge and strategies to plan more successful health communication interventions.

There is an extensive list of BC theories available in the literature. For instance, Michie et al. (2014) identified 83 different BC theories. Davis et al. (2015) identified 82. This high volume is a reflection of a scientific and pragmatical growing interest in this area and of its relevance for guiding interventions and supporting planning decisions within health interventions. Scientific evidence indicates that theory-based health interventions are more effective, being more competent in reaching efficient and consistent results (Cane, O'Connor & Michie, 2012; Painter et al., 2008; Noar & Zimmerman, 2005). Communication strategies within a health intervention should consider the theory that is applied and communicate accordingly, focusing on the constructs, processes, or determinants in which the intervention intends to act on.

A main widely accepted idea in this field is that BC is a process that evolves in stages or along a continuum. Individuals are placed along a path that reflects their likelihood to change based on specific constructs (such as motivation, intention, knowledge). The goal of interventions is to move individuals along the path. The goal of research has been to identify and isolate the variables that predict behaviour and explore how to impact them. Many limitations have been pointed to continuum models, for instance, progress is neither linear nor unidirectional, one path 'does not fit all', knowledge does not always translate into intention, and intention does not always result in behaviour. These are gaps that still call for research, for empirical testing and comprehensive understanding. Human behaviour is

complex by nature and, occasionally, not entirely predictable due to the wide range of variables and nuances that intervene, from cognitive, to emotional, social or cultural.

Some models in health BC assume that the process evolves in stages or phases, such as the ***Transtheoretical Model*** (TTM)¹ or the ***Health Action Process Approach*** (HAPA) and that the progress is not unidirectional, resembling a spiral (DiClemente & Prochaska, 1982; Velicer, Prochaska & Redding, 2006). These phases commonly originate from an unawareness status, in which a person is not aware of his/her behaviour as unhealthy, he/she is not worried and, many times, not informed about the benefits of a healthier behaviour or the harm of the unhealthy behaviour. The subsequent phase is usually associated with the awareness of the problem and a motivating phase that will contribute to the development of an intention. From intention, the process evolves into action, passing by first attempts, which can suffer relapses, and progressing to a more constant durable action/behaviour. Some theories address a final maintenance stage in which the health behaviour is maintained, and the person does not feel tempted to go back to the previous unhealthy behaviour.

The ***Theory of Reasoned Action*** (TRA) and the ***Theory of Planned Behavior*** (TPB) envisioned intention (to act) as the best predictor of behaviour (Ajzen, 1985, 1991; Nisbet & Gick, 2008). However, people do not always act in full accordance with their intentions (Velicer, Prochaska & Redding, 2006). In this sense, solving the intention-behavior black-box has been one central goal in this field. Health behavior models such as the *TTM* and the *HAPA* have made efforts in this direction by exploring post-intentional factors.

Several authors have enumerated what they considered the central theories in this field, commonly identifying the *TTM*, *HAPA*, *TPB*, *TRA*, ***Socio-Cognitive Theory*** (*SCT*), ***Social Learning Theory*** (*SLT*), and the ***Health Belief Model*** (*HBM*). For instance, Glanz, Rimer & Viswanath (2008) mentioned: *SLT*, *TRA*, *HBM*, while Painter et al. (2008) referred to: *TTM*, *SCT*, *HBM*; and Michie et al., (2014) to: *TTM*, *TPB*, *SCT* and ***Information-Motivation-Behavioural-Skills Model*** (*IMB*). On the other hand, Simpson (2015) mentioned as central theories: The ***Socioecological Model***, *TTM*, and *HBM*. These theories are considered central because they represent the most used and cited theories in the field. Michie et al. (2014) conducted a systematic literature search, overseen by a multidisciplinary group of experts in the field, to identify BC theories and develop a complete compendium explaining each theory. Within this work, the authors developed a fascinating analysis to the connection between theories, applying a social network analysis and examining the relationships and patterns between theories. This work departs from a commonly accepted

¹ For ease of reading, the first time a theory is mentioned the name was formatted in bold.

awareness that, although there is a plethora of theories, most of them address a small subset of constructs and there is a high amount of overlap, derivations, and influence between them (Michie et al., 2014). Therefore, conducting an interconnectedness analysis seemed paramount to better understand this field and how theories were developed. During this process (social network analysis), data yield four theories as the main ones in this area (accounting for 63% of the articles identified) – the *TTM*, *TPB*, *SCT* and *IMB*. Four additional theories were identified as relevant (accounting for plus 12%) – *HBM*, *HAPA*, *SLT* (precursor of *SCT*) (Michie et al., 2014). The network density was 1.8, indicating low density, whereas the centrality measure indicated that, on average, a theory contributed to one or two theories, and that 60% did not contribute to any theory. An out-degree score equal or greater than four was found on seven theories, indicating that they gave origin to four or more theories in this field, and therefore are to be considered central. Concluding, central theories were: **Change Theory** (contributing to four theories), **Protection Motivation Theory** (contributing to six theories), *TTM* (contributing to six theories), *SCT* (contributing to 12 theories), *HBM* (contributing to 13 theories), *TPB* (contributing to 17 theories), and *Self-Efficacy Theory* (contributing to 23 theories). The following table (Table 4) illustrates central theories and most cited theories, based on this work.

Table 4. Central theories in health BC (Michie et al., 2014)

Central theories in the field (Identified from a SNA as based theories that were used to create new theories – Michie et al., 2014)	Theories most cited/ used in the field (Accounting for 75% of articles identified via a rigorous data collection – Michie et al, 2014)
Self-Efficacy Theory (23)	-
Theory of Planned Behaviour (17)	Theory of Planned Behaviour (13%)
Health Belief Model (13)	Health Belief Model (3%)
Social Cognitive Theory (12)	Social Cognitive Theory/ Social Learning (13%)
Transtheoretical Model (6)	Transtheoretical Model (33%)
Protection Motivation Theory (6)	-
Change Theory (4)	-
-	Information-Motivation-Behavioural-Skills Model (7%)
-	Self-Determination Theory (3%)

-	Health Action Process Approach (HAPA) (3%)
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Source: Own elaboration based on Michie et al. (2014).

For the purpose of this dissertation, the next table (Table 5) presents a summary description and explanation of TTM, HAPA, HBM, TPB and SCT and Socioecological Theory.

Table 5. Central theories in health BC

Theory/ Model	Primary reference	Key concepts	Summary description
<i>Transtheoretical Model (TTM)</i>	Prochaska & DiClemente (1982) Prochaska, DiClemente & Norcross (1992) Prochaska & Velice (1997)	Stages of change Readiness to change Pre-contemplation Contemplation Preparation Action Maintenance Spiral pattern of change	Health BC progress through five levels related to readiness to change. People are at different stages of readiness to adopt healthy behaviours. At each stage, different strategies/ process will foster the moving to the next stage. Interventions should focus on stages and constructs for moving to the next stage.
<i>Health Action Process Approach (HAPA)</i>	Schwarzer (1992) Schwarzer (2008)	Outcome expectancy Risk perception Intention formation Action (plans, control, barriers) Self-efficacy (recovery and maintenance)	This model suggests a motivation phase and an action (volition) phase. Motivation phase is based on a decision-making process about risk perception and self-efficacy originating the development of intention to act. The action/ volition phase reflects the translation of intention into action. This phase is influenced by recovery and maintenance self-efficacy as self-regulatory processes.
<i>Health Belief Model (HBM)</i>	Rosenstock (1974) Rosenstock, Strecher & Becker (1988)	Perceived threat (susceptibility and severity) Perceived benefits Perceived barriers Cues to action Self-efficacy	For health BC to happen, people need to perceive the threat of disease (their susceptibility and its severity), the benefits of the healthier behaviour and the barriers to action. Benefits need to outweigh the risks/ threat. The likelihood of preventive action is a result of beliefs.

<i>Theory of Planned Behaviour (TPB)</i>	Ajzen (1985, 1991)	Behavioural beliefs – Attitude Normative beliefs – Subjective norms Control beliefs – Perceived behaviour control	Intention is the direct predictor of human behaviour, and is determined by attitude, subjective norms and perceived behaviour control. Attitude is determined by behavioural beliefs; subjective norms are determined by normative beliefs and perceived control is determined by control beliefs.
<i>Socio Cognitive Theory (SCT)</i>	Bandura (1986) Bandura (1998)	Person Environment Behaviour Self-efficacy Observational learning	This theory explains human behaviour using a dynamic reciprocal triad: personal factors, environment influences and behaviour. This theory derived from the Social Learning theory. It argues that behaviour is not only determined by personal knowledge and emotions, but also by social observational learning, reinforcement, self-control, and self-efficacy.
<i>Social Ecological Model (SEM)/ Ecological approaches (community level)</i>	Bronfenbrenner (1977; 1999) Stokols (1995) Mc Leroy et al., (1998, 2003)	Attitudes Social norms Self-efficacy Intention to change Social ecology Culture/ Environment Multiple level of influence (interpersonal, intrapersonal, institutional, community, society)	This model highlights the relevance of the social and ecological settings in which interventions take place. It is argued that an effective intervention is one that is conducted at multiple levels (individual, interpersonal, organisational, community, public policy). Interventions need to be embedded in the social and cultural contexts (family, peers, school, community, traditions, beliefs).

Source: Own elaboration, based on the sources identified and on Michie et al. (2014).

The actual current list of health BC theories and models is long and exhaustive. Therefore, a common doubt when starting an intervention project is to objectively understand which model works better and which one is more effective to yield the desirable change in that particular intervention. However, there is little evidence and support in the literature for this step, in practical terms. Facing this complexity, and the little guidance on how to select the most appropriate theory, this choice is many times based on personal intentions, convenience, or previous experience, rather than on a thorough knowledge of all models

(which may be a heroic task considering there are more than 80 available theories and models) and a mindful decision on which framework can reinforce sounder results over the short and longterm (Bandura, 1998; Slater, 1999; Michie et al, 2014).

As a result of this complexity, many studies and interventions show a lack or poor application of theory to guide planning and implementation (Michie & Prestwich, 2010; Davies, Walker & Grimshaw, 2010; Cane, O'Connor & Michie, 2012; Michie et al., 2014). After reviewing 235 studies, Davies, Walker and Grimshaw (2010) concluded that only less than a quarter used theories of BC, and only 17% truly applied a single theory in a structured fashion during intervention. Moreover, evidence suggested that only a third of studies identified in health journals are based on theory, while another review found that about 50% reported using theory (Prestwich et al., 2013). Other studies argue that only a small number of studies in this field applied theory in health intervention design, indicating that, even though some cite theory, the design and implementation of the intervention was not genuinely and systematically guided by it (Michie & Prestwich, 2010; Prestwich et al., 2014; Michie et al., 2014).

Rather than developing new theories or deciding on taking the brave path of developing a thorough knowledge of them all, research in this field is calling for a collective effort to build from existing theories aiming for integration and de-complexification. This could either be done by applying different strategies, as, for instance, addressing the similarities and common constructs in the several prevailing theories, or, on the contrary, the divergences between them. As stated before, although there is an extensive list, most theories are complementary, interconnected and overlapping. Indeed, new theories can be necessary to address specific questions, new subjects, or new cultural environments. However, from a comprehensive knowledge of several theories and models and practical experience in the field, it is believed that there is already an extensive list of models and a very deep and rich knowledge of the several constructs and phases involved in the process of health BC. The essential challenge now is an effort to integrate these perspectives and bring value from the whole, rather than from its parts. This was one of the theoretical objectives of this dissertation: to integrate theories and reach a complementary overview, and to offer a practical tool to support the decision on which model/ theory to use and which constructs to assess and intervene in each phase, considering the aim of each intervention.

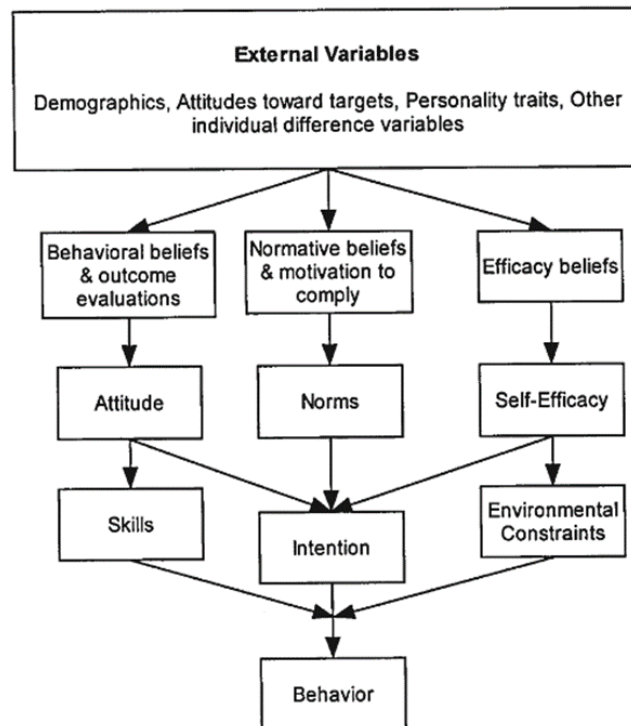
2.2. Cross-frameworks in health behaviour change – in search of models' integration

Although there is a high complexity and number of health BC models, few cross-frameworks and integrative perspectives have been proposed. Following a chronological timeline, Witte (1995) was one of the first authors to propose an integrative framework, developing the **Persuasive Health Message Framework**. The author focused on the communication sphere of health interventions, exploring the impact of health messages and how to best design effective messages to promote BC in health promotion campaigns. His goal was to design persuasive health messages with change promoting power. The author combined elements of three theories from related fields: the field on BC, the field of communication (persuasion) and the field of psychology (fear appeals), respectively, the TRA (Fishbein & Ajzen, 1967), the **Elaboration Likelihood Model (ELM)** (Petty & Cacioppo, 1986) and the **Protection Motivation Theory** (Maddux & Rogers, 1983). Witte (1995) argued that transient and constant factors of a health message should be addressed to better design health promotion campaigns. This framework considers as constant elements in a health message: a) threat (a message should include a threat based on fear), b) efficacy response to that threat (a behaviour that can be adopted to prevent the threat and that is relatively easy to be adopted), c) cues (credibility, attractiveness, power of the source or type of appeal, number of repetitions, language used in the message) and d) audience profile (the message should be tailored to the audience). The transient elements are those that need adjustment depending on the different population and goals of the intervention – message goals and the environment/ culture (Witte, 1995). It is not entirely clear how the author selected the theories for his model, as no information is given about methodology or data collection. However, its contribution represents the beginning of a growing concern with integrating existing models and contributive domains.

Fishbein (2000, 2001, 2002) also developed an attempt to a more integrative perspective of BC theories. The author highlighted a growing consensus over the fact that only a reduced number of variables need to be considered to understand behaviour adoption, and that the most used theories have been the *HBM*, the *SCT* and the *TRA*. Based on these theories, the author identified four factors that contribute to BC: 1) risk perception (perception that if healthier behaviour does not occur, the person is susceptible to disease), 2) individual's attitude toward the behaviour, 3) perceived norms and environment support, and finally, 4) self-efficacy. This framework suggests a path to BC. In a first phase, the author argues that intention is originated by attitudes toward the behaviour, perceived norms, and self-efficacy about performing the behaviour. When a strong intention is achieved, the skills

to perform the behaviour and no environment constraints are needed to originate the desired actual behaviour. However, it is not totally clear, how the author decided upon the theories to integrate and whether the path to BC was empirically tested.

Figure 5. Fishbein (2000) integrated framework



Source: Fishbein et al. (2002).

Departing from these ideas, Michie et al. (2005) developed the **Theoretical Domains Framework (TDF)**, as an attempt to build a consensus approach to health BC models. The framework was initially published in 2005 (Michie et al., 2005) and refined in 2012 (Cane, O'Connor & Michie, 2012), aiming to simplify theories relevant to health BC, and make it more accessible to researchers and health professionals planning and implementing interventions. *TDF* was developed from expert consensus on relevant theories and models and their key constructs. The procedure used to reach a framework was 1) identification of relevant theories and constructs, 2) creating of theoretical domains (such as categories), based on the theories identified, 3) evaluation of the importance of each theoretical domain, 4) validation of domains list, and 5) establishment of interview questions aiming to guide

practitioners in the field. A qualitative approach using focus group methodology was developed with a sample of 18 health psychology theorists, 16 health services researchers and 30 health psychologists. Consensus was reached on 12 theoretical domains. This framework is essentially focused on identifying theoretical domains, organising the different theories on theoretical and thematic categories, and identifying the main constructs (or determinants of BC). The authors also elaborated a guide based on interview questions for health practitioners. The *TDF* is based on qualitative methods and does not hypothesise on causal relationships between constructs or how they are determined, as Fishbein (2000) framework suggested. There is also no attempt on a path to BC, but rather a categorical organisation of theories. Although *TDF* procedure was totally independent from Fishbein's integrated approach, the agreed domains overlap with those identified in Fishbein (2000), albeit adding a few more, thus reinforcing both frameworks. The following table presents these results (Table 6).

Table 6. Theoretical Domains' Framework and Fishbein's Framework

TDF Domains (2005) 12 Domains/ 103 constructs	TDF Domains (2012) 14 Domains/ 84 constructs	Fishbein Domains (2000)
Knowledge	Knowledge	-
Skills	Skills	Skills
Social/ professional role and identity	Social/ professional role and identity	Self-standards
Beliefs about capabilities	Beliefs about capabilities	Self-efficacy
Beliefs about consequences	Beliefs about consequences	Anticipated outcomes/ attitude
Motivation and goals	Goals	Intention
Memory, attention, decision	Memory, attention, decision	-
Environmental context and resources	Environmental context and resources	Environment constrains
Social influences	Social influences	Norms
Emotion	Emotions	Emotion
Behavioural regulation	Behavioural regulation	-

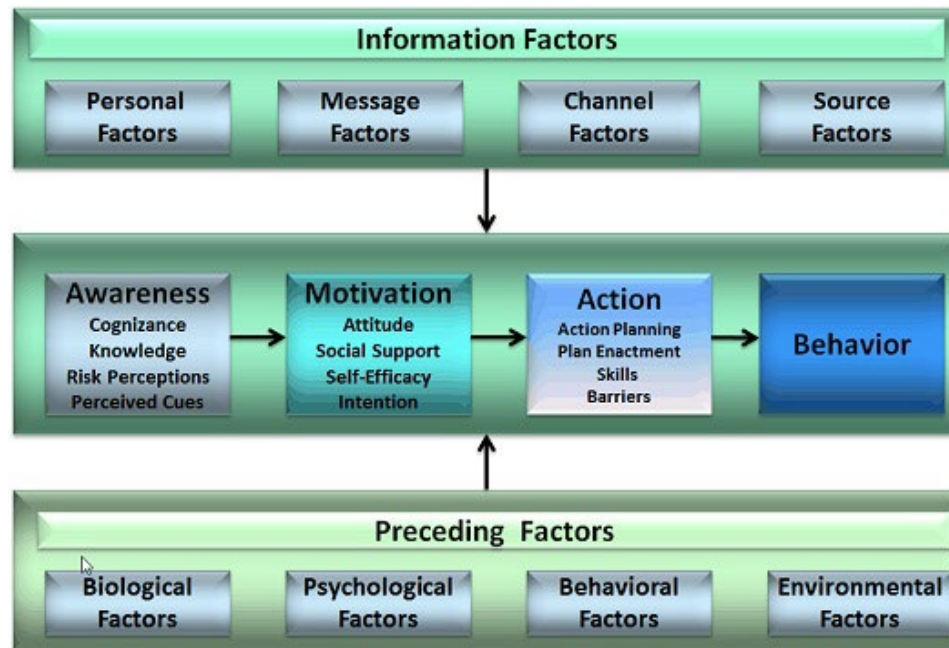
Nature of the behaviours	Nature of the behaviour	(also emphasised)
-	Intentions	Intention
-	Reinforcement	-
-	Optimism	-

Source: Own elaboration based on TDF domains (Michie et al., 2005; Cane, O'Connor & Michie, 2012) and Fishbein (2000).

Another integrative model proposed was the ***I-Change Model*** (De Vries et al., 1988; De Vries & Mudde, 1998). This model derives from the ***Attitude – Self influence – Self-efficacy Model*** and represents an integrative model that combines ideas and constructs from *TPB*, *SCT*, *TTM*, *HBM* and ***Goal Setting Theories***. It proposes three stages for the process of BC: 1) the awareness phase, 2) the motivational phase, and 3) the action phase. The framework offers insights to discuss pre-motivational phases, arguing that to initiate a process of change, one should be conscient (aware) of his/her own behaviour and informed about the desired health behaviour. Therefore, in this first phase, knowledge is considered paramount, referring to the information about the benefits of performing the behaviour. Knowledge has been a debated concept in BC theories with some theories indicating little evidence of its impact on actual behaviour (Bauman, et al., 2002), and others stating the opposite. Indeed, some authors argued that knowledge is an important predictor of motivation, that, in turn, is essential to achieve a desired health behaviour (Eggers et al., 2014; Kasten et al., 2019). A second relevant factor of the awareness phase is behavioural cognizance. It refers to the awareness of a person's own behaviour and the gap between this and the desired one. Risk perception and perceived cues are also relevant constructs in this phase (De Vries & Mudde, 1998; DeVries, 2017). The second phase of the process was called motivation phase and includes attitude, social support, self-efficacy, and intentions (De Vries & Mudde, 1998; DeVries, 2017). It is argued that attitude consists of the perceived cognitive and emotional pro and cons of adopting the behaviour. Social support refers to the perception of others that already implemented this behaviour (role models), the support from others, and the social norms related to the behaviour. Self-efficacy can be defined as a self-perception about a person's ability to perform the behaviour. These motivational factors are also influenced, not only by the factors of the earlier awareness phase, but also by information factors (personal, message, channel, source) and preceding factors (biological, psychological, behavioural and environmental). The action phase is determined by action

planning, plan enactment, skills and barriers, culminating in the final behaviour (De Vries & Mudde, 1998; DeVries, 2017). The following figure (Figure 6) shows the I-Change Model design.

Figure 6. The I-Change Model

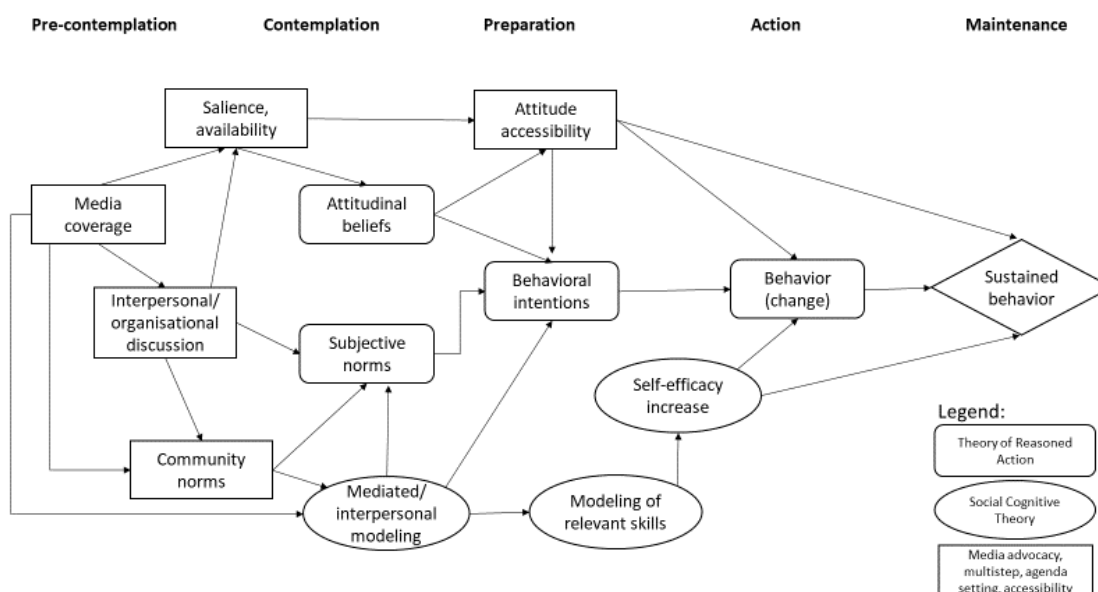


Source: DeVries (2017).

Slater (1999) proposed a framework focused on communication campaigns and message design that integrated theories from different fields. The author built his framework using the stages-of-change model (Prochaska, DiClemente & Norcross, 1992) and integrated theories of media effects (such as **Agenda-Setting**, **Multistep flow**, **Media Coverage**, **Situational Theory**), theories of persuasion (such as **Protection Motivation** and **Parallel Process Theories**), and theories of BC (such as the **TRA**, the **SCT** and the **Attitude Accessibility Theory**). He claimed that theories of persuasion and BC were complementary and useful in answering different types of communication problems and that the insights and strengths of one theory, fulfilled the limitations of another theory, when properly articulated (Slater, 1999). In his perspective, these theories were complementary, and its integration brings added value to the field. The stages-of-change model provided the structure that allowed such integration, associating the strengths and weaknesses of each theory with a stage in the process of BC. In this case, it is associated with one of the five proposed stages in the *TTM* – precontemplation, contemplation, preparation, action, maintenance.

The process of moving from precontemplation to contemplation stages is promoted by media effect theories and psychology theories. This happens when constructs of attention, awareness or recognition of pros and cons (of adopting a behaviour) become salient in the media and to the audience (Slater, 1999). Furthermore, media coverage can contribute to this process and foster discussion among social groups, influencing social and intra-personal perceptions on the specific topic being addressed. The process from contemplation to preparation is well examined and explained by the *TRA*, which considers beliefs about the behaviour outcomes, about social pressures and expectations of others as determinants at this stage. Persuasion in the message is relevant here as well. However, according to the author, *TRA* does not clearly explain how to promote the moving from preparation to action (from intention to behaviour). In this case, *SCT* (Bandura, 1986), *SLT* (Bandura, 1977) and the concept of self-efficacy are useful to explain this step. Self-confidence in one's own ability to successfully perform a specific behaviour is an important predictor for the behaviour. At this stage, ***Social Learning Theory***, social modelling, skills development, and persuasive media-based modelling can be also effective (Slater, 1999). Other relevant constructs are environment, interpersonal expectations, attitudes, and situational cues. The author mentions the *Attitude Accessibility Theory* and reflects on the relevance of adding situational cues to promote attitudes, increase repetition and power of the message. Two deliverables from this framework are: 1) a schematic explanation of the integration of the aforementioned theories, how they relate to each other and their value within the process of BC, as well as 2) a list of message design strategies using persuasion and BC theories across stage-of-change from the *TTM* that can guide communication researchers and practitioners on how to best design health messages. Both shown below in the figure (Figure 7).

Figure 7. Slater's integrated framework (Slater, 1999)



Source: Slater (1999)

Table 7. Message design strategies from integrated framework (Slater, 1999)

Precontemplation to Contemplation	Contemplation to Preparation	Preparation to Action	Action to maintenance
PMT: Saliency of threat, efficacy of advocated behaviour	TRA: Address key identified belief	SCT: Modelling necessary skills to carry our behaviour	TRA, PMT, SCT, ELM: continue to reinforce relevant beliefs, perceptions of normativeness of behaviour.
ELM: Emphasis on source selection, less on the message	PMT: Saliency of threat, efficacy of advocated behaviour	AA: Provide appropriate situational cues	
Maximize message exposure, use of examples	SCT: Modelling social reinforcement of behaviour	TRA, PMT: Reinforce appropriate beliefs regarding behaviour	
	ELM: use of anecdote, narrative	ELM: use of quantitative evidence	

Legend: PMT: Protection Motivation theory, TRA: Theory of Reasoned Action, SCT: Social Cognitive Theory, ELM: Elaboration Likelihood Model, AA: Attitude Accessibility.

Source: Slater (1999).

3. Communication in school-based nutrition interventions

3.1. Nutrition and childhood obesity – a public health challenge of the 21st century

Childhood experiences shape adult life and have an impact on health status later in life. Psychology and child development studies have well documented the influence of children's early life experiences in their emotional, social, cognitive and behavioural traits in the future (Langford et al., 2015; Cassidy & Shaver, 1999; Shaffer, 2003; Ainsworth & Bowlby, 1991). Therefore, health prevention interventions in childhood and adolescence are of great relevance and a vital strategy to promote a healthier society for the future (OECD & EC, 2020).

Unhealthy nutrition habits and obesity are a serious public health problem, especially in children, as evidence indicates that overweight and obese children are more likely to stay obese into adulthood and more likely to develop health problems at younger ages (Langford et al., 2015; Sahoo et al., 2015; Oude Luttikhuis, 2009; Lobstein 2004). Furthermore, the number of obese children has been increasing globally (WHO, 2021; 2018) and both high, middle and low-income countries are dealing with high proportions of overweight and obesity for both adults, young adults and children (WHO, 2021; Kelishadi & Soleiman, 2014; Cheng To, 2012; El Mouzan et al., 2012). More specifically, in Europe the numbers remain high and at a worrying level, having tripled since the 1980s (EU Action Plan on Childhood Obesity 2014-2020). For instance, about 30% of 7 to 9 years old in Europe are overweight or obese (WHO Europe, 2018). One of the main causes of obesity or becoming overweight is having unhealthy nutrition habits. Other factors may include genetics, metabolism, sleep habits, psychological issues, environmental factors, and sedentary lifestyles (Sahoo et al., 2015). When speaking of dietary factors that contribute to weight gain, these include fast food, sugar, sugar-sweetened beverages and foods, processed food, refined grains, snack foods and portion sizes (Nollen et al., 2014; Sahoo, et al, 2015). On the other hand, there are also specific foods that are considered to promote healthier nutrition, such as fruit, vegetables, brown bread, wholegrain cereals, healthful sources of protein, drinking water (Rees et al., 2010; Pedersen, Gronhoj & Thogersen, 2016; Jones, Madden & Wengreen, 2014).

Dietary habits, along with changes in physical activity, sleeping habits and sedentary behavior are often an effect of environmental and societal changes and policies in sectors as health, nutrition, environment, education, transport or agriculture (WHO, 2021). A review of

studies on determinants of healthy eating in children and youth has differentiated between individual, collective and social determinants (Taylor et al., 2005). Collective determinants include socioeconomic status, accessibility of food (from food prices to food environments), education, employment, societal changes and social determinants which include cultural factors, peers and marketing. Globally, the way food is presented to people and even how it is prepared, has undergone many changes. High calories processed food is easily available, at a low-cost, in highly attractive packaging, which represents a social determinant. In addition, the sedentary nature of life increased, due to new ways of living, working, moving and entertainment. Moreover, eating patterns have been changing and the European lifestyle includes fast-food and high amounts of SSB (Duffey et al., 2012, COSI, 2018). For instance, OECD (2020) shows that, in Europe, some 56% of 15 years old reported not eating any fruit or vegetable per day, and that no more than 37% reported eating at least one piece of fruit every day and 34% one vegetable, while the EU guidelines are to eat between three pieces of fruit and three of vegetables per day. This report also states that around 19% of boys and 13% of girls reported drinking SSB every day. Furthermore, data from the European Children Survey (WHO, 2020; Williams et al., 2020) indicates that less than 50% of children eat fruit and/or vegetables daily. The European Food Consumption database also shows relevant data, indicating that low doses of fruit and vegetables consumption across EU countries, for instance, and high doses of sugar-sweetened beverages (EFSA, 2021). Other aspects, such as physical activity, sedentary lifestyles (watching TV, playing videogames), and even socioeconomic status (Mackenbach et al, 2008) play a role in the development of nutrition habits (EU Action Plan on Childhood Obesity 2014-2020). All these collective or social-based factors contribute to less healthy nutrition habits and, consequently, to gain weight. On the other hand, individual factors also influence nutrition habits. For instance, Taylor et al. (2005) identified as relevant individual factors for healthy eating, attitudes, knowledge and preferences. Preferences have been found as strong predictors for eating practices. For instance, dislike of vegetables or preference for vending machine snacks were found as strong barriers to healthy eating. Indeed, as explained, a multitude of factors may influence nutrition practices and thus affect weight management/ gain.

Sequentially, gaining weight or being obese are associated with serious health problems, such as non-communicable diseases (NCD) or chronic diseases – cardiovascular diseases, musculoskeletal disorders, type 2 diabetes, some types of cancers, respiratory diseases, hypertension, hyperlipidemia, liver and renal diseases (Bandini et al. 2005; WHO, 2015, 2021; Sahoo, 2015; Van Cleave, 2010; Chen et al., 2010). These diseases are one of the greatest challenges in health in the 21st century. Every year, 41 million people die prematurely from non-communicable diseases, equivalent to 71% of all deaths globally

(WHO, 2021). These diseases tend to last long and are a result of genetic, physiological, environmental and behavior factors. Indeed, lifestyle plays a relevant role here. Many chronic diseases are a result of risky behaviors and less healthy choices throughout life, such as having unhealthy nutrition habits over the long term. However, these habits can be modifiable and health-promoting behaviours can be adopted in order to prevent future health problems and promote a healthier life.

3.2. School-based nutrition interventions – promoting healthy food habits in the school context

Nutrition communication interventions play a relevant role in creating healthy individuals, families, communities. These programs can improve health indicators and behaviours, focusing on physical, nutritional, psychological or educational factors, promoting prevention and healthier lifestyles. In general, health promotion interventions use a specific setting to reach specific individuals and provide planned and structured activities, having as a top priority to foster informed decisions about health (Fertman & Allenworth, 2010). Health promotion has its roots in health education, fostering a variety of learning experiences that facilitate health-concerned behaviours. Health intervention strategies are delivered one-to-one, one-to-many, many-to-many and can use traditional teaching-learning methodologies, interactive or electronic media, mass communication, social marketing techniques, text messaging or other new media, depending on research goals and the audience (Fertman & Allenworth, 2010).

WHO (2009) conducted a systematic review on evidence-based interventions, policies and structures, offering evidence on effective interventions in the area of diet and physical activity (n=395 studies/ 261 interventions). School-based interventions were one of the most common used interventions to reach children, adolescents and young adults, as well, as the most effective in showing consistent improvements in knowledge, attitudes, behaviour, physical and clinical outcomes (WHO, 2009). Moreover, this review indicated that interventions generally focus on short-term results. However, behavioral outcomes, as well as clinical or physical outcomes, and habits maintenance, may take longer to manifest or to be implemented, calling for more longitudinal or long monitoring studies. Mass media interventions used paid and non-paid forms of media to increase knowledge and change attitudes and behaviors. Radio and television were the most used media in health

interventions, as well as print media (WHO, 2009). No studies applying new media technology were included in this review.

Interventions that are multi-component and adapted to the local context, culturally and environmentally, are the more effective and more likely to be implemented and sustained over time (WHO, 2009; Fertman & Allenworth, 2010). Interventions that use the existing social structures of a community, such as schools, facilitate implementation and sustainability over time. The school environment is an ideal setting when working with children and developing interventions aiming to assist children in having healthier behaviors, namely healthier eating habits (Kubik, et al., 2003; Maes et al, 2011; Whittemore, Jeon & Grey, 2013; Moore et al, 2009). Considering the amount of time children spend in schools and the educational activities promoted in this setting, the school context has been recognised as powerful to foster nutrition learning and implementing healthier nutrition practices (Langford et al., 2014). Another relevant literature review assessed 67 health interventions and identified positive outcomes per health topic (Langford et al., 2014). For nutrition interventions, the authors identified self-reported food intake (24-hour recalls) as a central measure outcome in school-based interventions. For obesity or overweight, BMI was the central outcome variable used. Moreover, results indicate that the length of nutrition interventions are usually short (less than 12 months), as also pointed out previously by WHO (2009), and commonly used baseline and endline assessments, and some also used short to medium term follow-up evaluations. A meta-analysis conducted in the same study indicated that nutrition only interventions were effective at increasing fruit and vegetables consumption among students and slightly effective for self-reported fat intake.

In another study, Roseman et al. (2011) analysed 26 school-based nutrition interventions with children and youth and proposed ten recommendations for better and more effective interventions in this context. These recommendations are: 1) behaviour-focused interventions, 2) multicomponent interventions to address multi determinants (knowledge, norms, preferences), 3) healthy food environment (food available in the school), 4) family involvement, 5) self-assessment during the intervention (namely for older children), 6) inclusion of quantitative evaluation measures, 7) community involvement, 8) awareness of heterogenous groups and difficulties thereof, 9) use of innovative technology to enhance engagement, and finally, 10) sufficient duration and intensity. Still in this study, the authors call attention to the benefit of using pre and post study measures to better assess evolution before and after (or during) the intervention. Moreover, results also indicated that intervention programs that used both knowledge-based and behaviour-based approaches were more effective.

3.3. School-based health nutrition interventions that use communication technologies

As mentioned in the previous section, school-based nutrition interventions have proliferated in the last decades representing an approach to reach children and adolescents as a group, commonly including health education, behavioral strategies, parental support, environment modification (Whittemore, Jeon & Grey, 2013). However, the cost of such interventions can be high, as well as the burden on collaborators as teachers, researchers, or other educational staff. Computer-tailored interventions and interventions using media communication technologies have emerged as a promising cost-effective and attractive strategy to overcome barriers related to engagement, motivation, high costs and effort for school staff (Kroeze, Werkman & Brug, 2006; De Vries & Brug, 1999; O'Donnell, Greene & Blissmer, 2014; Yang et al, 2015).

There is plenty of evidence to state that new and digital media is embedded in children's daily lives, and that children easily engage in activities that are delivered via new technologies, commonly showing curiosity and enthusiasm. For instance, Ofcom's report (2019) indicated that 35% of children aged 8 to 11 years have their own smartphone and 47% have their own tablet, 43% watch TV on other devices such as tablets, 74% play digital games (10 hours per week), 93% go online on tablets or on a mobile phone (13 hours per week), 77% watch YouTube and 18% have a social media profile. The EU Kids Online report (2018) indicated that children engage in a wide range of activities online, the most common for children aged 9 to 16 being schoolwork (85%), playing games (83%), watching video clips (76%) and instant messaging (31%). Similarly, Lenhart (2012) indicated that 34% of adult mobile apps' users have downloaded apps to be used by children on their mobile or tablet. Anderson and Jiang (2018), from the Pew Research Center, point out that 88% of US teens have access or own a laptop, some 95% have access or own a smartphone and that 45% of teens say they use the internet regularly. Children and youth are known by being confident and enthusiastic adopters of new media, usually sharing a positive perspective and feeling motivated with the interactive possibilities of new technologies. Adopting new technologies to deliver health communication content within health interventions can promote higher levels of engagement and acceptance of the intervention.

In this manner, new media communication technologies and computer-mediated interventions show a great deal of promise in supporting health behavioural change, particularly with younger audiences. Health interventions using information and

communication technologies can provide personalised automatic feedback on participants' health behaviour and provide suggestions on how to achieve the desired behaviour. They promote motivation and are easily distributed at a relatively low cost (Maes et al, 2011; Whittemore, Jeon & Grey, 2013; Orji, Vassileva & Mandryk, 2012; Yang et al, 2017). Interactive technology and new media are encouraging tools for achieving health promotion initiatives as they often offer interaction with other people, peers or experts, access to online information, and have the potential to motivate and deliver entertaining activities for health management (Street, Gold & Manning, 2013). However, few interventions have yet integrated mobile technologies, social interaction possibilities, game-based designs addressing nutrition and health behaviors towards nutrition (Yang et al, 2015). Some studies have shown positive effects of health interventions on dietary and exercise habits by using new media as the main communication tool, such as online games, serious games or videogames (Moore et al, 2009; Yang et al, 2015; Cullen et al, 2016; Banos et al, 2013; Jones, Madden & Wengreen, 2014; Joyner et al, 2017), mobile media (Struempfer et al, 2014; Nollen et al, 2014), computer-based interventions (Rees et al., 2010; Brug, Campbell & Assema, 1999), SMS interventions (Silva et al., 2015; Pedersen, Gronhoj & Thogersen, 2016; Lubans, 2012) or web-based computer programs (Ezendam, 2012; Maes et al., 2011).

According to Melo et al. (2017), who reviewed ICT-based health interventions that focused on nutrition habits, most interventions using media communication technologies reported being effective. Some of these interventions compared ICT-based to face-to-face interventions and the vast majority had greater outcomes in the ICT-based group. Moreover, interventions using ICT to deliver content allowed for better content tailoring and closer feedback (Melo et al., 2017).

In general, ICT-based nutrition interventions are broad, approaching a vast number of nutrition topics and outcomes, from the intake of healthy foods, like F&V consumption (Struempfer et al., 2014; Cullen et al., 2016), wholegrain cereals or brown bread (Rees et al., 2010), water (Baranowski et al., 2012), vitamins and micro-nutrients (fiber, vitamin C, calcium, iron) (Maes et al., 2011), the decrease of unhealthy food like SSB or fat intake (Nollen et al., 2014; Sharma et al., 2015), to food literacy and knowledge (Moore et al., 2009; Banos, et al., 2013), anthropometric indices (blood pressure, height, weight, BMI) and psychological outcomes (self-efficacy, beliefs, cognitive and emotional factors). Moreover, it is common that nutrition interventions also involve physical exercise.

Interventions using online games generally involve the delivery of a message (knowledge, information) that includes nutrition content by playing the game, but also involves the creation of opportunities (in the game) for testing knowledge and practicing

skills, such as choosing a healthier plate for an avatar, going to the supermarket, comparing food labels, preparing food and planning meals, nourish an avatar, differentiate food groups, among others, and offers immediate feedback based on scores, audio or written messages, which allows positive and negative reinforcement (relevant for behaviour change processes according to *Social Cognitive Theory*) (Banos et al., 2012; Sharma et al., 2015). SMS are usually applied as a channel for sending regular health messages, reminders, self-monitoring and feedback system based on specific pre-establish goals. As with the videogames, SMS also allows positive immediate reinforcement. In SMS-based interventions, participants usually receive messages promoting healthy nutrition, send messages at regular intervals informing on their behaviour and receive supportive feedback and guiding replies (Bech-Larson & Gronhoj, 2013; Fassnacht et al., 2015). Computer-based and mobile-based applications allow for tailored content, based on individual's self-reported intake of food, preferences, habits, and goals, also offering educational activities, knowledge development, planning activities and feedback (Maes et al., 2011; Rees et al., 2010).

Although there is a great deal of promise and evidence-based benefits identified from the use of new media in health interventions, there are also many concerns with the risks of such media exposure for children (negative effects on sleeping, attention, learning, prolonged inactivity, which relates to obesity and depression, exposure to inappropriate or unsafe content and contacts, threats to privacy). Moreover, there is evidence on the impact of TV, video advertisements and marketing on children's eating practices and preference, usually indicating that it can overshadow family guidance. Additionally, most times, food advertising promotes less healthy foods, such as high-sugar or high-fat foods, which are not indicated for children and is against what health interventions on nutrition foster (Taylor et al., 2005). This calls for extensive and cautious research on these matters and on how to best integrate new media and its potential to promote health and well-being and to endorse healthy behaviours, while reducing risks and negative outcomes and respecting the nature of the audience (children), which is vulnerable and may be easily influenced (Livingstone & Bovill, 2008; Livingstone & Helpser, 2010; Chassiakos et al., 2016; Robinson et al., 2017). As aforementioned, this dissertation includes a systematic literature review and meta-analysis to school-based nutrition interventions that used media communication technologies, with children aged from 6 to 14. Therefore, a richer and methodical literature review on this topic is available later in this dissertation, additionally contributing and developing some of the concepts and ideas discussed here.

II. Method

II. Method

Research problem

Obesity and unhealthy nutrition habits represent a serious public health concern, with the numbers of obese and overweight children rising globally every year (WHO, 2021). Furthermore, data indicate that overweight and obese children are likely to develop serious health problems at younger ages (Lobstein et al., 2004; Oude Luttikhuis et al., 2009; Sahoo et al., 2015), such as chronic diseases (chronic diseases) (WHO-4COSI, 2021; Van Cleave, Gortmaker & Perrin, 2010; Chen, 2010).

Nutrition is a topic that affects not only the individuals, but society and its institutions and that has profound implications on public health and well-being of people (Santos et al., 2013). In a world of pandemics, demographic growth, rapidly changing habits, sedentary lifestyles, growing scarcity of resources, climate change, economic instabilities and chronic diseases, the future of nutrition, how to best communicate about food and healthy eating habits, and how to produce long-lasting healthy lifestyles, and informed citizens poses extraordinary challenges to science, technology, public policies, and other diverse domains (Santos et al., 2013), calling for research, commitment, and creativity.

Even though indicators of life expectancy have been increasing over the years, many health conditions persist, and more importantly, many are caused by largely preventable behavioural risks such as food habits. Moreover, countries still need to put a higher priority on health promotion and prevention policies to foster health, reduce avoidable health risks, and decrease health expenditure (OECD, 2016). The current modern health system tends to focus more on treatment and much less on health prevention and promotion initiatives, which is counter-productive at both individual and macro-levels.

Health communication interventions play a key role in promoting a healthy society. To be effective, these interventions need to be tailored according to their target audience. In the case of this study, the target audience are children and adolescents. Media communication tools, namely the internet, mobile phones and applications, online games among others, have been showing satisfactory results with children, namely contributing to high engagement, interest, and satisfaction levels, which ultimately, contributes to more effective interventions.

The present work explores the potential of communication technologies within health communication interventions to best communicate about nutrition and to promote healthy eating habits to children in the school context. The work explores the different variables that have an effect on the different phases of the process of health BC, their relationship and how to influence them using communication strategies and technologies.

This dissertation evolves in three stages – theoretical stage, exploratory stage and empirical stage, including five studies, and contributes to the explained main research problem, but also to associated and complementary specific research problems in each study. The stages and studies are explained below, as well as the specific research problem for each study.

STAGE 1 – STUDY 1. Rethinking health behaviour change models from an integrated perspective

This study approaches the complexity of health BC models and the extensive literature and volume of models available. It constitutes an effort to integrate some of the most central theories in the field, and offer an integrated perspective and a practical operational tool to guide interventions and to reduce the complexity of choosing a theory/model to guide the development of an intervention. When one first starts working in this field, the first overwhelming impact is the existence of an extremely extensive literature and volume of models available, which originates the question on how to choose the best theory/model to guide an intervention and future steps. In this dissertation, I approach this problem in the first theoretical study by developing an integrative perspective and an operational analytical tool to guide future interventions on this decision.

STAGE 1 - STUDY 2. Systematic literature review and meta-analysis: school-based interventions using media technology to promote healthy nutrition habits among children aged 6 to 14 years

The second study identifies and analyses school-based nutrition interventions that used communication technologies, by applying a systematic literature review and meta-analysis methodology. The research problem approached in this study focuses on whether school-based interventions that use media technologies have a higher impact on nutrition habits, behaviour, or knowledge (when compared to more traditional approaches), enumerates the main theoretical frameworks used in this context, identifies the different

outcome variables that have an impact in the process, exploring also the main validated and used measures and the most used media technologies and their effectiveness.

STAGE 2 - STUDY 3. Surveys with parents on nutrition habits at school and school-based interventions to promote a healthy nutrition

The third study explores the views and perspectives of parents about children's nutrition at schools and the potential of media communication tools to influence children's nutrition. This study brings a new dimension to the discussion, the parents/ family environment. The research problem investigated here addresses not only the situation at school and how communication technologies influence children's decisions about food, but also includes a step towards moving from the micro individual approach to a more ecological macro approach – the family, the home environment, the perspectives of parents.

STAGE 2 - STUDY 4. Analysis of news about nutrition at schools – an overview of the current situation

The fourth study, like the third, is based on a more exploratory methodology, and includes the collection and analysis of news coverage about nutrition at school. This study further advances in the ecological environment children are involved in, including now not only the micro individual level (the children) and the closer group level (the family), but also the society, the policies and national regulations in place that affect how nutrition is communicated at schools. It questions what the hot topics are, the national guidelines, the transformations, the concerns, the policies that regulate this topic at a macro national level.

STAGE 3 – STUDY 5. School-based health intervention on healthy nutrition with children aged 9 to 12 years: promoting the increase of fruits and vegetables and the decrease of sugar-sweetened beverages consumption among students

The fifth study includes an empirical quasi-experimental study that operationalises the knowledge acquired in the previous studies and conducts a school-based nutrition intervention, comparing three experimental groups using different media communication technologies and strategies – group 1) traditional oral explanation, group 2) traditional oral explanation plus flyers, leaflets, posters, and group 3) traditional oral explanation plus online digital learning games. In this study, the main research problem questions a) whether an intervention using media technologies to deliver content will be more effective in terms of

knowledge development, behavioural intentions towards food, food consumption, self-efficacy, risk awareness, self-care, and, b) whether online games will better foster these variables and promote healthier nutrition habits in school-based health promotion interventions. Redundancy of the messages was present in all experimental groups, only varying the media used to convey the message and the message design itself to convey to the maximum communicative affordances of each media.

Research questions and hypothesis

RQ.1. How to choose the best health BC theory to plan an intervention? How to simplify the process of choosing a theory to guide an intervention? How to integrate the vast extensive list of BC theories available?

H.1. An operational and analytical integrated unified perspective can support the process of choosing a health BC theory for guiding an intervention by reducing complexity of the field, combining theories based on similarities and overcoming limitations based on the strengths of each theory. Most theories in the field are complementary, interconnected and some are even overlapping. To integrate theories and reach a complementary overview is a key strategy to promote a more unified field and promote more effective interventions.

This research question is mainly explored in Stage 1 – Study 1.

RQ.2. What variables have an impact on BC, what is the pattern of relationship between those variables, what variables are relevant in each stage of the process?

H.2. Awareness, knowledge, and risk perception can work as predictors of attitude formation; self-efficacy, self-care, perceived control can work as a predictor of intention; action and planning self-efficacy, overcoming barriers and social influences are predictors of behaviour.

This research question is mainly explored in Stage 1 – Study 1 and Study 2.

RQ.3. Are media communication technologies perceived as valuable and efficient tools in health promoting interventions, namely on nutrition, with children?

H.3. Health interventions can foster their effectiveness by including media communication technologies to convey the message, promote knowledge and further develop skills related to adopting healthy nutrition habits.

This research question is mainly explored in Stage 2 – Study 3 and Study 4.

RQ.4. Can school-based interventions that use media communication technologies be effective in promoting healthy nutrition to children (more effectively than traditional interventions)?

H.4. All media technology conditions used in the intervention will have a positive impact on health BC and outcome variables (assessed by an increase measured from baseline to endline assessment), when compared to the control group.

This research question is mainly explored in Stage 3 – Study 5.

RQ.5. What is the most effective media communication technology to promote health BC in children towards nutrition?

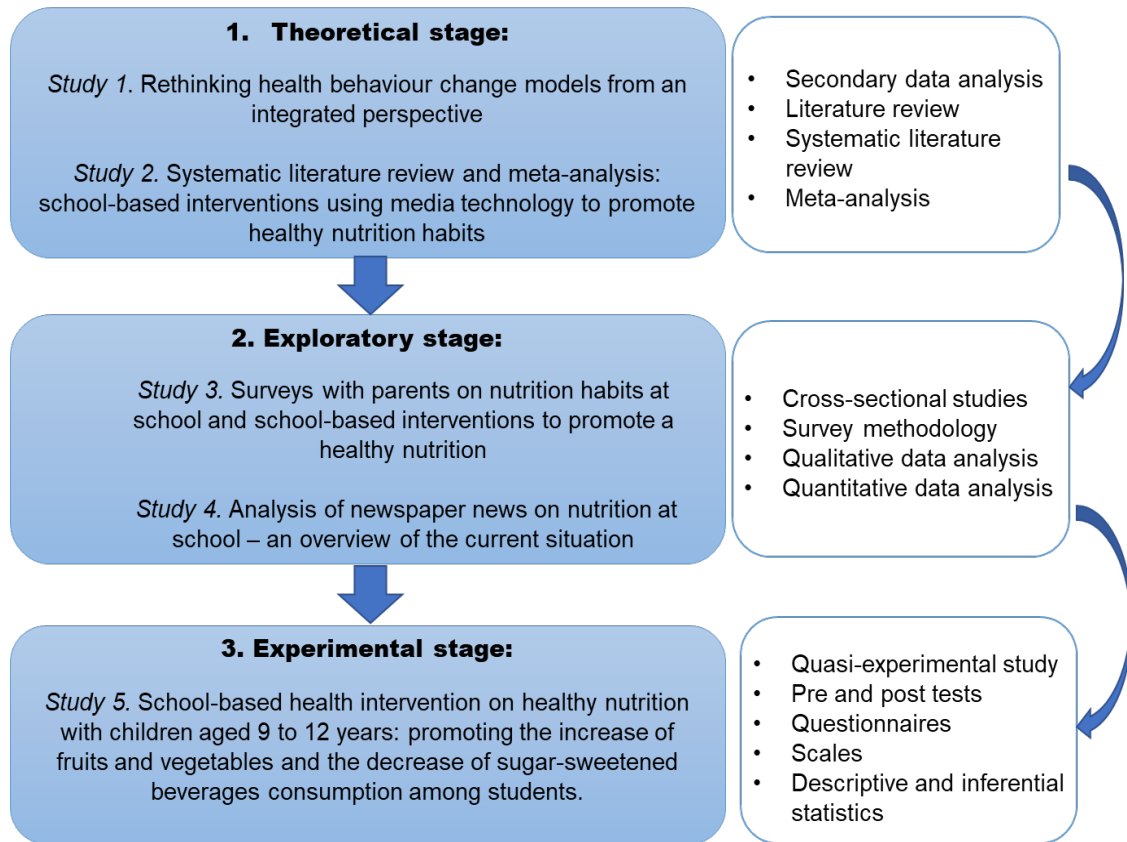
H.5. The impact of different media will vary in accordance with media affordances. The assumption is that visual and interactive media technologies will result in better performance, when compared to other groups. Visual and interactive media will be further ahead in the process of BC, presenting higher values in post-intentional variables (action/behaviour).

This research question is mainly explored in Stage 1 – Study 2 and Stage 3 – Study 5.

Research design

The following image (Figure 8) shows the research design used in this dissertation.

Figure 8. Research design – stages and research methods used



Source: Own elaboration

Methods

In this section the methodological aspects of each study are described.

STAGE 1 – STUDY 1. Rethinking health behaviour change models from an integrated perspective

1.1. Objectives

To reduce complexity in the field by reviewing and integrating some of the more commonly used models of health BC, aiming for an integrated perspective, built on complementarity and connectedness. This approach draws value from the strengths and

limitations of different theories, combining them to overcome weaknesses (limitations) of each other and to answer questions that a single theory hardly does.

The main objective of this study is to propose a complementary integrated approach with the potential to support the design of future health communication interventions that aim to promote BC. The final outcome of this work results in a useful tool for practitioners and researchers designing and implementing health interventions. This tool integrates the most central theories in the field and suggests a communication approach to health interventions, offering a complete analysis of which constructs are more relevant to address in each stage of the BC process to foster progress towards the desirable health behaviour.

1.2. Scientific background

Scientific evidence indicates that theory-based health interventions are more effective in promoting health BC (Cane, O'Connor & Michie, 2012; Painter et al., 2008; Noar & Zimmerman, 2005). However, choosing a theory to guide interventions is not a simple step as there are more than 80 BC theories (Michie et al., 2014; Davies et al., 2014), and very little guidance on how to best choose between them.

More than creating new theories, an essential current challenge is to integrate these theories to reach a more complete understanding of the BC process. This study integrates some of the most central theories in this field, by 1) identifying and merging similarities between theories, reducing conceptual complexity, and by 2) building from dissimilarities as key aspects to overcome limitations.

1.3 Type of study

This study is purely theoretical and based on combining literature review and information on different models of health BC. The work conducted in this study represents a logical exploration of the field of BC theories and assumptions thereof. Instead of focusing on specific theories, this work wishes to contribute to a more holistic analytic perspective, advancing with one of the initial objectives of this thesis.

1.4. Procedure

The process used to reach the aim of this study was to identify complementary factors and interconnected links between theories (and overlapping elements), envisioning the integration of frameworks and exploring differences as a value to overcome BC theories

limitations. Integrating these theories is not an easy task. Few cross-sectional frameworks have been developed (Witte, 1995; Slater, 1999; Michie et al., 2005; Cane, O'Connor & Michie, 2012), but more work in the field needs to be conducted towards a more complete unified understanding of BC that allows to de-complexify this particularly complex and vast field. This work will not only facilitate the operationalisation of theories within interventions, but also a thorough knowledge and comparison between the different theories and models developed within this field.

My approach to this problem aims to draw value, not only from the strengths and complementarity, but also from limitations and differences within each theory, combining them to overcome weaknesses of each other and to answer questions that a single theory scarcely solves. In this way, finding complementarity or even overlaps in the central theories was the first step taken, allowing to merge paired constructs and similar ideas into a common construct. The second step aimed at finding dissimilarities and integrating those that bring an added value to explain a specific stage or element in the process. Differences found in theories were seen as key aspects to move towards a well-meaning integrated perspective, as these may allow limitations of a single theory to be overcome.

DeVries (2017) distinguished between combining versus integrating, when aiming for a unified theory. This statement was based on the fact that integration implies critical testing of constructs and combining refers to a simple addition of constructs between different models. Here, I would like to add and argue that integration should bring added value to address specific limitations within a theory or group of theories. Different theories address different constructs and processes, steps or stages within BC. Integrating theories addressing distinct stages and/or bringing new constructs to the interplay explaining change, is key to overcome barriers and limitations. Following this rationale, one theory could be complemented by another one, addressing the gaps that otherwise would remain unaddressed. On the other hand, integrating similar theories, or similar steps from different theories is also relevant to the field because it reduces complexity, although probably less powerful to overcome limitations. When a specific theory is similar to another, and/ or the same or similar constructs are included in the same step or stage, this brings consistency, trust and reliability and supports the inclusion of those constructs in the final integrative framework.

This work is published here: Henriques, S. & Damasio, M.J. (2021). Re-thinking health behaviour change models from an integrated perspective: building from complementarity to reach a unified overview. In C.Vaz de Almeida & S. Ramos (EDS).

STAGE 1 – STUDY 2. Systematic literature review and meta-analysis: school-based interventions using media technology to promote healthy nutrition habits among children aged 6 to 14 years

2.1. Objectives

To analyse the impact of school-based promotion interventions on nutrition using media technologies, with children aged 6 to 14. More particularly, this study aims to 1) synthesise the best available evidence on the impacts and effectiveness of school-based prevention programs using media technologies designed to promote healthy nutrition habits; 2) enumerate and understand the main theoretical frameworks and models of health BC used in this particular context; 3) identify moderators and predictors of health BC; 4) explore the main validated instruments and tools used to assess health BC; 5) explore the most used media technologies and their effectiveness.

2.2. Criteria for including studies in the review - type of studies, participants, interventions and outcome measures

Only full papers of randomised control studies, experimental studies, quasi-experimental and quasi-randomised control studies were included in the final sample. Theoretical, positional, preliminary and methodological studies were not considered. Studies that measured outcomes immediately after and sometime after (days or months), such as follow-up measurements, were included.

Regarding the type of intervention, only school-based health promotion interventions on nutrition or diet that use media and communication technologies – educational, experiential, psychological, counselling or behavioral interventions, aimed at promoting healthy nutrition habits in children from 6 to 14, within school environment (school or pre-post-school settings) were included. Health interventions aimed at non-healthy subjects or health interventions outside of a school setting were not included.

Primary outcome measures of interest were attitudes towards nutrition, knowledge and literacy about nutrition, behaviors or nutrition practices (dietary intakes), food consumption (micro and macronutrients), behavior change regarding nutrition habits (change in portions or servings of healthy food, measured both by recall, food diaries, food frequency questionnaires, diet records), biomedical markers or dietary indices. Self-report,

questionnaires, inquiries, diaries, recall or observation were used to measure these outcomes.

2.3. Other inclusion and exclusion criteria

Language and dates were also used to restrict the search. Only studies written in English and Portuguese dated between 2009-2019 were included. To conduct a meta-analysis the following criteria were also verified: report of minimal statistical data, as means, standard deviation, sample size, descriptive statistics and inferential statistics (p-value, F, p or t values) for the estimation of effect sizes. When there was missing data, the main author was contacted to provide additional data.

2.4. Search strategy

Relevant studies were searched via scientific electronic databases and internet search engines. The following databases indexed in EBSCO & ISI Web of Knowledge were searched: EBSCO E-Journals; Academic Search Complete; PsycINFO; Regional Business News; Newswires; Library, Information Science & Technology Abstracts; ERIC; Business Source Complete; Psychology and Behavioral Sciences Collection; PsycBOOKS; Cochrane Library CENTRAL; Scielo; PubMed NCBI.

Further procedures were performed to ensure search breadth. 1) bibliographies of included studies were hand-searched, 2) hand search of websites of organizations and foundations in the area. 3) grey literature was also included, such as google scholar search engines, conference proceedings and thesis repositories.

Search terms were developed using relevant keywords. These terms were organised to produce a Boolean search phrase for each combination. The following table (Table 8) presents the keywords used. Logical Boolean operators between columns “AND” and between rows “OR”.

Table 8. Keywords and Boolean search

Nutrition	Intervention	Children	Media technologies
Eating	Health promotion	Child	ICT
Diet	Health intervention	Teens	Information technolog*
Dietary	Health education	Teenager*	Communication technolog*
Food	Health literacy	Youth	Media technolog*

Food intake	Training program*	Adolescent*	Media
Food consumption	Gamification		Mobile phone
Nourishment	School program		Phone
Vegetables	School intervention		SMS
Fruit			Text message
			Flyer
			TV
			Television
			Radio
			PC
			Computer
			Online
			Tablet*
			Ipad*
			Mobile app*
			Games
			Digital game
			Computer game
			Online game

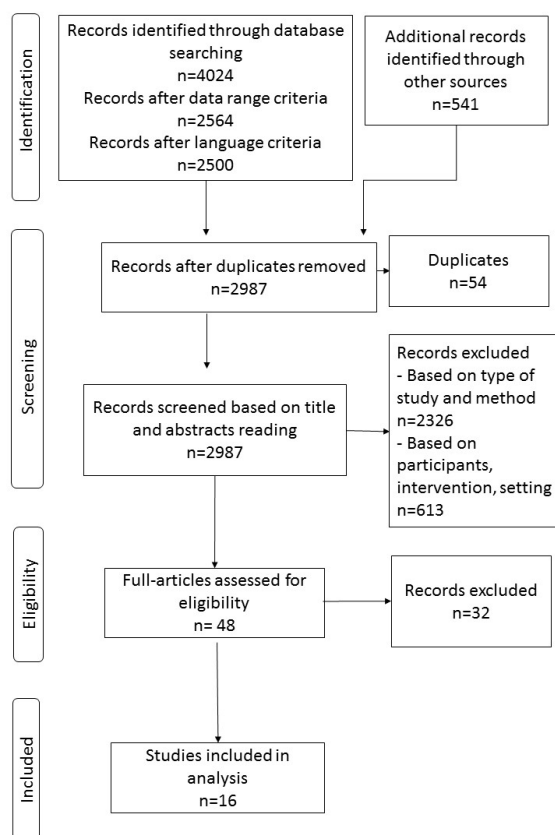
Source: Own elaboration

2.5. Data collection process and analysis

An initial search yield 4 024 results. Date range (n = 2 564) and language were considered as baseline criteria (n = 2 500; English = 2 490; Portuguese = 9). Additional records were identified through other searches (n = 541). Total sample included 3 041 records.

Articles were imported to EndNote reference manager and screened independently with the support of Covidence software. Duplicates were removed (final sample n = 2 987). This first round was performed based on title and abstract reading. Those that did not meet the eligibility criteria were excluded (sample n = 661). Articles were screened against the eligibility criteria for type of study, type of participants, type of outcome measures, type of intervention, type of setting (sample n = 48). Afterwards, each full-paper article was independently examined. Some 32 were excluded and 16 constituted the final sample. The following flow-chart illustrates the process (adapted from PRISMA).

Figure 9. Flow diagram of data collection process (adapted from PRISMA)



Source: Own elaboration

STAGE 2 - STUDY 3. Surveys with parents on nutrition habits at school and school-based interventions to promote healthy nutrition

3.1. Objectives

In this study a survey with parents from school-aged children was conducted, aiming to better understand their perspectives regarding their children's nutrition habits in general, and particularly at school, the school food practices and policies, and their views on the potential of media communication tools to influence their children's everyday food practices and promote healthier nutrition habits. While other studies in this dissertation focus on the individual level (the children), this study intends to bring the perspective of the parents and family, framing a more intimate social level in which children are involved in – the family context.

3.2. Type of study

This work follows a purely exploratory approach and inductive reasoning to explore the current situation regarding nutrition in schools, from the perspective of the family. As typical exploratory approaches, this study departs from data (the survey) to reach theory, using a ground up approach to build onto explanations and theoretical approaches. The main idea is to generate meaning from data to identify patterns, preferences, and draw conclusions, later in the research process. This study applies a survey methodology, using an online questionnaire to collect data directly from parents and/or close family members.

3.3. The survey

This cross-sectional research was conducted using an online survey. A questionnaire was prepared in Google Forms comprising five sections and a total of 36 questions.

- Section 1 was an introductory section that included general information about the survey, asked consent for participation, explained the purpose of data collection and analysis, the voluntariness of participation, filtering questions (age, being a parent, having children attending school from 1st year to 9th grade).
- Section 2 collected demographic information (sex, place of residency, education, number of children and ages, number of children attending school, school year, type of school and children health issues).
- Section 3 included questions about nutrition knowledge, habits, and practices, both at home and at school, and the perspective and opinion of parents about those practices. It also included questions about how nutrition is approached in the school curriculum and activities.
- Section 4 included questions about food behaviour practices and consumption frequency, external factors that influence children's food practices, food shopping behaviours, food preparation.
- Section 5 addressed children's media communication technologies practices, ownership, impact/ influence on children's behaviours, in particular food consumption, perspectives about the potential of these tools to foster (positively or negatively) children's food behaviours.

The survey was voluntary and anonymous and took on average 12 minutes to be completed.

3.4. Sampling process and dissemination strategies

This study applied a non-probability sampling technique, including a convenience and snowball sample of parents of children of school age (6 to 14 years). The link for the online questionnaire was shared on social media (Facebook groups) and by email to a database of personal contacts and to schools' general email contact. Respondents were also asked to forward or post the link for the questionnaire among their contact groups.

3.5. Data analysis

Data were analysed using SPSS 28.0.1.1 statistical software focusing mainly on a descriptive and exploratory statistical analysis.

STAGE 2 - STUDY 4. Analysis of news about nutrition at schools – an overview of the current situation

4.1. Objectives

In the present study, an analysis of news coverage that addresses the issue of healthy eating and nutrition practices in the school context was conducted. The main objective of this work is to focus on a macro level analysis, national level, of the situation of nutrition in the school context, the school policies, and national regulations that affect food practices and food consumption at school. Other studies in this dissertation focus on a more individual level approach of food practices and healthy eating at school. This study intends to bring a contribution to better frame the situation in a broader societal context, focusing on the social, cultural and political environment.

Moreover, the main objectives of this study are to identify the main discussed themes within news about nutrition at school, to explore why these themes were broadcast (newsworthiness), the values and beliefs shared within the news, the places where the reported event took place, the sources of information used, the forms of intervention addressed, the regulations and policies discussed, and, in general, the role of the media and its power to disseminate information about school-based nutrition practices.

4.2. Type of study

This work follows a purely exploratory approach and inductive reasoning to explore the current situation regarding nutrition in schools, at national level. The study departs from observation and analysis, not following a specific theory or set of theories (or having a specific theory preference) to inform data analysis. As typical exploratory approaches, this study departs from data (the news) to reach theory, using a ground up approach to build onto explanations and theoretical approaches. The main idea is to generate meaning from data to identify patterns, theoretical preferences, and conclusions, later in the research process.

This inductive approach to data analysis was chosen to avoid influencing the data and the analysis process with previous theoretical preferences, allowing interpretations and theories to freely emerge from the news.

4.3. Sampling process and criteria for inclusion

SABADO magazine was selected because it is a generalist national magazine with good acceptance levels for general contents (Netaudiences, 2020). As a determining advantageous factor compared to other potential magazines of a similar journalistic nature, SÁBADO offers a robust online search engine, that enabled an extensive search of the journalistic pieces already published, by crossing words and using Boolean operators. This choice was justified by convenience and efficiency, considering this study was conducted in the peak of the Covid-19 pandemic while strict curfew rules were in place. The SABADO magazine is published on a weekly basis, covers general content and belongs to the Cofina Group.

The inclusion criteria comprised of all news published in SÁBADO magazine, from the different editorial lines and sections, on the subject in question, published between 2018 and 2019, identifiable through the online search engine. The search was carried out using the following keywords and Boolean operators (“AND” between columns and “OR” between lines) (Table 9).

Table 9. Selection and inclusion criteria

What	Who	Where
Nutrition (Nutrição)	Child* (Criança*)	School* (Escola*)
Nourishment (Alimentação)	Infant (Infantil/is)	College (Colégio)
Food (Comida)	Youth* (Jovem/ns)	Education (Ensino)
Eat (Comer)	Student* (Aluno(s))	
Diet (Dieta)	Adolescent (Adolescente(s))	

Source: Own elaboration².

Regarding the selection process, all options made available by the search engine were considered for inclusion (n = 547). Then, an analysis was made of the year of publication, removing all the news articles that were not published in 2018 or 2019 (n = 389). Subsequently, the title and headers of the news items were analysed. All news articles that did not include information on the three dimensions of inclusion in these elements (shown in the table above – what, who and where) were removed from the final sample (n = 20). In a final step, all the news articles were read in full and those that did not directly refer to the three dimensions mentioned above were excluded. The final sample included 19 news articles.

4.4. Procedure

A content analysis of the news articles was conducted with the support of NVIVO12 software. As explained before, the analysis process followed an inductive reasoning approach, departing from the news content. An initial fluctuating reading of the news articles was conducted in order to start identifying recurring topics/ contents. This initial reading allowed the development of categories of analysis, that were created along the reading process. The list of categories follows a hierarchical organization and was built from bottom-up, being adapted and transformed as necessary, based solely on the news contents, and following a constructivist approach. The final grid for analysis includes supra-categories and sub-categories, with a minimum of one level and a maximum of three levels of underlying categories.

After the development of the grid for analysis, the news articles were analysed one by one by identifying the categories in the text. The unit of analysis was the sentence. The typology of information sources was then adapted according to Lopes et al. (2012) and Araújo et al. (2016).

² The search was conducted in Portuguese. Both a translation and the Portuguese word used in the search are displayed in this table

Table 10. Analysis grid (only displaying the first level/ supra-category)

Categories
Behaviour (target behaviour)
Editorial
Food (macro or micro-nutrients)
Goals/ Values
Health
Information and communication technologies
Intervention (type of intervention)
News coverage (national, international, regional, etc)
Main topics (motives/ worthiness)
Overweight/ Obesity
Place (where)
Politics/ Political parties
Public sectors (Health, Food, Education, Agriculture, etc)
Regulation/ Policies
Sources of information
Target audience

Source: Own elaboration

STAGE 3 - STUDY 5. School-based health intervention on healthy nutrition with children aged 9 to 12 years: promoting the increase of fruits and vegetables and the decrease of sugar-sweetened beverages consumption among students

5.1. Objectives

The main objective of the intervention was to promote the increase of fruit and vegetables (F&V) and the decrease of sugar-sweetened beverages (SSB) consumption, by children aged 8 to 12 years, in the school context.

5.2. Research design

This school-based nutrition intervention used a cross-sectional quasi-experimental research design applying a baseline and endline assessment to control and treatment groups. The intervention included three groups – a control group and two treatment groups. The contents of the intervention were the same for all groups, though 1) the control group used a traditional teaching-learning exposition, focused on oral explanation, brainstorming and the usage of the white board available in the classroom. 2) The first treatment group

delivered the same intervention content using a traditional oral explanation plus printed communication materials, such as flyers, leaflets and posters, that the students could take home or leave in the classroom, hang in the walls or keep in their notebooks. 3) The second treatment group delivered the same nutrition content using the same traditional oral explanation along with playing digital learning games (serious games) about the topics being taught.

Random assignment to treatment and control group was completed at class level (cluster randomization), meaning participants were not randomly assigned to each group individually, but within their class, due to convenience, organizational purposes and ethical reasons.

5.3. Participants and sampling strategy

Students from 4th, 5th, and 6th grades, aged 8 to 12 years ($n = 67$, mean = 10, SD = 0.873) attending Real Colegio de Portugal, located in Lisbon, Portugal. Some 25 students from the 6th grade were assigned to the control group, 20 students from the 4th grade were assigned to the print communication materials group, and lastly, 22 students from the 5th grade were assigned to the serious games' treatment group. In total, 57% were male and 43% were female.

5.4. Intervention procedure

The intervention was integrated in students' classes, in the different grades, as the contents aligned with school goals and programme. Informed consent was obtained from parents. The sessions were conducted by the researcher and a teacher was present most of the time. The researcher prepared all materials and a booklet for the classes, which was distributed to all children in all groups (see annex 1).

In the school year of 2021/22, eight sessions of 45 minutes were held with each group, during school time (total 360 hours). The intervention included the following main topics: 1) what is healthy nutrition and what are macro and micronutrients, 2) food groups (food circle, food pyramid, eatwell plate), 3) balanced meals, 4) food labels, 5) choosing food in the supermarket, 6) what are real foods and what are artificial foods, 7) Malnutrition consequences. In each topic, F&V were emphasised and discussed, as well as sugar foods, in particular SSB.

As explained, the dependent variable in this experiment was the type of communication materials, technologies and communication strategies used in each group.

Along with traditional educator led sessions, the control group included only oral explanations, brainstorming, active participation, whiteboard, and slides. The treatment group 1 included the same traditional led lessons but also involved the use and/or creation of printed communication materials, such as flyers and posters. In each session the children were offered a flyer with information addressed in the class. When possible, these materials were operational tools the children could use in their daily routines, instead of only written information (Figure 10).

Figure 10. Examples of flyers used in treatment group 1



BEBER ÁGUA É ESSENCIAL PARA A TUA VIDA

A IMPORTÂNCIA DA HIDRATAÇÃO

A ÁGUA TEM FUNÇÕES ESSENCIAIS NO NOSSO ORGANISMO:

- REGULA A TEMPERATURA DO TEU CORPO.
- FAVORECE O BOM FUNCIONAMENTO DOS TEUS ÓRGÃOS, PRINCIPALMENTE RINS E INTestino.

QUANDO NÃO BEBES A QUANTIDADE SUFICIENTE DE ÁGUA, PODES SENTIR:

- DORES DE CABEÇA,
- REDUÇÃO DA CAPACIDADE DE CONCENTRAÇÃO E MEMÓRIA.

POR ISSO, RECOMENDA-SE QUE BEBAS 1,5 A 2 LITROS DE LÍQUIDOS POR DIA.

AO ESCOLHERES UMA BEBIDA, PREFERE A ÁGUA.

SE, ÀS VEZES, QUISERES VARIAR, LÊ O RÓTULO E ESCOLHE BEBIDAS COM MENORES TEORES DE AÇÚCAR E ADITIVOS.

BEBER ÁGUA TEM MUITAS VANTAGENS. QUANDO ESTÁS HIDRATADO MELHORAS NO TEU DESEMPENHO, FAZENDO E ENGAJANDO NAS TUAS ATIVIDADES. ADOTAR A ÁGUA COMO BEBIDA PREFERIDA, CONSEGUES CONTROLAR MELHOR O TEU PESO.

O AÇÚCAR O CORANTES O CONSERVANTES

E PARA RECOMPENSAR:

$H_2O = \left(\text{FAZER O QUE GOSTAS} + \text{ESTAR COM QUEM GOSTAS} \right)$

VÊ A QUANTIDADE DE AÇÚCAR DAS BEBIDAS

COMO INTERPRETAR O RÓTULO DA TUA BEBIDA?

LISTA DE INGREDIENTES: ÁGUA, AÇÚCAR, DIÓXIDO DE CARBONO, CORANTE E SÓLIDOS SUSPENSOS.

INGREDIENTE	TEOR (g/L)	POSSÍVEL (LITROS)
ENERGIA	0g	0g
LÍQUIDOS	0g	0g
ADITIVO DE CARBONO	0g	0g
ADITIVO DE AÇÚCAR	0g	0g
FIBRA	0g	0g
PROTEÍNAS	0g	0g
SAL	0g	0g

DEVES SABER:

A QUANTIDADE DE AÇÚCAR VARIÁVEL DE BEBIDA PARA BEBIDAS DEVERES COMPARAR A INFORMAÇÃO NUTRICIONAL DAS SUAS BEBIDAS POR TOTAL.

PODES DETERMINAR A QUANTIDADE DE AÇÚCAR BEBIDA NO RÓTULO (POR DOSI) POR E FICA COM O NÚMERO, PROIBINDO DE COLOCAR DE CHÁ, COLHER DE CHÁ = 4g DE AÇÚCAR.

EX.: 100g DE AÇÚCAR DE AÇÚCAR (COLHER CHÁ) = 4g DE COLHERES DE CHÁ DE AÇÚCAR.

Fonte: Ministério da Saúde, 2016. Nota: Não substitua a água. Tenha cuidado com a ingestão de bebidas açucaradas. Evite ou reduza o consumo de bebidas açucaradas.

Classificação dos Alimentos

IN NATURA
Retirados diretamente de plantas e animais sem alteração

MINIMAMENTE PROCESSADOS
Passaram por processos de limpeza, moagem, congelamento, que não envolvem adição de sal, açúcar, óleos e outras substâncias

PROCESSADOS
Fabricados pela indústria com adição de sal ou açúcar, para aumentar a durabilidade

ULTRAPROCESSADOS
Formulações industriais, que, além de açúcar, sal e óleo, possuem uma lista grande de ingredientes, como gorduras modificadas, amidos, proteína de soja e aditivos químicos

FRUTAS

janeiro-abril

- ABACATE
- GEADA
- ABIU
- BANANA
- NANICA/MAÇÃ
- FIGO
- SOLERA
- KIWI
- LARANJA
- PERA
- LIMÃO TAITI
- MAÇÃ GALA
- MAMÃO
- PÊSSEGO
- PITAYA

maio-agosto

- ABACATE FORTUNA
- ATEMÓIA
- CARAMBOLA
- CUPUAÇU
- LARANJA BAHIA
- MANGOSTÃO
- MARACUJÁ DOCE
- MEXERICA
- MORANGO
- QUINCAM
- TANGERICA
- PONKAM

setembro-dezembro

- ABACATE BREDÁ
- ABACAXI
- ACEROLA
- AMEIÇA
- AMENDOIM
- AMORA
- BANANA PRATA
- CAJU
- CASTANHA
- CEREJA
- COCO VERDE
- FRAMBOESA
- GRAVIOLA
- JABUTICABA
- LARANJA PERA
- LIMA DA PÉRSIA
- MAÇÃ FUJI
- MANGA
- MARACUJÁ AZEDO
- MELÃO
- MELANCIA
- NECTARINA
- NÉSPERA
- PHYSALIS
- ROMÃO
- SAPOTI
- UVA

VERDURAS

janeiro-abril

- ACELGA
- ALFACE
- CHICÓRIA
- ESCAROLA
- NABO
- CRÉOANO
- REPOLHO
- RÚCOLA
- SALSA
- SALSÃO

maio-agosto

- AGRIÃO
- COUVE
- ESPINAFRE
- LOURO
- MILHO VERDE
- NOYASHI
- RABANETE

setembro-dezembro

- ALHO PORÓ
- ALMEIRÃO
- ASPARAGO
- FOLHAS DE SETE-ROSA
- BRÓCOLIS
- CATALANHA
- CEROLINHA
- FOLHAS DE CENOURA
- CORNITO
- COUVE DE BRUXELAS
- ENDIVIAS
- ERVA DOCE
- ESPINAFRE
- FOLHAS DE UVA
- HORTIÇA
- MANJERICÃO
- NABO
- PALMITO
- RABANETE
- RÚCOLA

Source: Direcção Geral de Saúde - Programa Nacional para a Promoção da Alimentação Saudável (posters 1, 2 and 3). Other sources online (posters 3, 4, 5)

The treatment group 2 included the same traditional led lessons plus the use of digital learning games that approached the contents discussed in class. Serious games play was done during the session, for at least 15 to 20 minutes per session. Most games were freely

available online. Games were organised per topic, including the following: food groups, food circle/ food plate, prepare a healthy meal, food label literacy, choosing foods in the supermarket, real and artificial foods. For examples of the games played in class, see the following figures (Figure 11).

Figure 11. Examples of online learning games used



Food Groups Game





LUNCH-O-MATIC
A Cafeteria Challenge



Roda dos Alimentos

Joga conosco!



Completion: 12 out of 12

HOW TO PLAY

Challenge Choose the food or drink that has the most grams (g) of total sugars per serving.

1 Total sugars include added sugars and sugars found naturally in many nutritious foods and drinks (like fruit and milk). Sugars provide calories, or "energy," for the body. Each gram of sugars provides 4 calories.

Tip Total sugars does not have a % Daily Value (%DV), so use the number of grams to compare and choose foods and drinks. If a food or drink has more grams, it is higher in total sugars.

Remember to look at all three labels. This round compares grams of total sugars per serving, which is in the middle part of the Nutrition Facts label.

24 servings

8 servings

7 servings

American Cheese Slices

RAISINS

Cheese Puffs

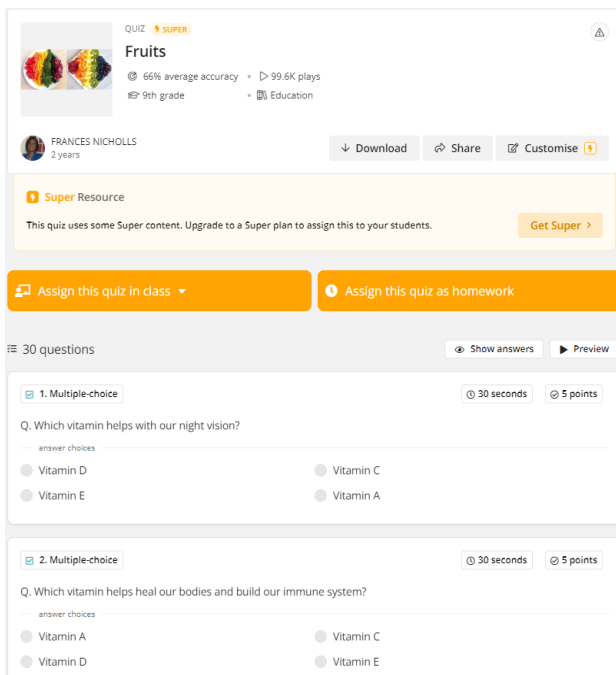
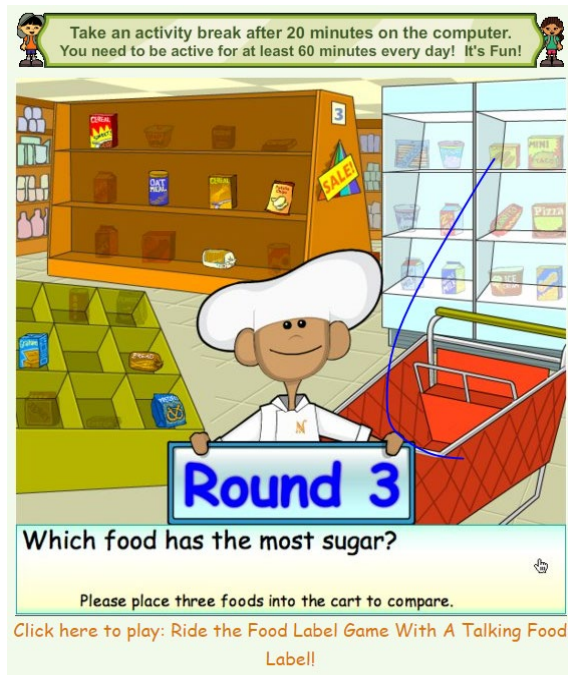
SELECT

SELECT

SELECT

American Cheese

Nutrition Facts		Amount/serving	% DV	Amount/serving	% DV
Total Fat 3.5g		3.5g	4%	Total Carb. 2g	1%
Saturated Fat 2g		2g	10%	Fiber 0g	0%
Trans Fat 0g		0g		Total Sugars 1g	
Cholesterol 10mg		10mg	3%	Includes Added Sugars 0%	
Sodium 220mg		220mg	10%	Protein 3g	
Calories per serving 50		Vitamin D 4% • Calcium 25% • Iron 0% • Potassium 0%			



Source: Described in the text below.

The first image (left) shows the 'Food groups game' from Sheppard software, the second image (right) shows the 'Sortify nutrition game' from the BrainPOP website, the third image (left) is the 'Lunch-o-matic game' from Arthur games PBS Kids website, the fourth image (right) is the 'Roda da alimentação' game from Mimosa website, the fifth game (left) is the 'BlastOff game' from FNS-USDA website, the sixth game (right) is the 'Label lingo' game from Whyville website, the seventh game (left) is the 'Food label game' from Nourish Interactive games website, and the last game, the eighth game (right), is a fun quiz game from Quizizz website. Other digital games from Richard Buddy about F&V and SSB were used, though these were not freely available online and required an installation.

5.5. Intervention plan, outcome variables and measures

The theoretical work on the integrative perspective of health behaviour models conducted at the beginning of this PhD thesis guided the intervention plan regarding the outcome variables (see literature review section 3.4. A proposal for an integrative framework to health BC theories). This tool was driven by the TTM and HAPA models and offers advice on the health indicators to address, depending on the stage(s) in which the intervention is planned, and on the type and content of communication. It assumes that the process of BC evolves in stages. At each stage, different strategies/ processes will foster the moving to the next stage. Considering this, the present intervention planned to act in the contemplation and preparation

stages, and in the beginning of the action stage (first steps). The following table shows the stages and the relevant variables to act on and promote (and measure) for each stage (Table 10).

Table 11. Stages of behaviour change and relevant outcomes variables to progress to the next stage

Contemplation (getting ready)	Preparation (ready)	Action (behaviour)
Knowledge, pros / cons	Intention (action planning, coping planning)	Behaviour
Beliefs (outcome expectancy, risk perception, social, control)	Motivation	
Perceived control	Self-efficacy (planning and coping)	
Self-efficacy (pre-action)	Self-care	
Attitude	Internal and external barriers	

Source: Own elaboration

The outcome variables assessed before and after the intervention were nutrition knowledge, food label literacy, actual behaviour (frequency of F&V and of SSB consumption using a nutrition frequency survey and 24 hour recall strategy), barriers to change, self-efficacy, nutrition self-care.

Nutrition knowledge was measured using the updated version of the General Nutrition Knowledge Questionnaire (Kliemann et. Al, 2016) and the Nutrition Knowledge Questionnaire (Turconi et al., 2003). These measures use multiple choice questions. Only group 1, group 2 and group 3 from the General Nutrition Knowledge were used, considering the contents and goal of the intervention.

Food label literacy was measured using the most recent version of the Food Label Literacy for Applied Nutrition Knowledge (FLLANK) questionnaire (Reynolds et al., 2012). However, food labels were updated with real Portuguese food labels that can be found on products in the supermarket (5 food labels were used).

Actual behaviour was measured using a nutrition frequency survey (Turconi et al., 2003) and 24 hour recall strategy for two days (one weekday and one weekend day). Nutrition frequency included 6 questions with yes/no answer and frequency. For example, 'Do you eat fruits and vegetables every day?' offering a yes/no answer, and then asking, 'If yes, how many portions (200g) you eat in each day?' (1-2, 3-4, more than 4) or 'If no, how many times do you eat fruit and vegetables in one week?' (1-2, 3-4, more than 4). The 24-hour recall asked 'how many fruits did you eat yesterday' and 'what were those fruits', plus

‘how many vegetables did you eat yesterday’ and ‘what were those vegetables’. And then, the same questions were repeated for last Saturday.

Barriers to change regarding nutrition were measured using the Turconi et al., (2003) survey, including 9 items and applying a Likert scale. These included questions such as ‘Do you know which foods should be restricted to reduce intake of sugar?’, ‘Do you know how to eat healthy?’.

Self-efficacy was measured using Turconi et al. (2003) self-efficacy scale, which includes 8 items with a Likert scale and asked question such as ‘Do you think you are able to modify your diet if necessary?’, ‘Do you think you are able to use nutrition advice aimed at improving your health?’.

Finally, **nutrition self-care** was measured with Moore Index Nutrition Self-Care (MIN-SC) (Moore, 1995; Moore, Pawloski & Baghi, 2005; Jaimovich, Campos, Serrano & Moore, 2009), including 50 items designed to measure regular dietary intake, planning, adjustment and nutrition skills and using a frequency scale from never to always/ daily. This instrument consists of items such as ‘I read about nutrition’, using a Likert scale.

As explained before, the intervention was planned to act in the contemplation and preparation stages, and on the initial phase of the action stage (see literature review section 3.4. A proposal for an integrative framework to health BC theories). The following table (Table 11) shows the actual outcome variables measured and the strategies to assess these variables.

Table 12. Stages of behaviour change and relevant outcomes variables to progress to the next stage

Contemplation (getting ready)	Preparation (ready)	Action (behaviour)
Nutrition knowledge Food label literacy	- Self-efficacy planning	- 24-hour recall - Frequency of food consumption
Self-efficacy beliefs, perceived control (able to...)	- Nutrition self-care (intention, action planning)	
	- Barriers to nutrition change	

Source: Own elaboration

5.6. Data collection process and analysis

Data collection was conducted before and after the intervention (baseline assessment and endline assessments). All measures were compiled together in a single document, similar to a school activity sheet (see Annex II). Students were informed that there were no right or wrong answers and that this activity was not a school assessment.

Analysis was conducted to examine differences in responses for each outcome variable between baseline and endline assessments, using non-parametric repeated measurement procedures, namely Wilcoxon Signed Rank test. Differences between groups at baseline and endline were also assessed using non-parametric independent measurement procedures, namely Chi-square and Kruskal-Wallis test. Data were analysed using SPSS 28.0.1.1 (14) statistical software. Statistical significance is reported using p-values and a 95% confidence level.

III. Data analysis and results

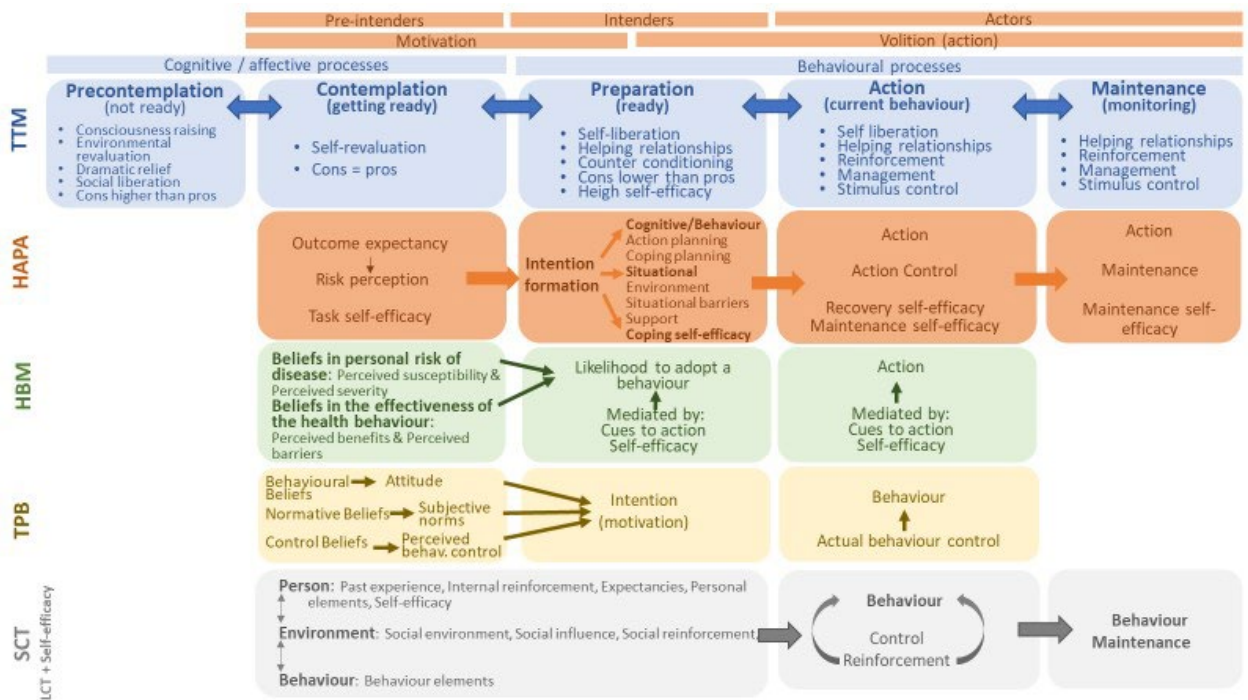
III. Data analysis and results

STAGE 1 - STUDY 1. Rethinking health behaviour change models from an integrated perspective

To develop a common framework to integrate theories, the first dilemma to answer was which models should be included from the so many available. This choice was based on the work of Michie et al (2014), as it is the most recent and it addresses the exact same question (which are the most used models, and which are the most central ones). The identified theories/models are the *TPB*, the *SCT* and *SET*, the *HBM*, the *HAPA* and the *TTM*.

As explained, the initial step was to identify similarities and constructs, and then to identify dissimilarities and gaps in these theories. Secondly, to integrate similarities into common concepts and dissimilarities into key strategy concepts (to provide input for the gaps). The *TTM* was used as a framework to integrate the theories identified, based on stages of change. In each stage, constructs were included, according to the mentioned theories. This work is not a new theory, neither a model, it is an operational framework that offers an overview of the main theories in the field and the related constructs associated with a specific stage. It intends to support the work of those developing health interventions, by offering an integrated perspective and a schematic visualisation of the process of BC, as described in the theories included. It also aims to offer suggestions to overcome limitations, based on inputs from other theories. The main constructs that contribute to progressing between stages are identified. This work can and shall support intervention plans and recognition of the mediator variables that should be addressed and fostered at each stage, to progress to the next one. This perspective also assumes that the BC process is very complex and that interventions would benefit from acting in a specific stage or set of stages, by addressing the constructs that are identified as having an impact at that specific stage, rather than intending to monitor and promote change from the first stage to the last (from an unawareness to maintenance stage). The following figure (Figure 12) presents the first deliverable of this process, a comparison between theories. Colours are used to easily identify which theories proposed each stage(s), process(es) or construct(s).

Figure 12. A comparison table between health BC models



Source: Own elaboration

From the bottom up of the table, the SCT derives from the SLT (Bandura, 1986) and it includes the concept of self-efficacy. The theory argues that BC occurs in a social context from a dynamic and reciprocal interplay between the person, the environment, and the behaviour. The theory stresses social influences, internal and external reinforcements and also past experience of the person (Bandura, 1986). One limitation of this theory is that it does not address the initiation of the behaviour. However, it contributes to the maintenance of the behaviour. Other limitations are the lack of an emotional dimension, and other personal factors besides past experiences. It has also been claimed that it is too broad and is difficult to operationalise.

The TPB (Ajzen, 1985, Ajzen 1991) originates from the TRA (Fishbein & Ajzen, 1980) and explains change through behavioural intention (attitude), subjective norms (social support and social expectations) and behaviour control. It also brings to the game the construct of beliefs. Its main limitations are associated to the fact that it does not consider other factors such as past experience, emotions, resources, and information. It assumes BC is a linear process and it does not clearly explain the progress from intention to behaviour, nor it considers maintenance or pre-awareness stages.

The *HBM* assumes that a person's belief in the personal threat of disease (perceived susceptibility and severity) along with a person's belief in the effectiveness of the health behaviour to avoid that disease (perceived benefits and barriers) are central constructs (Nancy, Marshall & Becker, 1984; Glanz & Bishop, 2010). These constructs influence the likelihood to adopt a behaviour, which is also mediated by self-efficacy and cues to action. It is limited by the fact that it does not account for social or environment factors, or other personal, emotional or cognitive factors in the process. Moreover, it does not address the pre-awareness phase nor the maintenance phase.

The *HAPA* (Schwarzer, 1992; Schwarzer, 2008) framework, like the *TTM*, suggests that BC process evolves in stages, the motivational stage and the volition stage. It comprises three groups of individuals: the pre-intenders, the intenders and the actors. The motivational phase culminates with the development of intention. The volitional phase includes both intenders (did not initiate action, but intend to), and actors (have already initiated action). At this point, planning is the key strategy construct to progress from intention to action. This theory suggests two strategies, action planning (where, how, when, how long regarding the action) and coping planning (anticipation of barriers and temptations and solutions to overcome). The theory also includes situational, cognitive, and behavioural elements and suggests self-efficacy as a valuable construct during the whole path of BC. It identifies distinct types of self-efficacy, such as task, coping, recovery and maintenance self-efficacy.

The *TTM* (Prochaska & DiClemente, 1983, 2005; Prochaska, DiClemente, & Norcross, 1992) focuses on intentional changing and argues that the process of change unfolds in six stages: precontemplation, contemplation, preparation, action, and maintenance. Moving between stages is not linear, rather like a spiral as it can be reversed. Different intervention strategies and constructs are effective in different stages. Ten processes of change have been identified – consciousness raising (increasing awareness), self-revaluation (self-appraisal: how the unhealthy behaviour affects the person), environment revaluation (social appraisal: how the unhealthy behaviour affects others), social liberation (environment opportunities), supporting relationships (support of others), counter-conditioning (substituting thoughts and behaviour by healthier choices), reinforcement management (rewarding the positive behaviour) and stimulus control (control the environment to offer promoting support and reduce temptations). Limitations include the clear definition of stage's boundaries, the time needed for each stage and few environmental elements.

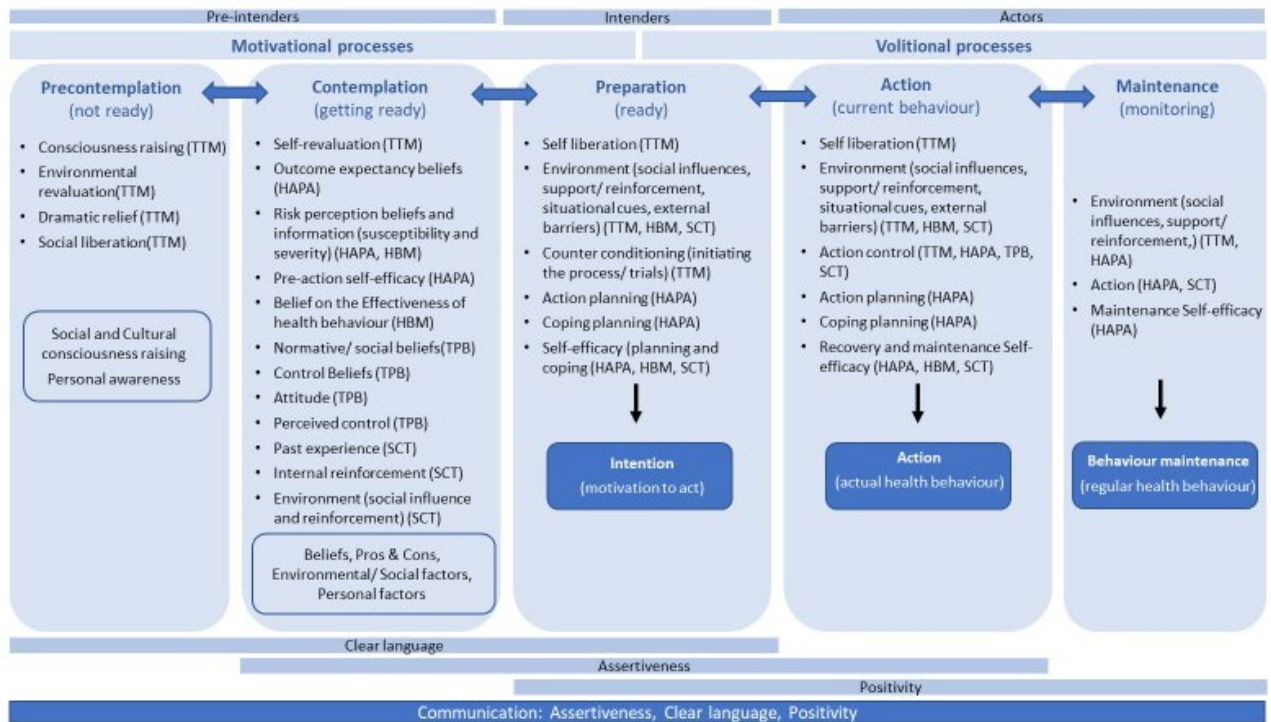
According to Vaz de Almeida (2020, 2019) communication practices significantly influence the relationships between health professional and patients, and therefore, influence

how they progress along the process of BC. Previous work in health BC change has emphasised the relevance of communication processes, being it oral and face-to-face communication (Vaz de Almeida, 2018; Armas et al., 2018; Wanyonyi et al., 2011), or written communication, such as health messages (Witte, 1995; Slater, 1999). Several authors have studied the influence of communication in the process of BC and focused on different dimensions of communication – language, agency, persuasion, health literacy, tailored messages, therapeutic relationships (Ma & Miller, 2020; Updegraff et al., 2007; Morrison, Kukafka & Johnson, 2005; Cacioppo & Petty, 1989). A consistent group of studies have also been studying the potential of media technology as promoting or monitoring tools within health interventions, supporting the work of health professionals (Dallery, Cassidy & Raiff, 2013; Keyworth et al., 2018; Olson, 2016). Introducing a communication level in the integrated perspective was, hence, considered beneficial.

The *ACP* model argues the relevance of assertiveness, clear language and positivity in communication along the process of health BC. The model assumes these skills as interconnected. Assertiveness is associated with objectivity, clarity, self-efficacy, self-analysis, ability to control feelings and impulses, motivation, understanding of health messages (Vaz de Almeida, 2020). Clear language usage is communicating in an understandable and accessible way that considers the target audience reception processes (Vaz de Almeida, 2020). Positivity is related to approach goals and actions, focused on empowering skills and ability to undertake action, and promotes motivation and self-efficacy when used to describe patient's behaviour, similar to external positive reinforcement. These communication skills should be used along the process of BC when developing health interventions and distributing health messages. According to data from the model (Vaz de Almeida, 2020, 2019, 2018), although these three communication skills are relevant along the whole process, clear language is very important at initial phases, to promote awareness and understanding of what a health behaviour is and how can one perform it (precontemplation, contemplation and preparation phases). Assertiveness is critical to facilitate motivation, self-efficacy and impulses control, thus being more relevant in contemplation, preparation and action phases. Positivity is also important along the process, but highly relevant in the preparation and action phases, when someone starts single attempts of the behaviour, and needs external reinforcements. It is also very relevant for the maintenance phase, promoting consistency and stability of the behaviour.

The image below (Figure 13) represents an integrated overview, including all relevant constructs and processes in each stage. It serves as a useful guide to understand the concepts to address in a health communication intervention, based on the body of theory of health BC.

Figure 13. An integrated perspective



Source: Own elaboration.

In the first stage, also called the precontemplation stage, the inputs are mainly from *TTM*, as no other theory contributed to explain how individuals move from the unawareness (precontemplation) to the awareness stage (contemplation). This theory elaborates that five processes are relevant to promote moving from this stage to the next. These are based on: 1) personal consciousness, such as an increasing awareness about the health behaviour, having a first contact with information; 2) the dramatic relief or emotional reaction to that behaviour; 3) the social or cultural consciousness, comprising the understanding of the impact of that behaviour on others, and finally on 4) social liberation with the understanding of the opportunities and support of society.

The second stage, called the contemplation stage, is the most addressed in the theories chosen for this overview. The central concepts are the beliefs – risk perception beliefs (susceptibility and severity), beliefs about the effectiveness of health behaviour, those about the social norms and the environment (peers and society), self-efficacy (a person's beliefs in their ability to succeed in undertaking the desirable action), and finally, outcome expectancies (beliefs on anticipated consequences of engaging in the behaviour). These

beliefs interact with other constructs such as attitude development, past experience, internal and external reinforcements.

The preparation stage is when a person is getting ready to act, therefore, the central concept is intention development. The intention is influenced by numerous factors. For this stage, the *HAPA* suggests action and coping planning as central processes. Self-efficacy is also relevant to move from this stage to the next, mainly self-efficacy related to planning and coping. Other suggested processes and constructs are self-liberation in the form of commitment to the behaviour and believing that it is possible to achieve it, social/environment influences, reinforcements, and counter conditioning (initiating the process through trials). This stage is mainly about getting motivated to act and reinforcement about being able to do it.

The action stage is where the behaviour finally takes place. In this stage, control over the behaviour and over the environment, social support, self-liberation, action and coping plans are relevant, as well as recovery self-efficacy. At this stage, the individual is already performing the behaviour, but relapses may occur and the knowledge on how to deal with them is very relevant to maintain the behaviour over time. The last stage, the maintenance stage, occurs when a person has been maintaining the behaviour for some time, not having significant relapses, and not feeling tempted to go back to the unhealthy behaviour. The relevant constructs at this stage are action and the environment, as well as maintenance self-efficacy.

As closing notes, it is important to highlight that the stage progression was grounded on the *TTM* theory, that served as a scaffolding structure to build the comparison and the integrated perspective, allowing one to organise distinct theories and constructs coherently in a logical path to BC. The comparison table visually identifies the relevant constructs from each theory, associating them to a specific stage. From the table it is easily observed that some theories focus on specific stages but lack attention on other stages. Integrating theories and constructs meant that these gaps were to overcome. The integrated perspective table offers a summary of the central constructs and processes in each stage, guiding on which variables are relevant to address, measure and promote in each stage (to foster progress to the next). Health professionals and researchers can easily understand which constructs are significant at a certain stage in the process of BC, and which theory contributed the most to the identification of those constructs, which facilitates the process of selecting a theory to guide an intervention.

STAGE 1 - STUDY 2. Systematic literature review and meta-analysis: school-based interventions using media technology to promote healthy nutrition habits among children aged 6 to 14 years

A comparative table was developed offering information on type of study, participants, intervention, theoretical models, instruments, outcomes, ICT used, analysis, results and conclusions (Annex III).

2.1. Description of studies – type of studies, location, participants

A total of 16 records related to school-based nutritional interventions with children, aged 6 to 14, using digital media technologies, were identified and eligible for this review. Most studies were conducted in the U.S. (8), followed by Denmark (2), Portugal (2), Korea (1), Netherlands (1), Spain (1), U.K. (1).

Regarding the type of research design, 9 studies were randomised controlled trials (RCT), from these, 2 were cluster RCT. Five studies used a quasi-experimental research design, applying measure outcomes for treatment and control group. However, these studies did not have participants randomly assigned to experimental groups. In these cases, schools were the unit that defined whether students were in the treatment or control group, mostly due to ethical and practical reasons. Two studies used a single-case experimental design, alternating treatment and no treatment days, using both pretests and posttests to compare dependent variable results. In both these cases, the whole school (all classes) was part of the intervention (collaborative gameplay) and a comparison was made alternating the target dietary behavior. In addition, the dependent variable was repeatedly measured across conditions (intervention days and non-intervention days). The target behavior was randomly selected, and students were notified daily. In these cases, the school served as treatment and its own control with repeated measurements across phases.

Participants were mostly male and female, except for two studies that only worked with female groups, in both cases the intervention took place in girls-only schools and no particular reason was offered for that. As mentioned before, children were aged 6 to 14 years old. Only one study included students aged six, for all other studies the younger age was eight. Applying an interval scale, two studies included children aged between six to eight; nine studies included children aged nine to eleven; six studies included children aged twelve to fourteen. All studies included school-based interventions. Most studies used classrooms

as a unit of analysis for treatment and control groups, and randomization was performed based on class and not on individuals. Samples range from 49 to 2 477 students, with a mean of 511 individuals (SD = 624,35).

2.2. Interventions

As previously mentioned, all studies focused on dietary practices. The main purpose of the interventions was to promote healthy eating. 11 studies intended to promote healthy eating by increasing the intake of fruit and vegetables (Struempler et al., 2014; Cullen et al., 2016; Silva et al., 2015; Pedersen, Gronhoj & Thogersen, 2016; Jones, Madden & Wengreen, 2014; Joyner et al., 2017; Baranowski et al., 2012; Bech-Larsen & Gronhoj, 2013; Rees & Baker, 2010; Sharma et al., 2015; Fassnacht et al., 2015). Eight also included physical activity (Moore et al., 2009; Fassnacht et al., 2015; Silva et al., 2015; Baranowski et al., 2012; Ezendam, Brug & Oenema, 2012; Sharma et al., 2015; Yang et al. 2017; Banos, et al., 2013). Four studies focused on general **healthy eating, nutritional practices** based on quantities and diversity (Moore et al., 2009; Ezendam, Brug & Oenema, 2012; Sharma et al., 2015; Yang et al. 2017; Ezendam, Brug & Oenema, 2012). Two studies focused on promoting **nutritional knowledge** as the basis to encourage healthy eating (Moore et al., 2009; Banos, et al., 2013). One study worked with brown bread, wholegrain cereals, fruit and vegetables (Rees & Baker, 2010). Two studies focused on decreasing sugar-sweetened beverages, or sugar consumption, or snacks (Nollen et al., 2013; Sharma et al., 2015). One study included water consumption (Baranowski et al., 2012)

The duration of the interventions varied greatly, from two weeks to one year, with an average duration of 12 weeks (SD = 11,21). Most of the studies use a baseline assessment, post assessment (after the intervention) and four studies perform a follow-up (1 to 4 months after the intervention).

2.3. Theoretical background

For many studies, it was unclear if a theoretical model had been used to guide the intervention. Literature reviews focused mainly on explaining the problem of obesity, offering numbers and statistics, as well as associated health and societal problems. Some also focused on the digital media technology that was used for the intervention, its particularities, advantages, and disadvantages. Regarding the studies that did express the use of theoretical background, the most common is the *SCT* and *Self-Efficacy* (Bandura, 1977;1988), the *TPB*, *Gamification*, serious games, game-based learning, collaborative

learning, *Adoption Theory*, *Goal Theory* (goal setting strategy), *Experiential Learning Theory*, *Self-Care Deficit Theory*, *Implementation Intention Theory*.

2.4. Media and communication technologies used

The most common media technology used in interventions were games, both videogames, online games, serious games (7), SMS (SMS-based monitoring and feedback system) (4), mobile app, internet, computer-tailored leaflet, IPTV, iPads (in one intervention each). There were no interventions using more than one communication technology.

2.5. Outcome measures, measured variables, instruments used

Main outcome measures were based on dietary intake and nutritional practices. The majority of studies measured nutrition intake, being fruit and vegetables, brown bread, water, sugar-sweetened beverages; nutrition knowledge, nutrition practices, anthropometric indices (blood pressure, height, weight, BMI) and psychological outcomes (self-efficacy, beliefs, cognitive and emotional factors).

The following list represents a comprehensive list of all outcomes measured: blood pressure, BMI, body fat, brown bread, calcium, carbohydrates, protein, fibre, fruit, F&V, snacks, sugar, SSB, total fat, vegetables, water, wholegrain cereals, nutrition behavior, nutrition knowledge, self-care practices, self-efficacy.

The most common methods used to assess these outcomes were checklists, questionnaires and surveys (11 studies - Struempler et al., 2014; Moore et al., 2009; Silva et al., 2015; Yang et al., 2017; Rees & Baker, 2010; Nollen et al., 2013; Pederson, Gronhoj & Thogersen, 2016; Ezedam, Brug & Oenema, 2012; Sharma et al., 2015; Fassnacht et al., 2015; Bech-Larsson & Gronhoj, 2013). Seven studies used 24 hour recalls (self-report of breakfast, lunch, dinner, snacks) (Struempler et al., 2014; Cullen et al., 2016; Rees & Baker, 2010; Nollen et al., 2013; Baranowski et al., 2012; Ezedam, Brug & Oenema, 2012; Sharma et al., 2015). Eight studies used anthropometry, height, weight, BMI, waist circumference, blood pressure (Yang et al., 2017; Banos et al., 2013; Moore et al., 2009; Nollen et al., 2013; Silva et al., 2015; Baranowski et al., 2012; Ezedam, Brug & Oenema, 2012; Fassnacht et al., 2015). Two studies used Plate-waste-measure (Jones, Madden & Wengreen, 2014; Joyner et al., 2017) and one study analysed psychological outcomes (Rees & Baker, 2010).

There is a lack of uniformity in the instruments and measures used. Most of the studies developed their own tailored measures, to serve their own objectives. Only a few used already validated and published measures. In this systematic review the following

instruments were identified: Checklist: 'What's for lunch?' (Struempfer et al., 2014); 'Nutrition knowledge questionnaire' (28 items) (Moore et al., 2009); 'Nutrition knowledge questionnaire' for children (35 items) (Banos, et al., 2013); 'Psychological questionnaire' (beliefs) (30 items for each food) (Rees & baker, 2010); 'Adolescent nutrition self-care questionnaire' (50 items) (Moore et al., 2009); 'Food frequency and physical activity questionnaire' (Silva et al., 2015); 'Food frequency questionnaire' (Vereecken & Maes, 2003 cited by Silva et al., 2015; Fassnacht et al., 2015); 'Food frequency questionnaire' (Ezedam, Brug, Oenema, 2012); 'Family eating and activity habits questionnaire' (Golan & Weizman, 1998 cited by Silva et al., 2015; Fassnacht et al., 2015); 'Self-efficacy survey' (Perry et al, 2008 cited by Pederson, Gronhoj & Thogersen, 2016).

2.6. Effects of interventions

A meta-analysis was conducted to aggregate the results of the 16 studies that matched the inclusion criteria. The final goal is to estimate a measure that summarises the results from all the studies. This aggregation is a procedure that weighs the results of each study according to its precision. Precision is estimated based on dispersion, namely variance. A study with a wider variance will automatically represent a smaller weight in determining the pooled result of the analysis, when compared with a study with a greater precision, namely, lower variance.

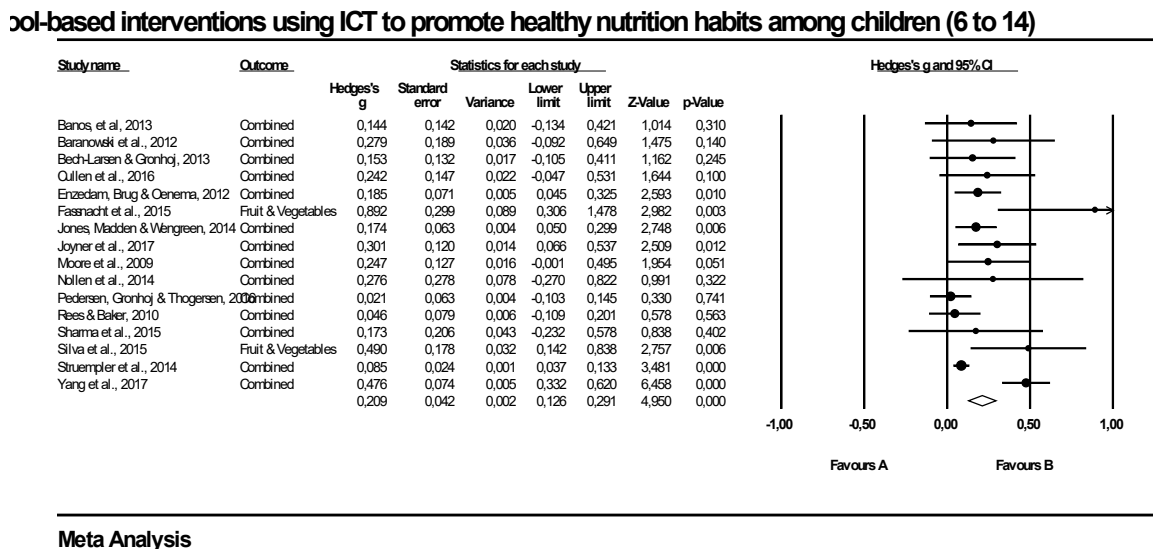
A random effect model was chosen to pool the results, as there is a low but significant degree of variability between the studies ($Q=15,527$, $df=15$; $I^2=3,395$, $p<0,001$) and this procedure considers statistical heterogeneity and allows for the possibility that population parameter values vary. Since the condition that all studies come from the same distribution is not fully satisfied, this estimate offers a wider confidence interval and a more conservative and reliable model that best represents variability (Higgins et al., 2019; Monteiro, 2010; Leandro, 2005). This distribution is estimated by taking into account random sample variance (within-study-variance) and population effect variance (between-study-variance). Further exploration of the causes of heterogeneity is approached later in this analysis.

The following image (Figure 14) shows the forest plot obtained with the random effect model. The Hedges's g for the 16 studies is 0.209, standard error of 0.042 with a confidence interval of 0.126 to 0.291. Data indicate that health nutritional interventions using ICT have a low to moderate significant effect to promote healthier nutrition habits in children ($Z = 4.950$; $SE = 0.042$; $p < 0.001$). As there was more than one outcome measured in each study, the software computed a combined measure based on a mean of all outcomes per study,

respecting the assumption of interdependence between outcomes from the same study, as data come from the same people.

Figure 14.

Figure 14. Forest plot



Meta Analysis

Source: Own elaboration with Comprehensive Meta-Analysis software (CMA)

The following image (Figure 15) illustrates the studies' weights and standardised residuals, clarifying how these values are considered under the fixed and random effect model. This emphasises the importance of using a random effect model, as it is more robust to outliers than the classical fixed effect model and, therefore, beneficial when dealing with a degree of variability. The weights used the estimate of the heterogeneity, as well as the within-study-variances, since the analysis is designed to recognise sources of variation.

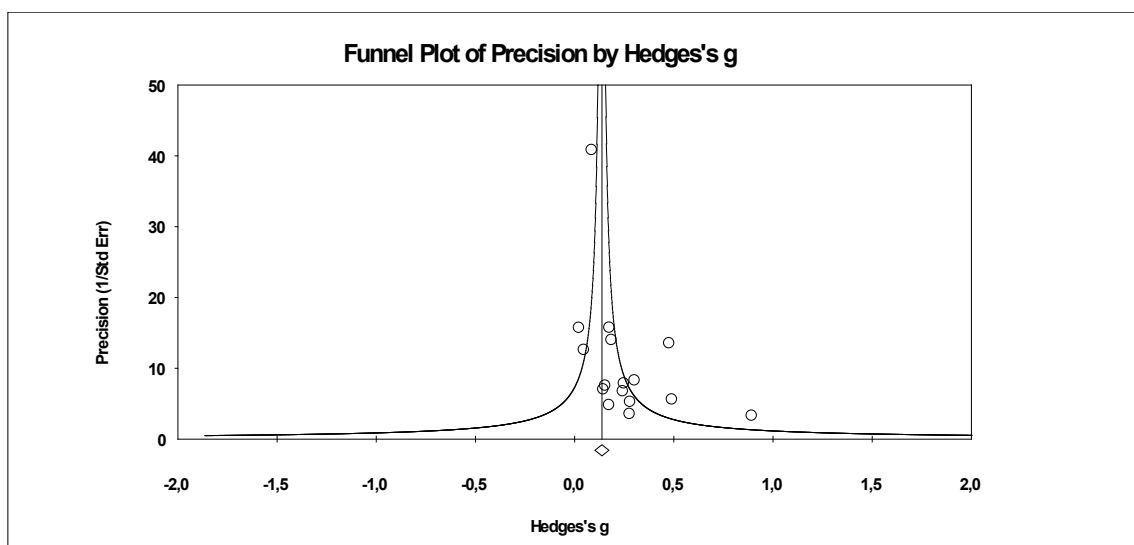
Figure 15. Weights and residuals

Model	Study name	Outcome	Hedges's g and 95% CI					Weight (Fixed)		Weight (Random)		Residual (Fixed)		Residual (Random)	
			-1,00	-0,50	0,00	0,50	1,00	Relative weight		Relative weight		Std Residual		Std Residual	
	Banos, et	Combined						1,61		5,17		0,04		-0,36	
	Baranowski	Combined						0,90		3,55		0,75		0,32	
	Beck-Larsen	Combined						1,86		5,61		0,12		-0,32	
	Cullen et al.	Combined						1,43		4,54		0,71		0,18	
	Enzenbach	Combined						6,35		9,15		0,68		-0,18	
	Fassnacht	Fruit & Vegetables						0,36		1,71		2,53		2,14	
	Jones,	Combined						9,02		9,69		0,60		-0,27	
	Joyner et	Combined						2,24		6,18		1,38		0,56	
	Moore et	Combined						2,01		5,86		0,88		0,23	
	Nollen et	Combined						0,42		1,93		0,50		0,22	
	Pedersen,	Combined						8,00		9,68		-1,92		-1,46	
	Rees &	Combined						5,15		8,63		-1,19		-1,19	
	Sharma et	Combined						0,76		3,12		0,17		-0,15	
	Silva et al.	Fruit & Vegetables						1,02		3,87		1,99		1,34	
	Struempfer	Combined						53,67		11,91		-3,15		-1,08	
	Yang et al.	Combined						5,94		9,00		4,73		1,99	

Source: Own elaboration with Comprehensive Meta-Analysis software (CMA)

To test for the presence of publication biases, multiple methods and estimates were used. A funnel plot by precision allows the visual analysis and detection of systematic biases of publications (Figure 16). A symmetrical funnel shape indicates absence of biases, showing all studies symmetrically distributed around the mean effect size. Large studies appear toward the top of the graph and tend to be closer to the mean effect size, on the other side; studies with smaller samples appearing near the bottom of the graph, usually presenting a more random variation around the effect size mean. In the presence of bias, an asymmetrical shape is achieved, presenting a higher concentration at the bottom of the graph on one side of the mean, more than the other side. As it is possible to observe in the present graph, there is a large concentration of studies around the average effect-size, showing more studies around the right side, than the left side.

Figure 16. Weights and residuals



Considering the assumption that studies that indicate a significant difference have higher probability to be published, this implies that some studies (with non-significant or negative results) are more difficult to find and have a lower probability of being included in a meta-analysis. Trim and Fill procedure builds on this idea, examining whether there are missing studies on the left or on the right of the summary effect, imputing the studies and recalculating the effect size. Duval and Tweedie's Trim and Fill method suggests 4 imputed studies, meaning that there is a low concern with missing studies, indicating low publication bias.

Begg and Mazumdar's rank correlation (Kendall's tau) reports the relationship between the standardised effect size and the variances (or standard errors). However, the power of the test is very low when there are a small number of studies ($n < 25$) (Begg & Mazumdar, 1994). Therefore, we opted for Egger's regression, though it also should be used carefully. This regression offers the degree of funnel plot asymmetry, measured by the intercept from regression of standard normal deviates against precision (Egger et al., 1997). It uses the actual values of the effect sizes and their precision, rather than ranks. Although, as a measure of asymmetry, the regression intercept lacks clear interpretation, being difficult to provide guidelines for interpreting the magnitude of the intercept, for this reason a common practice is to report the p-value of the Eggers' regression intercept, allowing a decision on the original null hypothesis (H_0 : no publication bias), as well as confidence interval values. Moreover, a number of studies discuss that 95% of confidence interval of the intercept of the regression line should go through the zero line, indicating there is no significant publication bias. The results indicate there is no evidence indicating a concern with publication bias ($p = 0.137$; IC: -1.018 to 4.354; $t = 1.26987$, $df = 14$). According to Rosenthal's failsafe N, the number of missing studies (with mean effect of 0) that would lower p-value to a non-statistically significant level would be 277. However, this method only considers statistical significance, rather than clinical significance, and assumes that the mean effect size in the hidden studies is null, when it could be negative, requiring fewer studies. It also combines p-values across studies, which is not considered the best practice today, meaning that this estimate should be used with caution as well.

A search for the causes of heterogeneity and evaluation of outliers was conducted and tested, as well as a subgroup analysis to further explore heterogeneity derivation. In this particular case, we believe variability was found mostly due to methodological reasons

(differences in the research design and interventions, namely regarding contents of the intervention, outcomes, duration and ICT used) and clinical reasons (differences in participants, interventions, type of food/ nutrition approached in the intervention).

Measurements in human and social sciences have an inherent natural heterogeneity, the main goal being to derive meaningful evidence and to be able to interpret results based on theory and pragmatically apply them in fieldwork. Theoretically, the group of studies included in this analysis falls under a specific category – health interventions using ICT to promote better nutrition habits. They have all undergone a straight inclusion criteria selection. However, these studies vary between them regarding: individuals age (though there is a specific age range criteria), different ICT used in the interventions and different media affordances thereof (TV, games/ videogames/ collaborative games, digital games, online/Internet, SMS/mobile, iPad/ computers), duration of the interventions (varies across studies), adding (or not) physical exercise to the intervention, as well as the type of food or nutrition habit approached in the intervention (promote healthy food consumption: brown bread, fruit, vegetables, wholegrain cereals, water, fibre; or reduce unhealthy food consumption: snacks, sugar, sugar sweetened-beverages, fat, salt, etc). These features influence heterogeneity. A sensitivity analysis (to outliers) revealed low power to explain this variability.

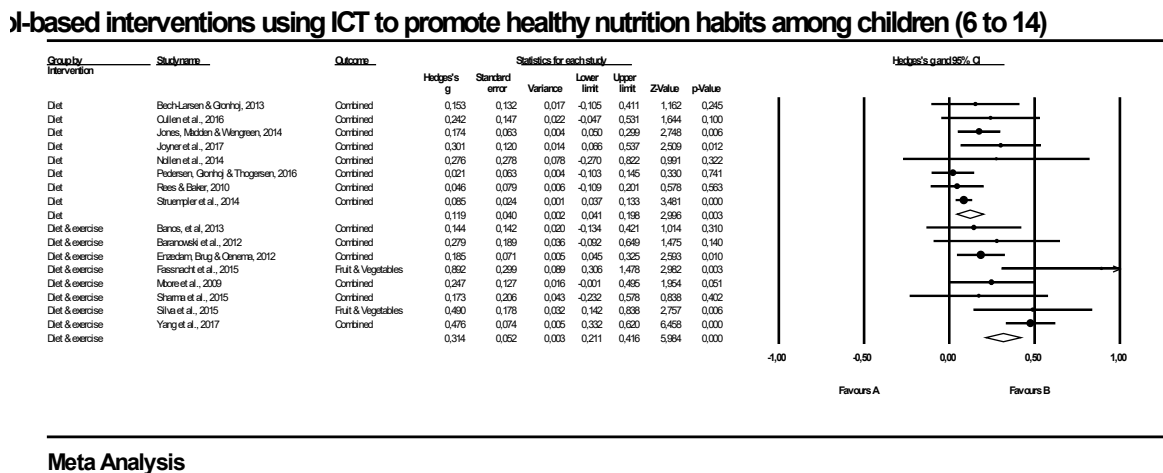
2.7. Subgroup analysis for heterogeneity exploration

A subgroup analysis was considered the best method to explore and explain the causes of heterogeneity and draw valid conclusions from the pooled treatment effect, allowing a better understanding of treatment effectiveness (Higgins et al., 2019; Richardson, Garner & Donegan; 2019). The subgroup analysis distinguished between studies in which the intervention focused only on nutrition (called “*Diet*” group), and studies where intervention focused on diet, but also including some kind of physical exercise (“*Diet&Exerc*”). *Diet* subgroup includes eight studies (3 674 participants in treatment groups, 2 806 participants in control groups) and *Diet&Exerc* subgroup includes eight studies (1 146 participants in treatment groups and 1 207 in control groups). When performing sub-group analysis, it is relevant to approach whether there is a statistically significant subgroup interaction, the covariate distribution of the subgroups, the plausibility and importance of the interaction (or lack of it) and the possibility of confounding factors (Richardson, Garner & Donegan, 2019).

A random effect model was used to combine studies within each subgroup. A fixed effect model was used to combine subgroups. The study-to-study variance is assumed to be

equal for subgroups, being computed within subgroups and pooled across subgroups. The following image (Figure 17) presents the forest plot obtained.

Figure 17. Forest plot



Meta Analysis

Source: Own elaboration with Comprehensive Meta-Analysis software (CMA)

For the *Diet* subgroup the mean effect size in Hedges's g is 0.119; with a CI of 0.041 to 0.198, a Z-Value of 2.996 and a corresponding p-value of <0.001. This indicates that this type of intervention has a low but statistically significant impact. For the *Diet&Exerc* subgroup Hedges's g is 0.314, with a CI of 0.211 to 0.416, a Z-Value of 5.984 and p-value of <0.001, indicating a moderate and statistically significant impact of the interventions. A sufficient number of studies were included in each subgroup, clearing any covariate distribution concern in this analysis. Also, theoretically and clinically, there is no evidence that there are any covariates or confounding factors associated with this subgroup analysis that should be considered.

The second group (*Diet&Exerc*) effect size indicates a higher impact, meaning that health interventions promoting nutrition habits would benefit from including physical exercise as well, within the interventions' activities. The test for subgroup differences suggests that there is a statistically significant subgroup effect of the type of intervention used ($p=0,003$). The subgroup effect is quantitative. Regarding heterogeneity, results indicate that a subgroup analysis is the most powerful method to analyse this sample data, as results indicate a lower and non-significant heterogeneity within each subgroup (subgroup *Diet*:

$Q = 4.685$; $df = 7$; $p = 0.330$; $I^2 = 0.748$; subgroup *Diet&Exerc*: $Q = 10.326$; $df = 7$; $p = 0.053$; $I^2 = 32.207$).

This result indicates that physical exercise can potentially work as a moderator variable, strengthening the effect of health interventions in this area. Meaning that health interventions using ICT to promote healthier nutrition habits would benefit from including physical exercise, reflecting in better results for nutrition. Although this analysis indicates a high plausibility that interventions using diet along with exercise are more effective, than interventions focusing on diet only, it would be beneficial to include more studies in each of the subgroups. A large sample would enable to better exploration and confirm these results. An interesting upgrading to this meta-analysis would be to perform a subgroup analysis based on outcomes and on type of ICT used in the health interventions. This would enable an understanding of the outcomes that would benefit from these interventions, as well as which ICT would have a higher impact. A larger sample, namely regarding ICT usage, would be necessary. However, for the moment when this analysis was conducted, there were not sufficient studies found, that fulfilled the required criteria for inclusion. Considering that we are living in an ever more mediatised environment, media is everywhere, and a substantial number of health interventions using ICT are being conducted at the moment, we believe that this will be possible in the future, and it would represent a powerful improvement to the present analysis.

2.8. Further data exploration

Subgroup analysis based on outcomes and on ICT used within the interventions were performed to further explore the data. The study sample measured a considerable list of outcomes, however only those that were measured in more than two studies were selected for analysis, even though this still represents a very small sample, meaning that results should only be understood as indicative, needing additional confirmation, and thus, used with caution. Fixed effect model was used when there is no concern with heterogeneity ($p < 0.05$). When heterogeneity was found, a random model was preferred.

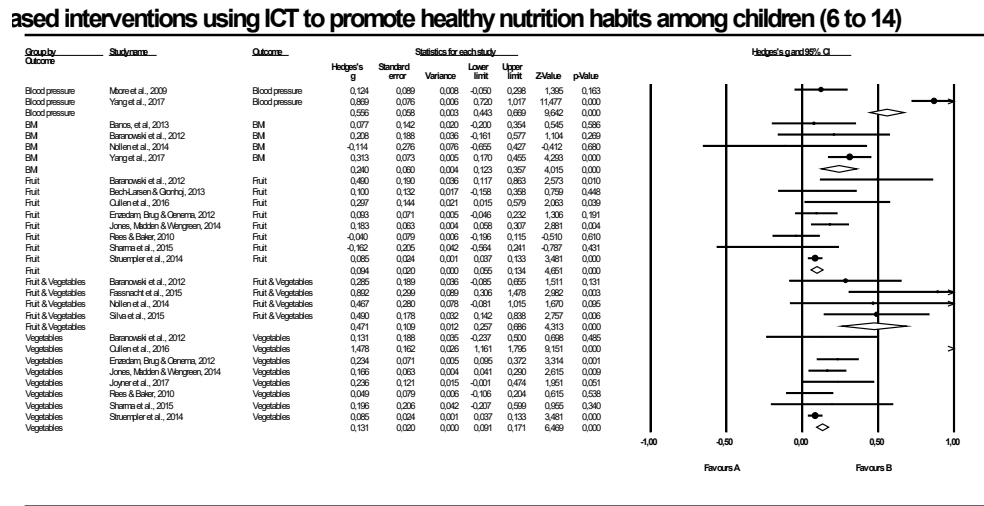
Results indicate that interventions using ICT to promote healthy nutrition among children (6 to 14) have a significant positive impact on:

- Fruit and vegetables ($g = 0.471$; 95% CI of 0.257 to 0.686; $Z = 4.313$; $p < 0.001$),
- Vegetables ($g = 0.287$; 95% CI of 0.125 to 0.449; $Z = 3.466$; $p < 0.001$),
- Fruit ($g = 0.094$; 95% CI of 0.055 to 0.134; $Z = 4.651$; $p < 0.001$),
- Blood pressure ($g = 0.505$; 95% CI of -0.200 to -0.809; $Z = 3.249$; $p = 0.001$)

- BMI ($g = 0.240$; 95% CI of -0.123 to -0.357 ; $Z = 4.015$; $p < 0.001$).

The following image (Figure 18) shows the forest plot obtained.

Figure 18. Forest plot



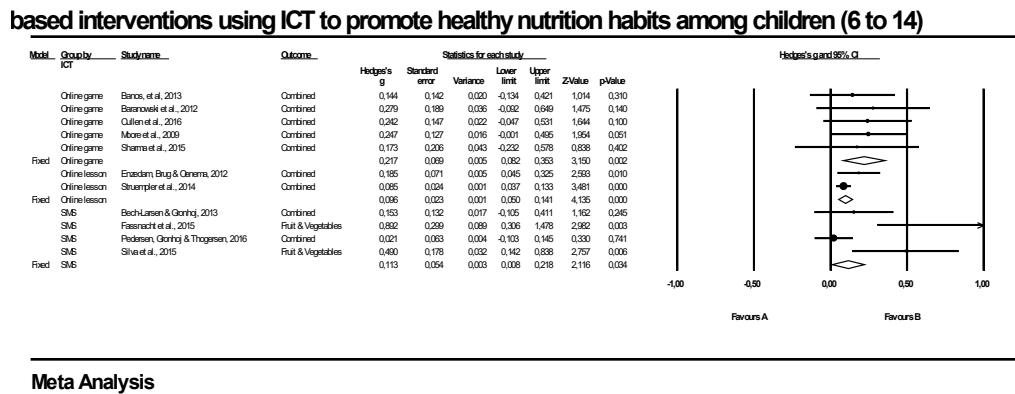
Meta Analysis

Source: Own elaboration with Comprehensive Meta-Analysis software (CMA)

A sub-group analysis based on the ICT used within the interventions was also performed to further explore the data. Nonetheless, as in the previous analysis, results are merely indicative and exploratory and should be used with caution, mostly due to the small number of studies that use the same ICT.

Data indicates that **online games** represent the ICT with higher significant effect to promote nutrition among children ($g = 0.237$; 95% CI of 0.331 to 0.705 ; $Z = 5.427$; $p < 0.001$), followed by **SMS** ($g = 0.195$; 95% CI of 0.031 to 0.358 ; $Z = 2.337$; $p = 0.019$); **online lesson** ($g = 0.096$; 95% CI of 0.050 to 0.141 ; $Z = 4.135$; $p < 0.001$). The following image (Figure 19) shows the forest plot obtained for the ICT group comparison.

Figure 19. Forest plot

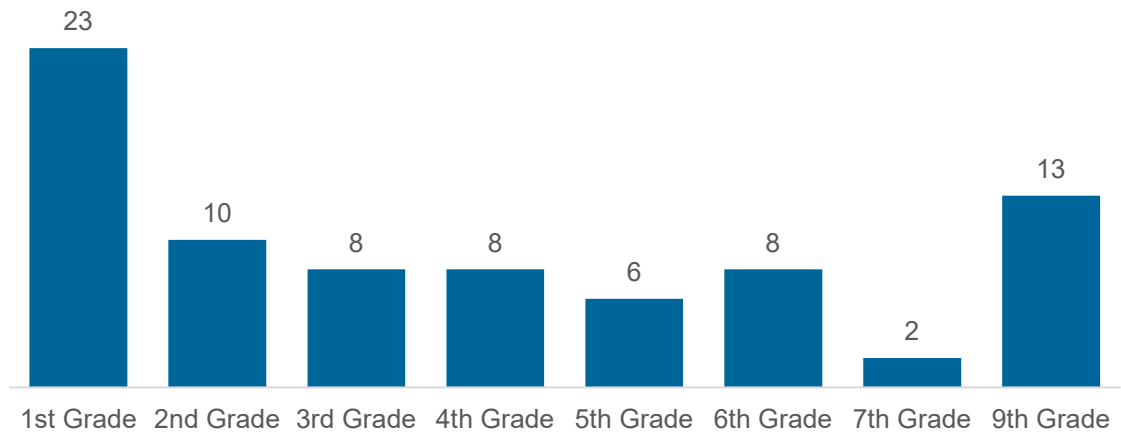


Source: Own elaboration with Comprehensive Meta-Analysis software (CMA)

STAGE 2 - STUDY 3. Surveys with parents on nutrition habits at school and school-based interventions to promote a healthy nutrition

The sample of this study comprises of 78 parents of school aged children, attending school from the 1st to the 9th grade. Most are female (92%) and only 8% are male. The sample is well distributed regarding the place of residence, with 64% living in big cities (n = 50), 23% living in small to medium cities (n = 18) and 13% living in small villages (n = 10). Regarding education level, most have a university degree (either bachelor's, master's, or doctoral studies) (62%, n = 48), followed by secondary school degree (33%, n = 26) and primary school (5%, n = 4). The following graph (Figure 20) shows the distribution of the children per school grade. Most attend the public school (80%, n = 62) while 12 attend a private school (15%) and four attend a semi-private school (5%). Regarding health problems, two children were diagnosed with a degree of autism (Asperger) and five were diagnosed with type 1 diabetes.

Figure 20. Sample distribution per grades

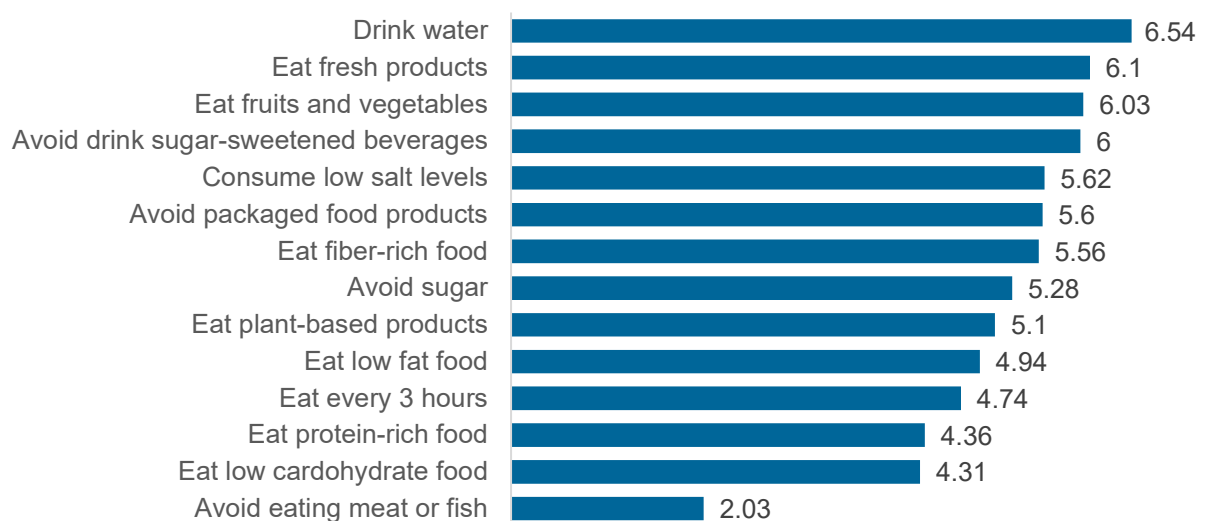


Source: Own elaboration with Excel

3.1. Nutrition knowledge, habits and practices at home and at school

Most parents considered drinking water, eating fresh food, F&V, fibre-rich food and avoid drinking SSB and eating packaged food as the central guidelines for a healthy nutrition, which shows parents are informed about what is healthy nutrition. In general, parents believe that their children's nutrition is healthier at home, than at school, showing an average level of 3.7 at home and 3.2 at school, in a Likert scale from 1 to 5. The following graph shows the level of agreement (mean) of parents (using a scale from 1 to 7) with sentences regarding what is healthy food habits food.

Figure 21. Parents' perspectives about what is a healthy nutrition



Parents shared that 'lack of time' (56% n = 44) and the 'high prices of healthy food' (59%, n = 46) as their top barriers to prepare healthier nutrition options. Furthermore, they also identified 'lack of ideas to cook healthy dishes' (27%, n = 21), 'difficulties in analysing and understanding the nutrients of each food product' (23%, n = 18) and 'difficulties in offering diversity' (23%, n = 18) as strong barriers for healthier nutrition at home.

Most parents explained that their children take snacks to school on a regular basis to eat during recess (n = 50), but usually do not take lunch (n = 64) as they eat in the school canteen. Regarding the snacks they take to school, most take fruit (n = 50), cookies (n = 40) and sandwiches (n = 32). Some take milk (n = 24) or flavoured yogurt (n = 20), cheese (n = 16) or chocolate milk (n = 16). Vegetables and natural yogurt were less frequently indicated (n = 7 each) (multiple choice question).

Parents showed a medium (neutral) satisfaction level with the food products given to their children at school, with an average of three on a scale from 1 to 5, as the following graph shows (Figure 22). Most parents explained that, even though their children are not overly concerned with healthy nutrition, they do show some concerns time to time and are aware that it is important to eat healthy (57%, n = 44), around two in ten said their children do not worry at all about eating healthy and one in ten explained that their children are not aware of this. Almost nine in ten explained that their children have studied nutrition at school before and 33% participated in school activities related to nutrition and 23% were involved at least once in these activities. Around 35% believed that the school has not organised activities related to healthy nutrition.

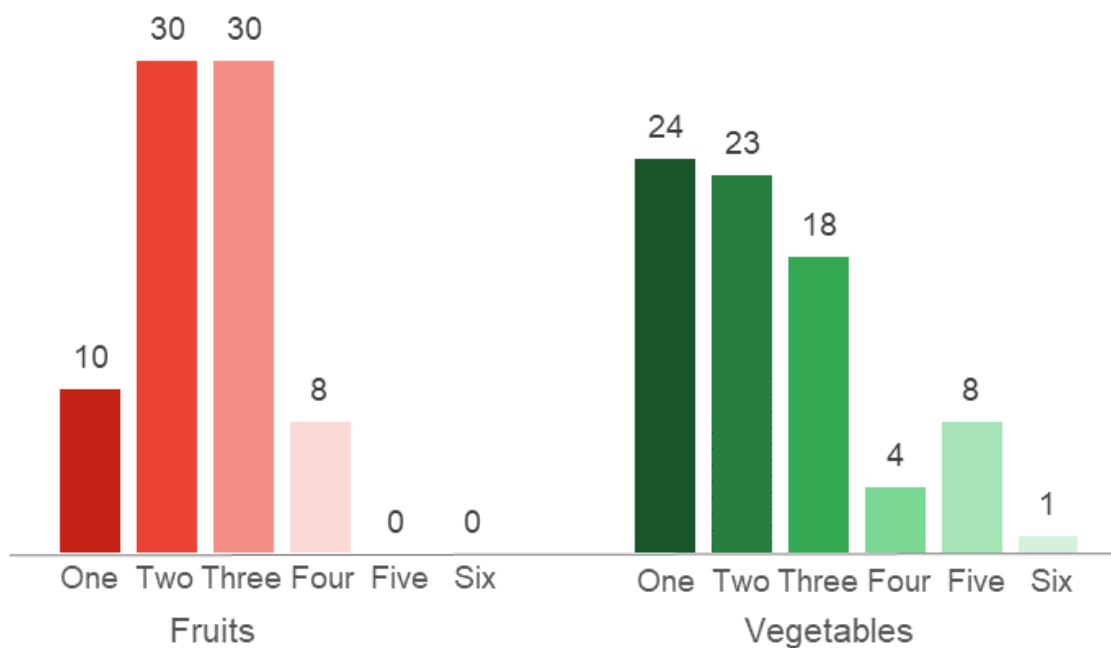
Figure 22. Parents' perspectives about food at school



Source: Own elaboration with Excel

Section 3 of the questionnaire was about eating behaviours and media and communication technologies usage. When asked about how many fruits and how many vegetables their children eat per day, most parents explained that their children eat between one to four fruits, with an average of 2.5 fruits per day and between one and six with an average of 2.1 vegetables per day.

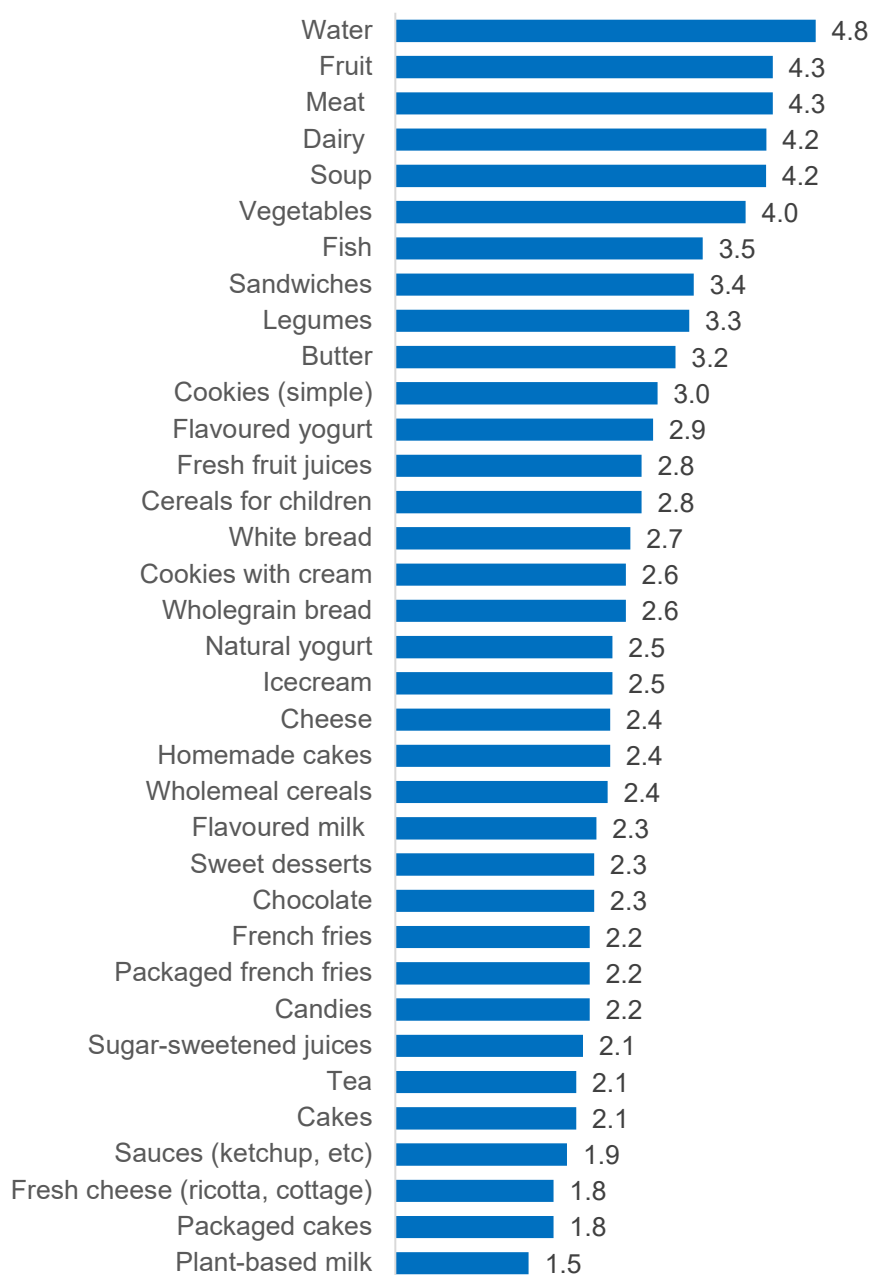
Figure 23. Parents' perspectives about their children eating habits regarding fruits and vegetables per day



Source: Own elaboration with Excel

Regarding food eating behaviours, whether children ate and how frequently on a scale from 1 to 5 (in which 1 means never and 5 means daily), parents indicated that their children frequently drink water and dairy milk or skimmed, and eat fruit, meat, dairy whole milk or skimmed, soup, vegetables, fish and sandwiches. Cookies, cereals, butter, bread and yogurts were also mentioned with a lower frequency, French fries, sweet desserts, sauces, candy, packaged cakes, and plant-based milk were mentioned less often. The following graph shows the values for each food product.

Figure 24. Parents' perspectives about their children food eating behaviours (in a scale from 1 to 5)



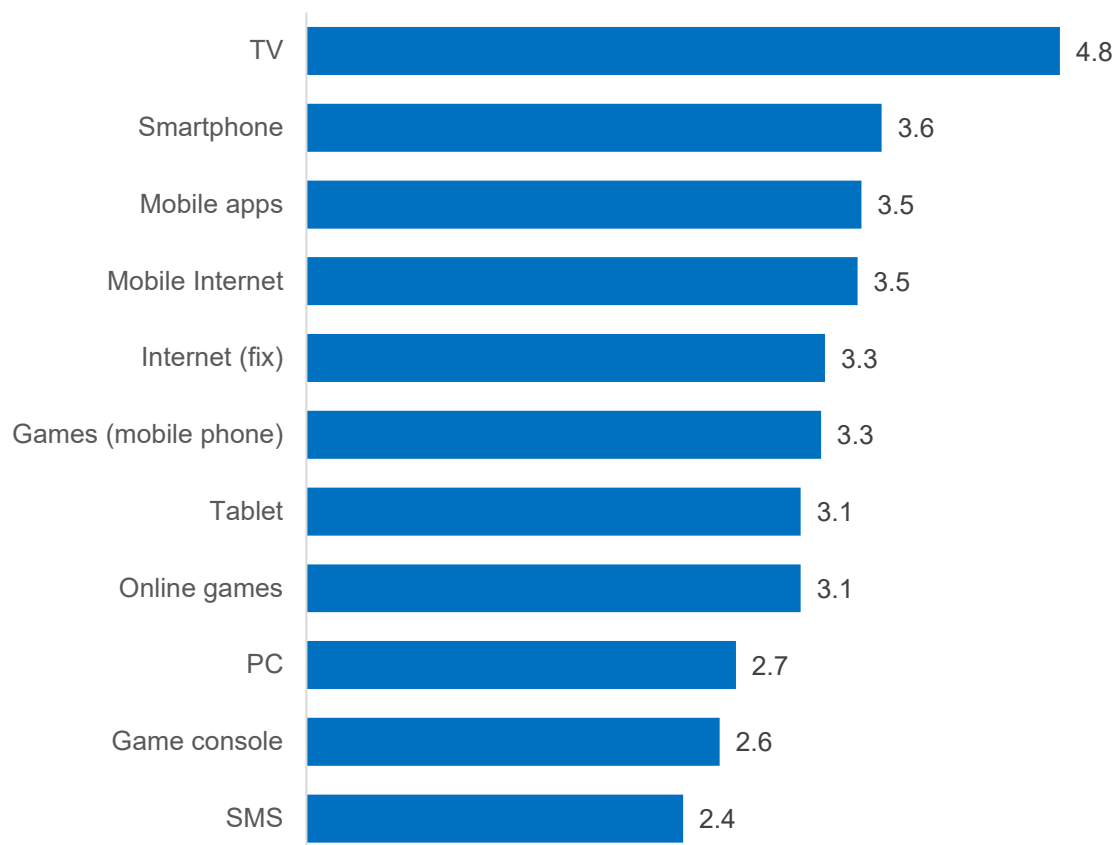
Source: Own elaboration with Excel

Parents were also asked which environment they considered having a stronger influence on their children's food choices. Very clearly, parents indicated the family (51%, n = 40), followed at a distance by their peers (18%, n = 14), the school (13%, n = 10) and content shared via media communication tools such as TV, the Internet, mobile apps, and games (13%, n = 10). Parents also explained that the influence from peers increases with age, with the older they are, the more influence their peers have on what they eat. Moreover,

in what concerns going to the supermarket and selecting/ buying food products, parents stated that they are the ones with decision power, allowing their children to choose food products in very limited situations (41%, n = 32). Some avoid taking children to the supermarket. When children go to the supermarket, they tend to show a stronger interest in choosing food for their breakfast, followed by afternoon snack, and they participate less in selecting food for lunch or dinner.

According to their parents, children use various media technologies on a daily basis, TV and smartphone being the most used. On a scale from 1 to 5, in which 1 meant they do not use it and 5 meant they use it daily, parents indicated their children's media usage. The following graph shows the average for each media technology identified. From the sample, more than four in ten children own a smartphone and more than six in ten own a tablet.

Figure 25. Parents' perspectives about their children media technologies daily usage
(on a scale from 1 to 5)



Source: Own elaboration with Excel

When asked whether media communication technologies could influence children's eating behaviour, on a scale from 1 to 10, the parents indicated they believe it has a strong influence, with an average of 8.3. Most parents (65%) revealed a concern with the effect of multimedia advertisements (TV, mobile apps), saying that it negatively influences their children's eating behaviours, promoting less healthy food as snacks, sweets or highly processed foods. A few (26%) believe that advertisements may have both a positive or a negative impact, depending on how it is planned and what it shows. Parents explained that using children's favourite cartoons or characters to inform them about healthy nutrition could be an effective way to promote healthy eating, as well as ads on their favourite games. Marketing is seen as a powerful tool to influence children's behaviour.

Parents also considered that health interventions could benefit from including media communication technologies to better promote healthier nutrition behaviours and engage children in a joyful entertaining way, with an average of 8.1 on a scale from 1 to 10. TV, Internet and games (on the PC, tablet or mobile phone) were the technologies identified as the most appropriate to work with children and deliver a health intervention focused on promoting a healthy nutrition.

STAGE 2 - STUDY 4. Analysis of news about nutrition at schools – an overview of the current situation

The sample of this study included 19 news articles from SABADO magazine. Some 12 articles were published in 2018 and seven were published in 2019. All articles cited sources of information and were of small to medium size (two pages maximum). The following table presents the news articles that are part of this study (Table 12).

Table 13. News articles selected for this study

Title	Year	Date of publication
Alimentos com mais açúcar, sal e gordura banidos da publicidade para crianças	2019	21/10/2019
Direção-Geral de Saúde quer crianças a comer melhor nas escolas	2019	15/07/2019
Escolas continuam a gastar milhares de euros em chocolates e bolos	2019	05/01/2019
Escolas públicas têm falta de nutricionistas, alerta Ordem	2019	19/10/2019
Guia prático: diga não às bolachas e cereais nos lanches da escola	2019	16/10/2019

logurtes, sumos e chocolates vão deixar de ser publicitados a menores	2019	23/07/2019
Lei que proíbe publicitar produtos prejudiciais para menores já não entra em vigor	2019	23/06/2019
Alunos comem em pé junto a caixote de lixo	2018	24/01/2018
Bastonária dos Nutricionistas critica falta de fiscalização nas escolas	2018	17/09/2018
Distribuição de alimentos recomeça nas escolas da UE	2018	03/09/2018
Escolas vão ter menu vegetariano	2018	10/08/2018
Legislação sobre refeições escolares é rigorosa, mas queixas persistem	2018	03/10/2018
Novas refeições escolares vão eliminar 50 toneladas de plástico	2018	21/07/2018
O que devem levar as crianças na lancheira para a escola?	2018	22/03/2018
O que vai mudar na alimentação nas escolas?	2018	31/07/2018
OMS felicita Portugal por esforços na promoção de alimentação saudável	2018	05/01/2018
Pais denunciam falta de comida em escolas de Braga	2018	01/10/2018
Parlamento aprecia 16 medidas sobre alimentação nas escolas	2018	18/07/2018
Publicidade para crianças sem refrigerantes e bolachas	2018	21/08/2019

Source: Own elaboration

4.1. Editorial and news coverage

These articles were published in the following sections of this magazine: Portugal (n = 9), Ciência & Saúde (n = 5), Última hora (n = 3), Vida (n = 1) e Europa (n = 1). Regarding their coverage, the scope of most articles was at a national level (n = 17), only two had a local scope. One article, despite focusing on the national level, addressed the European initiative of healthy food distribution at schools through the application of European funds and guidelines, focusing on the implementation of this measure in Portugal.

Table 14. News coverage

	News (19)
Local	2
Nacional	17

Source: Own elaboration

4.2. Sources of information

All news cited their sources of information. Essentially, these sources were official (n = 14), such as the WHO, National Directorate of Health (DGS) or National Directorate of

Education (DGE), European Commission, Ministry of Education, City Council, National Programme for the Promotion of Healthy Eating (PNPAS-DGS). Expert sources were also cited ($n = 7$), such as nutritionists, professionals in the field of education, school principals. In a smaller volume, documentary sources are cited, such as dispatches, newspapers, research studies, legal and political documents. Finally, other sources, which include citizens, parents and associations of parents of children attending primary school, catering companies (from school cafeterias). The categorisation of sources of information followed the proposed structure from Lopes et al.(2012). Each article cited, on average, only one source, with a reduced number of news pieces mentioning more than one source ($n = 5$). The following table presents the collected data (Table 14).

Table 15. Sources of information used in the news articles of the sample

Sources	News 19	Text references 97
Documentary	5	28
Legal Dispatch	1	2
Journals	1	1
Research studies	1	12
Legal and political documents	1	12
COSI - Nutritional surveillance system	1	1
Experts	7	21
Nutritionists	5	16
School Directors	2	3
Education professionals	1	1
Official	14	43
PNPAS-DGS	5	10
Ministry of Education	4	4
DGS	4	10
City Council	3	6
DGE	2	2
WHO	1	5
European Commission	1	2
Others	3	7

Source: Own elaboration

4.3. Place/ Setting

Most news focuses on the school setting. For kindergarten (three to six years old) and 1st grade (six to nine years old) there is a higher concern with the food products that are offered to children or that are available at the cafeteria. For the 2nd and 3rd grades (from ten to 14 years) the articles focus more on the relevance of promoting health literacy and having a safe food environment at school, talking about regulations and restrictions on unhealthy food advertising inside the school and its surroundings. Finally, six articles focus on school surrounding space, addressing nearby establishments selling food products, restaurants and advertising spaces. The following table (Table 15) presents the data.

Table 16. Place

Place	News (19)	Text references (84)
School	15	76
1st cycle	4	8
2nd and 3rd cycle	1	2
Kindergarten	5	9
High school	2	4
University	1	2
School surroundings	6	8

Source: Own elaboration

4.4. Main topics identified in the news

The main topics identified in the news disclosed the current concerns and portrait of the present situation regarding this topic. A vast number of news pieces reported on complaint, non-compliance with regulations and negative situations, presenting an unfavorable picture. However, a more in-depth analysis indicates that there has been a political, regulatory, social and ecological effort in this area in recent years. This effort is related to new implemented regulations, marketing restrictions of unhealthy food, promotion of healthy food environments, promotion of health literacy and food literacy, political, social and environmental concerns, school menus, quality and quantity of food products, better involving nutrition professionals in schools. The following table (Table 16) presents the topics identified.

Table 17. Main topics identified

Topics	News (19)	References (441)
Regulation and policies	16	173
Situational picture	10	46
Risk situation/ non-compliance	9	43
School canteens / menus	9	35
Inspection and evaluation	5	15
Marketing restrictions to food products	4	32
Public recruitment processes	4	19
Sale restriction of food products	4	8
Distribution of healthy food at school	3	10
Nutrition professionals at schools	3	10
What children should eat at school	2	17
Non-healthy food products available at school	2	7
Valuing cost over quality of food (food for schools)	1	6
Ecological concerns	1	5
European funding for healthy school meals	1	3

Source: Own elaboration

The main topic discussed was **regulation** (news that presented and discussed regulations), with 16 news items addressing this subject, revealing the political and regulatory efforts made in this field in recent years. Given the high amount of news articles on regulation, a section dedicated exclusively to this topic will further explore it in more detail.

The second most common reason is the **portrayal of the situation** (news that gave a situational picture and awareness of the current situation), with nine news articles reporting complaints and criticism and one portraying a compliment. The criticisms refer to complaints about the cafeteria, such as a lack of food, unhealthy food, (low) quality of products, aggression and discrimination during the lunch period, lack of cleanliness of the facilities, lack of professional supervision of school meals preparation (not involving nutrition professionals/ nutritionists) and public procurement specifications. Reference is also made to the little investment in training students to make healthy food choices, the existence of few nutritionists in schools in the preparation of week menus, and the difficulties and delays in implementing regulatory measures on the advertising of unhealthy food products and products available in vending machines. Although most of the news refers to negative

situations related to school cafeterias, there are also positive references – choosing healthy foods, offering a vegetarian menu and vegetable milk options, allowing freedom of diets and diversified food choices at schools. It is also argued that school menus should be prepared by nutritionists, although this is not current practice in many places.

The third most common topic, **risk situations and non-compliance** (news that addressed non-compliance with regulations and risky situation regarding food in schools), was identified in nine news articles, mainly referring to problems occurring in the cafeteria, the availability of unhealthy food items, the lack of supervision and the delays in the implementation of national regulations. The news reported that there is a lack of supervision on compliance with the stipulated norms and approved regulations, and that unhealthy food products (high in sugar or fat) continue to be sold to children at schools, even though regulation prohibiting is in place.

Five news articles focused on the issue of **supervision and inspection** processes of food available and offered at schools. These news addressed the evaluation of measures taken to implement policies and regulations, identification of difficulties in implementing regulations, and whether these are actually being implemented. There is also reference to the need for more nutrition professionals to participate, both in the processes of implementation and management of policies and regulation related to food, and in monitoring compliance with them.

Restrictions on selling specific food products is mentioned in four articles, as well as the restriction on the marketing and advertising of food products. These restrictions are discussed not only within schools, but also in the surroundings, thus having an impact on food court areas, cafes, bars and shops close by, or within school areas. These topics also include references to information and communication technologies (ICT), such as cinema, billboards, Internet, radio, social networks and television. The regulation addressed in these news articles dictates restrictions on the advertisement of food products with a high content of sugar, salt or fat at schools and in surrounding spaces (100 metres), including advertising posters, television or radio programs for children, advertisements that anticipate or take place up to 30 minutes after children's TV or radio programs, cinema (movies for children), on the internet (on websites dedicated to children and social networks). It is also explained that DGS (Directorate General of Health) is responsible for drawing up a list of food products that should guide this regulation, identifying the particular foods that are to be restricted inside schools and in the surroundings.

4.5. Food policies and regulations

As mentioned, most news articles (n = 16) talked about food policies and regulations related to the school setting and the surroundings. Food policies are a set of measures whose central objective is to guarantee and encourage access, or restriction, to certain foods, with the aim of improving the health and nutritional status of citizens. The following table (Table 17) presents the identification of themes, from the news articles, about the topic of regulation and policies (in particular, what was discussed within the topic of regulation).

Table 18. Food regulation and policies

Food regulation and policies	News (16)	References (129)
New regulation	6	29
Regulations to marketing	5	27
Regulation about restrictions/ prohibition	5	22
Non-compliance with regulations in place	5	16
Regulation on the sale of food products	4	10
School menus rules	4	7
Enforcement of regulation/ inspection to implementation	4	7
Regulation on vending machine food products	2	4
Rates and fees in the regulation	2	3
Local meals preparation (within schools)	1	3
Handbook for parents and educators	1	1

Source: Own elaboration

The most common topic discussed within regulation and policies is the launch of new regulations. In the year of 2018 and 2019 at least four new regulations were issued regarding nutrition at schools. The regulations mentioned in the news articles were:

- 1) Complementary regulation to support the distribution of fruits, vegetables and dairy products at schools (Portaria 113/2018, Diário da República No. 83/2018, series I);
- 2) Free distribution of fruits to preschoolers at schools (Order No. 7255/2018);
- 3) Restrictions on advertisements aimed at children under 16 years of age for foods high in salt, sugar, saturated or processed fat content (Law No. 30/2019, 23 April, 14th rectification to the Advertising Code – Law No. 330/90, 23 October).

4) Nutritional profile of foods (guide for the regulation on advertising restrictions) (Law No. 7450-A/2019 Diário da República No. 159/2019, 1st Supplement, Series II 2019).

The news articles addressed these regulations, their measures and implementation processes. There was a clear prevalence of content published on the regulation about food advertisement restrictions at schools and in the surroundings, when compared to other regulations. On this topic, some news also approached the delay of the DGS in drawing up the fundamental document on the profile of foods, which should guide the regulation on food advertisement.

Additionally, the news wrote about regulations that have their basis on prohibiting and restricting conditions, highlighting the strong focus of legislation on restriction and prohibition as a form of intervention, protection, and promotion of a safe and healthy environment in schools.

The issue of non-compliance with regulations in place is also frequent. In general, some news articles exposed particular situations in which the regulations are not being followed, namely in terms of food available versus food to be limited at schools. Some articles stated that schools continue to sell and display publicity on unhealthy food products within the school setting. Criticisms are mentioned about the products available to purchase at school's bars, vending machines and, in particular, lunch menus not following DGS guidelines.

In addition to these situations, some articles also addressed the DGS's delay in drawing up the necessary document to inform the regulation on food advertising, which resulted in non-compliance with this regulation until the release of the document.

4.6. Actions endorsed in the news

This theme focused on identifying the central objectives and necessary actions endorsed in the articles. Unsurprisingly, the promotion of healthy eating in schools appears as the most mentioned call for action in the news, having been addressed in 15 news items with 50 text references. Healthy eating is an overly broad term and includes a variety of other aspects, concepts and definitions. In general terms, the main identified need was to promote adequate and healthy nutrition in schools.

Secondly, and closely related with the first identified topic, the articles call for the need to structure and maintain healthy eating habits, pointing out the relevant role of schools in this regard. It is argued (in the articles) that healthy eating habits and routines should be created in childhood, in order to educate and create healthy eating patterns from an early

age. Healthy eating is seen as a regular eating pattern that is pleasurable and tasty, in opposition to strict dietary restrictions. It is also discussed that children with unhealthy eating patterns today will be adolescents and adults with inappropriate eating habits in the future, which will have repercussions on their health. Chronic diseases are commonly mentioned as associated with the maintenance of unhealthy eating habits over time, unhealthy nutrition practices being recognized as a strong risk factor for chronic diseases.

The food environment comes as the third discussion point, as it is possible to observe in the table (Table 15), which indicates a clear appreciation for this theme. As previously mentioned, the creation of a healthy surrounding environment, where access and publicity to unhealthy products is limited, and where healthy options are available, is a central aspect that has been considered efficient for working with children at schools. It is argued that schools should be safe places also in terms of food.

The fourth topic identified is behaviour change towards a healthy eating. This topic differs from the first topic (healthy eating) because it focuses on the process of change from risk behaviour reduction, risk awareness and adoption of healthier habits towards nutrition. This topic appeared always closely related to food environments and promotion of quality of life over time (health). It is discussed (in the articles) the relevance of a responsible and safe environment, focusing not only on the individual, but also and mainly on the social and cultural contexts in which the individual is included. The environment is crucial to change behaviours towards healthy nutrition, in children. For instance, the type of food products that are available, the cost of the food products, the publicity and information about those products are relevant factors that can, or not, promote consumption.

To increase the quality of food products at school is a frequently mentioned concern. It is argued that the food products offered to children at school should be healthy, but also appealing and tasty. The articles discuss the importance of working on the beliefs that healthy food is tasteless, bland food. On the contrary, it is argued that healthy food is also tasty to the mouth and attractive to the eyes. Moreover, it is stated that nutrition professionals should supervise food products, from the selection process of the products to the preparation, cooking and conservation. In this category, reference is also made to the public recruitment of canteen catering companies for preparing food for schools and the preference given to cost, in detriment of product quality, often practiced by these companies. Experts interviewed in these articles mentioned a preference for local cooking (in the schools), instead of procuring external services. Local cooking avoids pre-heating and massive use of plastics, allowing the selection, preparation, cooking and conservation of food to be closely monitored. Noteworthy, a clear environmental and ecological concern was expressed in the

news, not only about the reduction of plastic associated with meals transported to school by external companies, but also about the importance of searching for local and seasonal food products, respecting the seasonality and availability of natural foods.

The objective of promoting community empowerment and health literacy, particularly for students, but also for teachers, educational staff, cafeteria employees, technicians, chefs and food assistants working at schools appears in fifth place. It refers to the ability of those involved to obtain, process and understand information about food and nutrition, to make conscious and appropriate choices and to awaken a critical and autonomous spirit in decisions related to food and health. The news mentioned that little is done to promote students' skills to make food choices, to be autonomous and responsible in regard to their nutrition. On the other hand, some news items talk about a new intervention programme that will be launched at schools to promote healthy nutrition habits in the school context and foster children and school staff in food literacy.

Table 19. Actions endorsed in the news

	News (16)	Text references (129)
To promote healthy eating	15	50
To structure eating habits	11	23
To promote healthy food environments	8	28
To promote behaviour change (towards healthy eating)	8	17
To increase product quality	6	9
To foster community empowerment/ health literacy	5	9
To develop sustainable, organic, local agriculture	3	6
To increase the hiring of nutrition professionals	3	6
To promote food security	3	4
To fight overweight	2	5
To combat social inequalities	2	7
To involve the children (participatory approaches)	2	3
To recruit surveillance/ inspection teams	2	4
To engage the community - parents, teachers, students	1	2
To have larger multidisciplinary teams at schools	1	2

Source: Own elaboration

4.7. Intervention/ proposed actions

In the thematic analysis conducted of the news articles that are part of the sample for this study, the theme intervention/ forms of interventions emerged as largely discussed. The table below (table 19) shows the topics identified here.

Table 20. Proposed actions/ intervention forms

	News (16)	References (129)
Ensure compliance with regulations	9	16
Regulatory restrictions on food products	8	27
Changing behaviours in food preparation	7	16
Better engage nutritionists at schools	5	9
Food environment	3	6
Education / training / food literacy	3	5
Food products available at schools	3	10
Tax approaches	2	3
Supply chains	2	3
Surveillance	2	2
Involve school community	1	1
Improve physical spaces	1	2
Promotion of physical activity	1	1

Source: Own elaboration

In first place, the need for a stronger intervention focused on assessment strategies and certification of compliance with regulations is suggested many times, regulations are not followed in full. According to the president of the nutritionist's national association, the government worked quite well in the elaboration of regulatory norms, but there is a deficient implementation of those norms that require a stronger supervision and support. As explained previously, some articles stated that many schools continue to offer what is considered unhealthy food products, which are high in sugar, salt, saturated or processed fats. Some experts indicated that the Ministry of Education is already preparing intervention teams, created for this purpose. Aligned with this, some experts' opinion is that the best way to move forward is based on the creation of safe and healthy food environments inside schools and in the surrounding places that facilitate healthy food habits. In this way, the responsibility of practicing healthy food habits at school is shared between different agents, not relying only on the students.

To change the way food products are selected, prepared and cooked was also considered a relevant measure to improve healthy eating at schools. Some experts mentioned the need to reduce the amount of salt used in food preparation, reduce the availability of sugary products and saturated fats, encourage local food products, natural foods, such as fruits and vegetables, include vegetarian options that do not need to be ordered in advance, provide appealing and tasty healthy dishes, guaranteeing the quality of food, prefer local, organic, seasonal food.

Another much-discussed measure concerns a stronger involvement of nutrition professionals in schools, with different responsibilities, such as the inspection of compliance with national regulations, creation of lunch menus, assessment of food quantities, food selection and preparation, elaboration of tasty and appealing menus, follow-up on the purchase of food products, the development of nutrition behaviour change programs that involve the school community.

Other equally important, but less frequent measures were also discussed in the news articles, such as the promotion of food health literacy and the empowering of communities and citizens to take informed decisions about their nutrition, from being able to read food labels to understanding nutritional needs; fiscal approaches (fees) for unhealthy foods; better involve health centres and health professionals in the school setting; supervision and improvement of supply chains; surveillance of students' health by measuring physical indicators such as weight or body mass index; promotion of physical exercise and workout programs at schools besides the common physical education class; increase the number of physical education classes per week; improve food spaces at school such as cafeterias and canteens; involve the school community in the process of promoting a healthy diet.

STAGE 3 - STUDY 5. School-based health intervention on healthy nutrition with children aged 8 to 12 years: promoting the increase of fruits and vegetables and the decrease of sugar-sweetened beverages consumption among students

The intervention involved 67 students from 4th, 5th and 6th grade, aged 8 to 12 years (n=67, mean=10, SD=0.873) attending *Real Colegio de Portugal*, located in Lisbon, Portugal. There was no drop-out rate from baseline to endline assessments. The following table (Table 20) shows the distribution of participants per group.

Table 21. Distribution of participants per experimental group

	Control	Treatment 1	Treatment 2
N	25	20	22
Grade	6 th grade	4 th grade	5 th grade
Median age	11	9	10
Sex	M=16, F=9	M= 13, F=7	M=9, F=13

Source: Own elaboration

Differences between baseline and endline assessments

Differences between pre and post tests were analysed and reported for each outcome measure - nutrition knowledge, food label literacy, actual behaviour (frequency of F&V and of SSB consumption and 24-hour recall strategy), barriers to change, self-efficacy, and lastly, nutrition self-care. Non-parametric tests were used due to sample size and absence of Normality distribution in most cases ($p < .05$). A 95% confidence level was used in this analysis.

Nutrition knowledge: Experts, Food groups, General knowledge

A descriptive analysis indicated an increase in the scores achieved from pre-test to post-test in all experimental groups for both parts of the nutrition knowledge questionnaire. A Wilcoxon Signed Rank test confirmed these increases were statistically significant in all groups for all parts of the survey (Part A – Experts: control: $Z = 3.62$, $p < .001$; treatment 1: $Z = 3.72$, $p < .001$, treatment 2: $Z = 3.43$, $p < .001$; Part B – Food groups: control: $Z = 2.82$, $p = .005$; treatment 1: $Z = 2.18$, $p < .030$, treatment 2: $Z = 3.75$, $p < .001$ Part C – General knowledge: control: $Z = 2.30$, $p = .022$; treatment 1: $Z = 3.04$, $p = .002$, treatment 2: $Z = 2.98$, $p = .003$) (Table 21).

Table 22. Descriptive and inferential analysis for nutrition knowledge

Nutrition knowledge - Experts			
	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)

Control	5.00 / 2-8	7.00 / 4-10	3.62 / <.001*
Treatment 1 - Posters	5.00 / 1-8	7.00 / 5-10	3.72 / <.001*
Treatment 2 - Digital games	5.00 / 1-8	7.00 / 3-9	3.43 / <.001*
Nutrition knowledge – Food groups			
	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)
Control	10.00 / 2-20	11.00 / 2-20	2.82 / .005*
Treatment 1 - Posters	9.00 / 4-13	10.50 / 4-19	2.18 / .030*
Treatment 2 - Digital games	10.00 / 4-13	13.00 / 4-20	3.75 / <.001*
Nutrition knowledge – General knowledge			
	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)
Control	2.00 / 0-3	2.00 / 0-5	2.30 / .022*
Treatment 1 - Posters	1.00 / 0-4	3.00 / 1-5	3.04 / .002*
Treatment 2 - Digital games	2.00 / 0-3	2.00 / 1-4	2.98 / .003*

* Statistic differences for the significance level of 0.05

Source: Own elaboration

Food label literacy

A descriptive analysis indicated an increase in the scores achieved from pre-test to post-test in all experimental groups, which was relatively higher for the treatment group 1 and treatment group 2. The following table (table x) shows the data. A Wilcoxon Signed Rank test indicated that scores were statistically significantly higher from pre-test to post-test in all groups (control: $Z = 2.95$, $p = .003$; treatment 1: $Z = 3.64$, $p = .001$, treatment 2: $Z = 3.53$, $p = .001$) (Table 22).

Table 23. Descriptive and inferential analysis for food label literacy

Food label literacy			
	Pre-test	Post-test	Wilcoxon test

	(Mdn / range)	(Mdn / range)	(Z / p)
Control	4.00 / 2-8	6.00 / 2-10	2.95 / .003*
Treatment 1 - Posters	3.00 / 0-6	8.00 / 2-16	3.64 / <.001*
Treatment 2 - Digital games	4.00 / 0-8	8.00 / 4-10	3.53 / <.001*

* Statistic differences for the significance level of 0.05

Source: Own elaboration

Nutrition self-efficacy

A descriptive analysis indicated that students in all experimental groups performed better in the post-test than in the pre-test, showing increased levels of self-efficacy, as it is possible to observe in the following table (table 20). A Wilcoxon Signed Rank test indicated that post-test scores were statistically significantly higher than pre-test scores in the treatment 2 group – digital games ($Z = 1.77$, $p = .043$), indicating that children in this group significantly increased their self-efficacy after the interventions (Table 23).

Table 24. Descriptive and inferential analysis for nutrition self-efficacy

Nutrition self-efficacy			
	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)
Control	29.00 / 20-33	29.50 / 24-36	1.77 / .076
Treatment 1 - Posters	28.00 / 22-33	29.50 / 22-34	1.86 / .063
Treatment 2 - Digital games	28.50 / 18-34	30.50 / 22-38	1.77 / .043*

* Statistic differences for the significance level of 0.05

Source: Own elaboration

Barriers to change

A descriptive analysis indicated that students in both treatment group 1 and treatment group 2 had better scores, than students in the control group. The following table shows the data achieved in this analysis, both descriptive values and test statistic values (standardised). A Wilcoxon Signed Rank test indicated that post-test scores were statistically significantly better than pre-test scores for the treatment group 1 – poster and flyers ($Z = 2.03$, $p = .045$) (Table 24).

Table 25. Descriptive and inferential analysis for nutrition barriers to change

Barriers to nutrition change			
	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)
Control	31.00 / 20-40	30.00 / 20-40	0.10 / .920
Treatment 1 - Posters	29.00 / 18-35	30.00 / 21-42	2.03 / .045*
Treatment 2 - Digital games	29.00 / 21-37	30.00 / 22-40	1.12 / .265

* Statistic differences for the significance level of 0.05

Source: Own elaboration

Nutrition self-care

A descriptive analysis indicated an increase in the scores achieved from pre-test to post-test in all experimental groups for nutrition self-care practices. A Wilcoxon Signed Rank test confirmed these increases were statistically significant in the treatment group 1 – posters (control: $Z = 2.86$, $p = .005$) and in the treatment group 2 – Digital games (control: $Z = 2.00$, $p = .045$), indicating that students in these groups have significantly increased their nutrition self-care practices after the intervention (Table 25).

Table 26. Descriptive and inferential analysis for nutrition self-care

Nutrition self-care			
	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)
Control	149.00 / 53-195	150.00 / 76-202	0.14 / .886
Treatment 1 - Posters	134.00 / 67-225	153.00 / 89-213	2.86 / .005*
Treatment 2 - Digital games	130.00 / 98-183	144.00 / 113-195	2.00 / .045*

* Statistic differences for the significance level of 0.05

Source: Own elaboration

Actual behaviour - Frequency of fruits, vegetables and of sugar-sweetened drinks consumption

A descriptive analysis indicated that, in general, students in all experimental groups performed better in the post-test than in the pre-test, indicating an increase in F&V and decrease of SSB consumption. However, a Wilcoxon Signed Rank test indicated this increase was only statistically significant in the treatment group 2 – digital games for fruits ($Z = 2.15$, $p = .032$), for vegetables ($Z = 1.97$, $p = .049$) and for SSB ($Z = -2.53$, $p = .012$). The following table (Table 26) shows the descriptive values (median and range) and the test scores achieved in the analysis.

Table 27. . Descriptive and inferential analysis for actual behaviour measured with a frequency questionnaire

Frequency of fruits consumption			
	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)
Control	4.5 / 0-7	5.0 / 2-7	0.40 / .689
Treatment 1 - Posters	5.0 / 0-7	5.0 / 0-7	0.72 / .474
Treatment 2 - Digital games	5.0 / 1-7	7.0 / 2-9	2.15 / .032*
Frequency of vegetables consumption			
	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)
Control	3.0 / 1-7	3.0 / 0-7	1.15 / .252
Treatment 1 - Posters	3.0 / 0-7	3.0 / 0-7	0.59 / .557
Treatment 2 - Digital games	2.5 / 1-7	3.0 / 1-7	1.97 / .049*
Frequency of sugar-sweetened beverages consumption			
	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)
Control	2.0 / 0-4	2.0 / 0-4	-1.29 / .197
Treatment 1 - Posters	2.0 / 0-4	1.5 / 0-3	-1.41 / .157
Treatment 2 - Digital games	2.0 / 0-4	1.5 / 0-3	-2.53 / .012*

* Statistic differences for the significance level of 0.05

Source: Own elaboration

Actual behaviour – 24-hour recalls

The 24-hour recall was conducted for both 'yesterday', which represented a weekday, and Saturday (a weekend day). The following table (Table 27) presents the descriptive and inferential results achieved in this analysis. In general, students slightly performed better from pre-test to post-test, which sometimes is not observed in the median score, but in the range values, showing higher minimum and maximum values. A Wilcoxon Signed Rank test indicated that post-test scores were statistically significantly higher than pre-test scores for:

- 1) Fruits consumption yesterday and Saturday in the treatment 2 group – digital games ($Z = 1.98$, $p = .048$; $Z = 2.08$, $p = .038$).
- 2) Fruits consumption Saturday in the treatment 1 group ($Z = 2.17$, $p = .030$).
- 3) Vegetables for both yesterday and Saturday in the treatment 2 group – digital games ($Z = 2.07$, $p = .039$; $Z = 2.95$, $p = .003$).

Table 28. Descriptive and inferential analysis for actual behaviour measured with 24-hour recall

Fruits consumption						
	Yesterday			Saturday		
	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)
Control	1.0 / 0-3	1.0 / 0-3	0.83 / .405	1.0 / 0-3	1.0 / 0-3	1.07 / .285
Treatment 1 - Posters	2.0 / 0-4	2.0 / 0-6	0.53 / .593	1.0 / 0-7	2.0 / 0-8	2.17 / .030*
Treatment 2 - Digital games	2.0 / 1-4	2.0 / 0-6	1.98 / .048*	2.0 / 0-3	2.0 / 0-4	2.08 / .038*
Vegetables consumption						
	Yesterday			Saturday		
	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)
Control	1.0 / 0-3	1.0 / 0-2	1.85 / .064	0.5 / 0-3	1.0 / 0-3	1.51 / 0.130
Treatment 1 - Posters	1.50 / 0-5	2.0 / 0-5	1.51 / .130	0.0 / 0-5	1.0 / 0-5	2.67 / .049*

Treatment 2 - Digital games	1.0 / 1-3	2.0 / 1-3	2.07 / .039*	0.0 / 0-4	2.0 / 0-3	2.95 / .003*
Sugar-sweetened beverages consumption						
	Yesterday			Saturday		
	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)	Pre-test (Mdn / range)	Post-test (Mdn / range)	Wilcoxon test (Z / p)
Control	0.0 / 0-2	1.0 / 0-2	0.88 / .377	1.0 / 0-2	1.0 / 0-2	0.88 / .377
Treatment 1 - Posters	0.50 / 0-2	1.0 / 0-3	0.37 / .714	1.0 / 0-3	1.0 / 0-3	0.37 / .714
Treatment 2 - Digital games	0.0 / 0-1	0.0 / 0-2	0.78 / .439	1.0 / 0-4	1.0 / 0-3	0.78 / .439

* Statistic differences for the significance level of 0.05

Source: Own elaboration

Differences between groups (control, treatment 1 and treatment 2) at baseline and endline assessments

Regarding socio-demographic variables, no statistically significant differences were found between the groups for sex ($\chi^2(2) = 3.339$, $p=0.188$). Unsurprisingly, significant differences at a 95% confidence level were found for age, considering each group belongs to a different grade, as explained before ($\chi^2_{KW}(2) = 52.393$, $p = 0.001$).

Regarding outcome variables assessed at baseline and endline, no statistically significant differences between groups at baseline and at endline assessments were found, except for the outcome variable food label literacy at post-test ($\chi^2_{KW}(2) = 13.69$, $p = .001$). Post-hoc pairwise comparison tests using Bonferroni correction for multiple tests indicated that the differences were found between 6th grade and 4th grade (6th grade: Mdn = 6, 4th grade: Mdn = 6) and between 6th grade and 5th grade (6th grade: Mdn = 6, 5th grade: Mdn = 8). This result shows that, even though in this outcome variable there were significant increases from pre to post-test assessment in all groups, treatment group 1 and treatment group 2 had significant higher increases when compared with the control group. The following table (Table 28) presents median scores, statistic test value and p-value for the pairwise comparisons.

Table 29. Descriptive and inferential analysis

Food label literacy

	Pre-test (Mdn / range)	Post-test (Mdn / range)	Pairwise comparison test (Z / p)
Control – Treatment 1	4.00 – 3.00	6.00 – 8.00	2.51 / .012*
Control – Treatment 2	4.00 – 4.00	6.00 – 8.00	3.57 / <.001*
Treatment 1 – Treatment 2	3.00 – 4.00	8.00 – 8.00	-0.94 / .250

* Statistic differences for the significance level of 0.05

Source: Own elaboration

IV. Discussion

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STAGE 1 - STUDY 1. Rethinking health behaviour change models from an integrated perspective

The field of health BC comprises of many theories and models. One of the challenges is how to select and apply the most appropriate one to a specific intervention. A conscious decision would need to be based on thorough knowledge of existing theories. However, that seems like a discouraging challenge when researchers face the prospect of more than 80 different theories to examine before starting to plan and design an intervention.

Literature has already indicated that many theories and models are complementary and inter-related (Michie et al., 2014; Fishbein, 2000). Complementarity arises when strengths from one theory help fulfil limitations of others. Moreover, theories complement each other when they focus on distinct phases of the process or different elements, bringing value to the field, and incorporating ideas from each other. For instance, *TBP* supports the identification of relevant factors to take into consideration when developing an intervention but ignores individual needs prior to engaging in a behaviour. It does not integrate the role of individual emotions, intentions, or self-control, which would certainly add value. Another example is *TTM* that includes self-efficacy, deriving from *SCT*, but lacks clear lines between stages within the process. *TRA* and *TPB* have been criticised for paying little attention to subjective norms and self-efficacy and to the gap between intention and behaviour. These theories would benefit from integrating others that more profoundly address that stage. Other aspects concern the difference between rational or emotional beliefs (DeVries, 2017; De Nooijer, Lechner & DeVries, 2003), being relevant to also include emotional beliefs in BC models. Moreover, some theories are based on drawing a path between constructs, and others on defining stages of change and constructs within each stage.

Theories are inter-related, not only because all are part of a major science domain called BC, but mainly because they are built from one another. They are commonly based on previously elaborated theories and bring new elements contributing to the process. Each theory reflects the cumulative knowledge in each given period in time, improved by empirical testing, observation, learning and experience. A new theory always builds from the existing knowledge. Experimenting generates new data, which in turn stimulate innovative ideas, new

paradigms, frameworks, and ultimately new theories. Therefore, theories are not majorly different from each other, nor competing. They are mainly complementary, and many can even be considered overlapping. The *SCT* theory, for example, was developed from the *SLT*, incorporating self-efficacy and new ideas on how the process of BC is accomplished. The *TPB* resulted from the *TRA*, including new concepts such as perceived behaviour control, which resulted from the *Self-Efficacy Theory (SET)* and the *SCT*.

A common concern about integrating theories is that it may result in a theory of everything (DeVries, 2017), a global theory with a low predictive power, or a very complex theory, as it involves more constructs and determinants of behaviour. It can be difficult to understand which theory is more powerful and which one better explains the variance in the model. However, as mentioned before, integrating theories requires using an analytical and critical process. This process would result in better theories and reduced complexity in the field.

The present work conducted an analytical review of the central theories in this field, building from complementarity, verifying from overlaps, and overcoming limitations from dissimilarities and interconnectedness. The final goal of this work was to propose an integrative framework in an operational way, by developing an analytical tool to guide future interventions. This tool was developed having as groundwork the analysis conducted by Michie et al. (2014) on the interconnectedness between theories, which originated a list of the main original theories in this field (which accounted for 63% of all articles identified) to which four additional theories were included (accounting for more 12% of the studies). In the first step of the development of this tool, theories were analysed in accordance with their own contribution to the field, how the process of BC was described and the relevant constructs to move in the path of BC towards the intended health behaviour. Both complementarity, intersection, overlaps, gaps, and limitations were explored in an attempt to bring value from the whole. The final tool offers an integrative approach that follows the structure of the TTM to integrate the theories accepting BC process as an evolution of stages. In each stage, specific constructs were included, following the original theories, as relevant to progress to the next stage. This guides on the important constructs, in each stage, that are relevant to act on to promote evolution in the BC process. This work is not a theory or a framework. It is an integrated perspective that operationalises the main theories in the field, how they are connected and complement each other, offering a schematic visualisation and recommendations on the main constructs to focus on when planning an intervention.

STAGE 1 - STUDY 2. Systematic literature review and meta-analysis: school-based interventions using media technology to promote healthy nutrition habits among children aged 6 to 14 years

The main purpose of this study was 1) to map existing studies that conducted a school-based healthy nutrition intervention using communication technologies to deliver the intervention contents, 2) to review the main theoretical frameworks, the outcome variables, instruments, technologies and methodological aspects in these studies, and 3) to synthesised the best available evidence on the impact and effectiveness of these interventions. A more structural objective of this study, and the reason why it was conducted in under this PhD work, was to review these aspects to better inform the design and research of a new intervention, which was the last outcome (study) of this thesis. A systematic literature review and meta-analysis were the methods chosen to achieve the aforementioned objectives.

The results from this systematic literature review and meta-analysis inform relevant findings and useful insights for health prevention interventions using communication technologies in the area of nutrition. Data extracted from the studies indicated positive outcomes, demonstrating significant low to moderate increases in nutrition knowledge and intake of healthy food (vegetables, fruit, wholegrain cereals, fiber, brown bread), decreases of unhealthy food (sugar sweetened beverages, high calorie snacks), decrease of anthropometric measures (BMI, blood pressure).

The school-based health promotion interventions included in this study fostered healthy eating among children aged 6 to 14. Healthy eating or having a healthy nutrition is an overly broad term which is not defined by a single food or action. In fact, it includes a variety of foods and nutrition practices (COSI, 202; WHO, 2021). For this reason, different interventions promoted healthy eating in diverse ways - some promoted the intake of healthy food; others included portions sizes and food groups; others promoted knowledge about healthy eating, considering knowledge as a predictor of behaviour; others focused on food literacy, food label literacy, and nutrition practices, and others on physical and psychological outcomes. Indeed, most studies measured outcome variables as nutrition intake (V&G, brown bread, water, sugar-sweetened beverages); nutrition knowledge and literacy; anthropometric indices (blood pressure, height, weight, BMI) and psychological outcomes (self-efficacy, beliefs, cognitive and emotional factors). In more detail, from the sample of 16 studies, 11 interventions promoted healthy eating by increasing the intake of F&V; one study

fostered brown bread, wholegrain cereals and F&V eating, two focused on reducing sugar, SSB, and one included water consumption; three studies focused on general healthy eating and nutritional practices; two focused on promoting nutritional knowledge as the basis to encourage a healthy eating. Half of the studies included physical exercise in their interventions.

Regarding the instruments used to measure the outcome variables, most studies applied checklists, questionnaires and surveys. Seven studies used 24-hour recalls, while half used anthropometry, two studies used plate-waste-measure and one analysed psychological outcomes as well. There is a lack of uniformity in the instruments and measures used. Most of the studies developed their own tailored measures, to serve their own objectives. Only a few used already validated and published measures. This reflects a need for the development, validation and dissemination of more reliable measures in this area, able to evidence the impact of the interventions and gather data of the intended outcomes. The conformity in the measures used will facilitate comparison between studies and a better understanding of the outcome behaviors, as well as all the methodological work on conceptualization, measurement, reliability and validity, allowing for a more precise assessment and consistency between studies.

As mentioned, the duration of the interventions varied from two weeks to one year (on average 3 months) and most of the studies used a baseline assessment and a post assessment. Only four studies performed a follow-up. A need for longer interventions and longitudinal assessments was felt to better capture the maintenance of the healthy behaviour overtime and to better understand the impact of the interventions on children development (Guralnik & Kritchevsky, 2010; Piesse, Judkins & Kalton, 2009). Behaviour change is not linear or simple process, knowledge or intention does not simple translate into behaviour, many factors are involved that need a deeper understanding (Ajzen, 1991; DiClemente & Prochaska, 1982; Velicer, Prochaska & Redding, 2006). Longitudinal studies have the power to better scrutinize the influence of different variables in the process and understand effects in the long term. Moreover, the interventions focused mainly on children as the agent of change and only a few involved school staff and parents. Interventions focusing on the different layers, environments and social groups where children are involved in tend to be more effective (Sallis & Owen, 2015; Golden & Earp, 2012). Therefore, a need to better engage other dimensions inside school was felt, such as teachers, and school staff, as well as parents and families, or even involving communities outside school could benefit the intervention and increase to power to promote change towards a healthier nutrition.

According to the literature (Ajzen ,1991; Nisbet & Gick,2008), knowledge and intentions work as precursors of behavior. Understanding food qualities and improving knowledge about nutrition and its benefits for health and well-being is a key step in fostering a healthier nutrition, increasing nourishment awareness and contributing to well-informed choices. Additionally, working on changing intentions and attitudes towards food consumption, promoting healthier eating and reducing unhealthy food consumption, is also a precursor for behaviour. However, people do not always behave in full accordance with their knowledge or intentions. Other factors are involved that may, or may not, motivate action (Schwarzer, 2008). Solving the intention-behavior black-box has always been a practical and intellectual challenge in health prevention areas (Lippke et al., 2004; Schwarzer, 2008), and nutrition is no exception. Applying theory should improve effectiveness (Davis et al., 2015; Michie et al., 2014). However, the field is extensive and some-what confusing. More than 80 theories co-exist, calling for a stronger effort in understanding the discrepancy or complementariness of theories. In general, it was unclear if a theoretical model was used to guide most of the intervention in this systematic literature review. The most common used theories were - SCT and self-efficacy, the TPB, Gamification (serious games, game-based learning, collaborative learning), *Adoption Theory*, *Goal Theory* (goal setting strategy), *Experiential Learning Theory*, *Self-Care Deficit Theory*, *Implementation Intention Theory*. A stronger effort to use theory in the planning and implementation of interventions was felt.

Regarding the communication technologies used within the interventions, the most common used were digital games (videogames, online games, and/or serious games); followed by SMS (SMS-based monitoring and automatic feedback system), mobile applications, internet-based interventions (websites), computer-tailored leaflets, IPTV, iPads. There were not found interventions using more than one communication technology. Results from a meta-analysis indicated that digital games (serious games) had a significant higher effect to promote nutrition amongst children, followed by interventions that used instant messaging systems (SMS) and allowed personalised feedback and stronger reinforcement strategies. Some previous studies have pointed out the relevance of games when working with children (Baranowski et al., 2016; Pakarinen et al., 2016; Ferrari et al., 2022). The results from this study also point in that direction.

Moreover, the literature showed that nutrition interventions are usually associated with physical activity interventions (at least half of the studies included some type of physical exercise promotion). Even though, for the purpose of this study the focus was on nutrition, and only outcomes directly related to nutrition were assessed, a meta-analysis confirmed that nutrition interventions with some type of physical exercise promotion are more effective. In what concerns the outcome variables promoted as part of a healthy eating practice, the

eating of F&V, followed by fruits alone, and vegetables alone, were the outcomes that revealed higher positive impacts in these interventions. However, these results should be interpreted with caution, as grouping interventions by either the communication technology used or the outcome variable promoted, originates small sample sizes with only indicative power. More research is needed to confirm these results.

STAGE 2 - STUDY 3. Surveys with parents on nutrition habits at school and school-based interventions to promote a healthy nutrition

In this study a survey was conducted with 78 parents of school-aged children aiming to explore children's nutrition habits at school and at home, the parents' perspectives on eating habits, and on the potential of media communication technologies to influence children's eating practices and deliver health nutrition interventions in the school context. This study intended to bring the perspective of parents on the research topic and frame the family/ home environment. The sample was mainly female with a medium to high education level and had their children at a public school. Five children were diagnosed with type 1 diabetes.

More than 422 million people worldwide suffer from diabetes, and it is expected that this number keeps increasing over the next years (WHO, 2022). In 2018, the estimated prevalence of diabetes in the Portuguese population (aged 20 to 79) was 13.6%, representing more than 1 million individuals (Sociedade Portuguesa de Diabetologia, 2018). Moreover, more than 40% of the Portuguese population had either diabetes or intermediate hyperglycaemia. Although diabetes tends to be more common among men and older population, type 1 diabetes usually occurs in childhood or adolescence (CDC, 2005, Roper et al., 2009), which is the case of the children whose parents participated in this survey. In 2015 in Portugal, type 1 diabetes reached 3 327 children and youth aged 0-18 years, which corresponds to 0.16% of the population in this age group, or 1 828 children aged 0-14 years, corresponding to 0.13% (Sociedade Portuguesa de Diabetologia, 2015; Registo DOCE – DGS, 2015). It is believed that the high number of parents of children with type 1 diabetes participating in this survey is due to a stronger concern of this parents and families with their children nutrition to properly manage the disease and avoid further serious health complications, being more available and predispose to participate in initiatives related to

children's nutrition and being part of social media groups related to nutrition (where the survey was disseminated).

Moreover, the survey results indicate that parents were relatively well informed about what is a healthy nutrition, associating it with drinking water, eating fruit and vegetables and avoiding SSB, salt and highly processed foods. Having a plant-based nutrition and eating fat were considered less relevant for a healthy nutrition by these parents. Parents indicated that their children have a healthier nutrition at home, when comparing it to school, and identified as the main barriers to offer healthy food options the lack of time and the high prices of healthy food. Parents stated their children eat, on average, 2.5 pieces of fruit and 2.1 pieces of vegetables per day. Most children have lunch at the school canteen and only take snacks to eat during the morning and afternoon breaks. Parents' beliefs and statements contrast with data from OECD (2020) which indicated that, in Europe, some 56% of 15 years old reported not eating any fruit or vegetable per day, and that no more than 37% reported eating at least one piece of fruit every day and 34% one vegetable. Data from the European Children Survey (WHO, 2020; Williams et al., 2020) indicates that less than 50% of children eat fruit and/or vegetables daily. The European Food Consumption database also shows relevant data, indicating that children eat low doses of fruits and vegetables across EU countries. Results from the survey represent parents' beliefs based on their food preparation practices at home, food available at the school canteen, their children report on what they eat during the day, and snacks sent to school and not returned home. Also, as previously mentioned, the sample may be biased towards parents with higher concerns with nutrition practices and better informed about diet due to the survey distribution and dissemination strategy and parents' availability to participate in the survey. In general, the survey results indicate that nutrition is a topic taught at school at various grades to children of different ages.

Parents believe that the family is the environment with a stronger influence on children's eating behaviours (for younger children), followed at a distance by their peers, the school and the contents transmitted via media communication technologies, such as TV, mobile apps or other multimedia channels. It was also explained (by the parents) that with age, children tend to value more their peers and be more influenced by social groups other than their family and the contents they watch on TV or other media. Ecological approaches to health behaviour change highlight the relevance of the different social ecological settings, arguing that an intervention to be effective should be embedded in the different social layers the individual is part of (family, peers, school, community, etc) (Stokols, 1995). This allows to address eating practices from a more holistic perspective, understanding not only the individual, in this case, the children, and their knowledge, preferences, beliefs, behaviours,

but also the contexts that influence and impact them (their behaviours, beliefs, preferences). Especially when referring to children and eating practices, one should understand that younger children are not responsible for food buying or food preparation, and are many times not involved in these practices/ choices. For instance, results from the survey indicated that parents prefer to go shopping without their children, and even when their children would go with them to the supermarket, they are only allowed limited choices, participating in food selection and buying in a limited way. Moreover, according to parents' reports, children tend to show more interest in selecting food options (in the supermarket) for specific situations, as for their breakfast or afternoon snacks, not being involved in selecting fruits or vegetables, or even other food for lunch and dinner options. The process of involving children in selecting food in a conscious and informed way, being able to understand nutrients, read a food label, have a balanced decision, and support them in developing strategies to not be influenced by the visual appealing packages, marketing strategies, and emotional preferences, is an educational path that takes time, dedication and effort. Younger children may not be prepared to be responsible for their food choices, but they can start to understand the process and the factors that guide decisions. Informed choices and healthy food behaviours can be reinforced in multiple ways, preparing them for the future.

According to the survey, TV, smartphone and mobile apps/ Internet are the most used media technologies (on a daily basis). There is a high penetration of media technologies on children's daily activities, and many own a smartphone and/or a tablet. According to Ofcom's data, nearly all children (from 6 years onwards) went online on 2021 using either a mobile phone (72%) or a tablet (69%). When online, the most popular activities were using video-sharing platforms, such as YouTube, social media, such as TikTok, or games. Regarding TV, children tend to watch paid-for or on-demand streaming services, such as Netflix, Amazon prime or Disney+ (78%). According to the EU Kids Online (2018), some 35% of children aged 8 to 11 have their own smartphone and about half have their own tablet. Being engaged in numerous online activities, the most common being schoolwork, playing games, watching videos and messaging. Survey results indicated that parents believe their children (particularly, teens) are highly influenced by the contents they watch on these devices and are particularly concerned with the impact of specific advertisements on children's eating behaviours. Restricting food marketing (for unhealthy products) has been identified as one of the top priorities in public health for reducing non-communicable diseases and premature mortality by 2025, being one of the 25 goals of the World Health Organisation (WHO, 2011; Norman et al., 2016). However, the effective response in place is still limited and food industries are still advertising their products in numerous ways. Children are frequently exposed to food adverts on TV and mobile media, and these are primarily for less healthy

food with attractive packages and associated with specific cartoon characters (children TV shows) (Boyland & Halford, 2013; Norman et al., 2016).

Several studies have shown evidence of the impact of advertisements and marketing on children and teenagers food consumption, preferences, knowledge at both food category (product) and brand level (WHO, 2009). In addition to focusing on the impact of advertisements on children's behaviours, many studies sought to draw attention to the importance of promoting strategies and developing children's skills to better cope with advertisements. The Raising Children Network (2022) identifies children's abilities to recognise advertisements and classify typical abilities per age interval, also explaining what children may not fully understand considering their age. For instance, children aged 3 to 6 years are able to identify an advertisement and differentiate it from other typical contents on TV and YouTube, but may not be able to differentiate specific video contents (e.g. unboxing toys) from marketing and may not understand the final aim of the advertisement (selling purpose). From around 7 years, children are better able to understand the final aim of an advertisement, can remember advertising messages, and can recognise a few persuasive techniques, but may still not fully understand specific marketing techniques (as product placement) and delicate persuasive techniques. From 12-13 years, children can usually understand the purpose of an advertisement and decide more consciously, but may still not fully understand tricky product placement, sponsored contents, social media influencers, and how data is collected and used in social media and on the internet to show them advertisements based on their interests (Raising Children Network, 2022).

Although the strong concern with the marketing of unhealthy food products, in general, the parents considered positive to use media technologies to promote a health intervention and believe these can better engage children in the long term. Media technologies were considered relevant and useful tools to use in health promotion campaigns to deliver contents about healthy nutrition, in particular, TV, Internet and games (on the PC, tablet or mobile phone) were considered as the most appropriate media technologies to be used, being able to foster children's interest and participation.

Limitations from this study are mainly associated with common constraints of using an online survey methodology, such as reaching a non-representative sample, not having access to the parameters of the population to which the survey was distributed, and including respondents with biases (e.g. more interested in the topic). Furthermore, online surveys are only completed by people who are literate enough to read the questionnaire and have access to the internet. For these reasons, this survey was included in the exploratory stage of this

dissertation, serving descriptive, indicative and exploratory purposes and not having a causal or conclusive intention.

STAGE 2 - STUDY 4. Analysis of newspaper news on nutrition at school – an overview of the current situation

This study performed a content analysis of articles published in SABADO magazine in the year of 2018 and 2019. The work focused on the role of the news in communicating about nutrition at schools and its potential to convey information and promote health literacy and situation awareness in the general public. The analysis identified the main topics addressed in the articles, news worthiness, objectives, values promoted, needs, forms of intervention and communication about regulation in health and education. Most news focused on the national context, while few were locally focused, and one was of international scope. All articles cited their sources of information, most being based on one source only.

The sources of information are crucial aspects in the news, also contributing to the value and worth of the article itself. A source of information is an entity, being it an organization, an individual, a group or a document, that offers information and data to the journalist, based on facts, descriptions, actions, and/or feelings about a given event (Santos, 2006; Pinto, 1999). Sources of information can be personal or documentary due to their nature; episodic or permanent due to their duration; local, national or international due to their geographic location; identified or anonymous/confidential in view of their identification; primary and secondary in view of the degree of involvement in the event; proactive or preventive in view of their action strategy (McNair, 1998; Pinto, 1999). In a more general perspective, the sources of information can be official, specialised institutional, specialised non-institutional, business, common citizen, among others, always having as final objective to promote the understanding of the addressed subjects (Lopes et al. 2012). In this sample, most articles used official sources, usually public well-known Institutions in the field of nutrition or education, such as the PNPAS, Ministry of Education, DGS, DGE, the WHO or the European Commission. The focus on these sources indicated a concern with sharing information on the national, European and International guidelines and best practices for food consumption at school. The second most common source of information was experts, mainly in nutrition and in education, which shows a concern about involving active agents in the field of nutrition at school and giving them a voice to provide their specialised opinions. In fact, the impact of health institutions on journalism as credible sources with value for the

news is remarkable. The data indicate that, in the health area (nutrition at schools), there is a predominance of institutional sources, more specifically official public sources, which seek to influence the media agenda, to manifest their guidelines, recommendations and implementation of regulation.

Regulation and policies were, by far, the most discussed topic in the sample of articles analysed, followed by situation awareness, issues related to the school menus and cafeterias, and non-compliance situations. In truth, the years of 2018 and 2019, as well as previous years, were marked by various political and regulatory developments linked to health, and in particular, to nutrition at schools. These policies have a close connection with the social and cultural context in which they are inserted, revealing a strong concern with the increase of non-communicable diseases and, specifically, with obesity rates among children, the nutritional quality of food, and the safety of food preparation and conservation.

In practical, food policies are a planned and transversal set of actions that seek to guarantee and promote the availability and access to healthy food products, with the final objective of improving the nutritional status and promoting the health of the population (Graça & Gregório, 2012; Helsing, 1997, PNPAS-DGS). Typically, two policy sectors are combined when referring to the regulatory context of food - the health sector and the agriculture sector. However, in the current situation, and considering the information shared in the articles analysed, other regulatory areas have been addressed when talking about food regulation at schools - industry, media and advertising, the environment, finance, and economy.

In the national historical context, several initiatives have been conducted with the aim of promoting and regulating the area of food, in particular at schools. Initially, the focus was based on combining the fields of health and education (strengthening the relationship between professionals of this area, and the presence of health professional in the school setting), followed by a phase of greater concern with food inspection and safety, marked by the development of the National Agency for Food Quality and Safety (DL 180/2000) and the Food and Economic Safety Authority (DL 237/2005) (Graça & Gregório, 2012). Subsequently, efforts focused on combating obesity, with the implementation of the National Program for the Promotion of Healthy Eating (PNPAS – DL 124/2011) and the Integrated Strategy for the Promotion of Healthy Eating (EIPAS – DR 249/2017). A greater concern with the consumption of sugar and salt and with the availability of vegetarian options at schools led to 1) the development of new policies restricting food products available in vending machines (Dispatch 7516-A/2016 of June 6, Diário of the Republic 108/2016), 2) policies committed to reducing the size of ordinary commercial sugar packets (2016), 3) the

commitment to reduce the salt content in bread (2016), 4) the new tax on sugary drinks (Law 42/2016 of December 28), 5) mandatory vegetarian options at schools (Law 11/2017 Diário da República 75/2017) and 6) the increase in the free distribution of fruits and vegetables in schools (Order nº 7255/2018 Diário da República 146/2018). The year 2019 marks the year in which food policies focused on communication, regulating the restriction on advertising aimed at children under 16 of food products and beverages that contain a high energy value, salt, sugar, saturated or processed fat acids, in schools, close to schools and even on television or cinema before, after and during children's programs (Law 30/2019, Diário da República n 79/2019). Following this regulation, supporting documentation was created by the DGS that determined the values to be taken into account when identifying food products that will have their advertising restricted, offering cut-off values for each food product, which should guide the new advertising law – nutritional profile for advertising restrictions (Dispatch 7450-A/2019 Diário da República 159/2019). In this way, school and children's environments are protected from exposure to communication contents that promote the consumption of unhealthy foods.

Of the topics associated with regulation, the one that caught the most attention and was more often discussed in the analysed articles was the restriction on the marketing of unhealthy food products inside schools and in the places in close proximity (Law 30/2019, Diário da República n 79/2019). This regulation seeks to protect children from the effects of publicity and advertisement of foods that, due to the high amount of sugar, salt, or fat, are considered harmful. This implies a clear concern with children's health and nutritional practices, as well as with the impact of media and communication technologies on this audience. Putting this regulation into action, with limits on advertising, was an essential and crucial step towards reinforcing action strategies focused on creating a healthy eating environment in and around schools. Considering the impact of advertising on children and the scientific evidence of its influence on the consumption behaviours of children (Lapierre et al., 2017; Oates, Watkins & Thyne, 2016), in particular food consumption behaviours (setting preferences, consumption and eating habits) (Cairns et al., 2013), a healthy food environment could not only presuppose limits to the availability of food products, but also limits to their dissemination and publicity.

According to mediatisation theory, media and communication technologies are deeply rooted and embedded in society's behavioural patterns, identity processes, social and cultural dimensions of meaning production. Any environment, in particular the food environment, should also be understood considering its relationship with media, how they affect one another. For instance, it is clear that media and communication technologies are embedded in institutions such as education and health, and in audiences, such as children.

Therefore, understanding the food environment and creating a safe food environment should not be seen as something independent from the media that are already present in that environment. When aiming to promote healthy food behaviours and to create a safe food environment, media regulation is a fundamental piece. Restricting the availability of food but allowing the presence of marketing and publicity of those foods, would not, by itself, produce a complete safe food environment.

The importance of promoting healthy eating environments and their impact on food choices is argued by several authors and organizations (WHO, 2020). The concept of food environment presupposes the idea that the environment in which one is included facilitates (or fosters) specific behaviours. For instance, if I am in an environment full of healthy food, most probably I will eat healthy food; if I am in an environment in which everyone exercises, very probably I will exercise as well (this is valid for any other behaviour, healthy or unhealthy). An environment refers to any physical, political, economic, social or cultural setting that may function as drivers of certain behaviours, based on the opportunities and conditions that are enabled in that setting (WHO, 2008; Caspi et al., 2012; Pacheco et al., 2017). In particular, the concept of food environment is linked to the accessibility of certain food products. The physical environment relates to the availability and quality of food products (are unhealthy foods available?); the economic environment relates to affordability versus cost of those food products (are unhealthy food financially accessible/ cheap?); the political environment links to existing regulations on food products (are there regulations/ policies regarding unhealthy foods?); the sociocultural environment relates to social groups (do my friends/ peers like and eat unhealthy food?). Scientific evidence indicates that there is a direct linear relationship between the food environment and eating habits (Caspi et al., 2012).

Moreover, promoting food literacy (health literacy), empowerment and training on nutrition is another fundamental piece to reach a complete safe food environment. Often in the analysed articles it is mentioned the need for a greater investment in this area, a stronger focus on health prevention strategies, on training initiatives that involve the whole education community and impact the different environments children are immersed in. In general, it is argued the importance of focusing on the community level, and not only in the individual level. Theoretically speaking, this concern with the different environments and layers in which the individual is included is very clear in the socio-ecological theory (ecological and social model - Sallis & Owen, 2015; Golden & Earp, 2012; McLeroy et al., 2003; Bronfenbrenner, 1999, Stokols, 1995). A concern with the individual, with the environments to which he is exposed, and the resources available in those environments is notorious in the analysis, arguing that eating behaviour is influenced not only by each persons' individual

characteristics, but also by the various contexts in which the individual is immersed in and by the relational dynamics enabled in these contexts.

The importance of the environment and the surrounding community, as well as the relationships of interdependence between the different agents and social, cultural and political spaces, is a subject that emerges as fundamental in the articles associated with food practices at schools. School-based interventions that aim at promoting healthy eating habits with children cannot be solely based on intervening with the children (their knowledge, self-confidence, preferences, habits, etc), but also on the environment in which children are included and on their social and cultural influences. Both the articles (through experts and official sources) and current scientific evidence indicated that action at multiple levels is more efficient, following an ecological intervention model. This implies not only intervening at multiple levels, involving multiple agents and stakeholders, and multiple contexts, but also understanding how these levels relate, depend on and influence from each other (McLeroy et al., 2003). Behaviour and attitudes towards health, and therefore towards eating practices, work as a system that needs to be approached as a whole, considering each part as an intervening factor in the process of changing behaviour

STAGE 3 - STUDY 5. School-based health intervention on healthy nutrition with children aged 8 to 12 years: promoting the increase of fruits and vegetables and the decrease of sugar-sweetened beverages consumption among students

This study aimed to promote the increase of F&V and the decrease of SSB consumption in children aged 8 to 12 years, in the school setting. The design of this quasi-experimental study compares the impact of using different media technologies and communication strategies to convey the message and promote the relevant skills to achieve the desired goal. The experiment included three groups – the control group, the treatment group 1 in which poster and flyers were used and the treatment group 2 in which digital learning games were used. The relevant outcome variables assessed were nutrition knowledge, food label literacy, actual behaviour (frequency of F&V and of SSB consumption and 24-hour recall) barriers to change, self-efficacy, nutrition self-care.

According to the World Health Organisation (WHO, 2020; WHO/FAO, 2003), children should eat more than 400g or five portions of fruit and vegetables per day and less than 10%

to 5% of their total energy should be sugars. Eating F&V and having a reduced sugar consumption helps to protect against all forms of malnutrition, as well as non-communicable diseases. For instance, limited evidence indicates that eating F&V is associated with a decreased risk of cardiovascular disease, diabetes type 2, osteoporosis, obesity and even some types of cancer (EC-HPDPG, 2022; DGE, 2016; DGAC, 2015). Having an unhealthy diet is directly linked to health risks and premature deaths (WHO, 2020). On average, at baseline, children from this study reported in their 24-hour recall eating 1.7 servings of F (slightly less than 2 fruits), 1.3 servings of V (around 1 vegetable) and 0.5 servings of SSB on a weekday, and 1.3 servings of F, 0.9 servings of V and 1 SSB on a weekend day, (in total, regardless the group). When organised in their experimental groups, data indicated no significant differences between groups. These numbers show that children were eating below the recommended portions of F&V per day, both during the week or during the weekend. The number of F&V servings on the weekend were lower than on the week, and the opposite is true for SSB which was higher during the weekend. These data may reflect the impact of school canteens and school nutrition plans regarding both F&V and SSB, which usually are planned by nutritionists and respect national scientific guidelines, offering F to children, and including V in cooking or in salads which are available for lunch to all children. Moreover, other reasons for these numbers, and in particular SSB higher consumption on weekends, may be related to the belief that on the weekends diet restrictions are relatively more relaxed and people tend to behave relatively differently regarding their nutrition, usually allowing more sugar intake and less food constraints on weekends.

As described in the results section, numbers of F&V consumption increased from baseline to endline in all groups, however this increase was only significant at 95% of confidence in the digital games group for the weekday 24-hour recall, and in the digital games and in the posters groups for the weekend day. No significant differences were found for SSB. At endline, students reported on average consuming 1.9 servings of F, 1.7 servings of V and 0.6 of SSB on a weekday, and 1.8 servings of F, 1.4 serving of V and 1 SSB on weekend days, regardless of the groups. The pattern identified at baseline, indicating children tended to eat more F&V in weekdays (school days), was maintained at endline, as well as the higher consumption of SSB on weekend days, in comparison to weekdays.

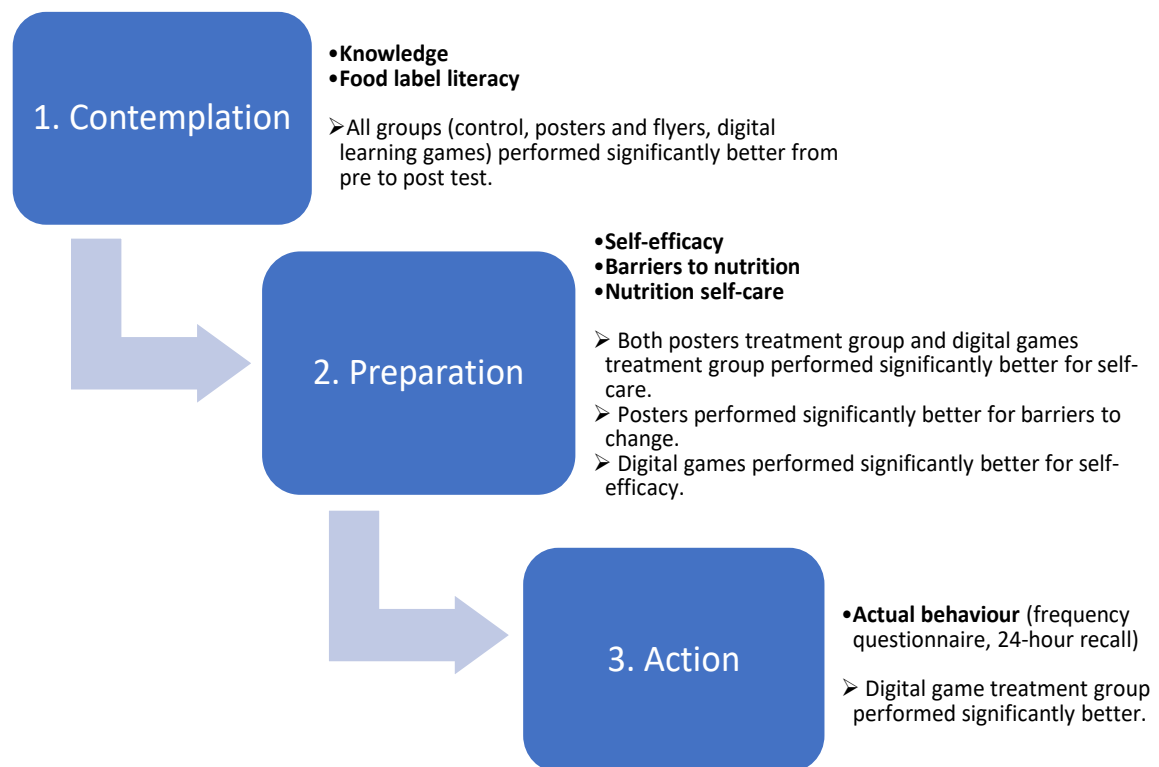
Furthermore, the results show that statistically significant differences were found between baseline and endline assessments for knowledge and food label literacy in all groups (both control, posters and digital games) indicating that the intervention was effective even in the control group for these variables. Significant differences were also found for self-care in the posters and digital games groups, suggesting that using communication strategies and technologies promotes significant higher levels of self-care in students, in

comparison to using only traditional teaching-learning strategies. Moreover, for barriers to nutrition change, the posters group revealed better and statistically significant results, whereas for both self-efficacy, and the actual behaviour, using a 24-hours recall and consumption frequency questionnaire, the digital games group performed significantly better.

In general, these results indicate the strong potential of nutrition interventions in schools. Even when only applying traditional teaching-learning strategies, children were able to learn more about nutrition and to better understand information in this field (knowledge and food label literacy were significantly higher at baseline for all groups) , which represents a first step to effectively adopt healthier nutrition practices in the future (awareness and contemplation phases). On the other hand, results also show evidence that using media technologies and communication strategies within a nutrition intervention promotes a stronger effect in the process of behaviour change, showing that both treatment groups (the posters and flyers group and the digital games group) performed better than the control group regarding self-efficacy, self-care and barriers to nutrition change (both treatment groups showed a significant impact from baseline to endline for these variables). This indicates that communication and media technologies are powerful tools to be included in an intervention when working with children promoting a positive impact. Moreover, the results show that the digital learning games group performed better regarding actual behaviour towards food consumption, showing significantly higher results at endline (after the intervention) in the food frequency questionnaire, for F&V and for SSB, and in the 24-hour recall for F&V (yesterday/ school day). This indicates that, even though I general communication technologies foster the impact of the interventions, using digital games showed an increased positive effect, when comparing to both the control group and the treatment group 1 (posters and flyers) for behaviour/ food consumption.

Considering the intervention plan, the outcome variables measured, as well as the integrative perspective that guided the intervention, the treatment games group revealed stronger effects along process of behaviour change, performing better not only for knowledge, food literacy, selfcare and self-efficacy, but also for actual behaviour, showing significant results in all phases of the process of behaviour change assessed in this intervention. The following image (Figure 26) illustrates the phases of the process in which this intervention focused, the outcome variables, and the results achieved, highlighting the stronger influence of digital learning games play along the path of behavior change.

Figure 26. Stages of behaviour change approached in the intervention, outcome variables measured and statistic significant differences



Source: Own elaboration

Previous studies have shown a positive impact of serious gameplay in health outcomes, and also in nutrition knowledge and behaviour (Ferrari, et al., 2022; Baranowsk et al., 2016; Arnab, 2015; Pakarinen et al., 2017). For instance, a systematic literature review of 25 learning games showed positive effects on learning outcomes (Baranowski et al., 2008). Another systematic literature review of 11 videogames for diabetes showed most had a positive significant impact on knowledge and disease management (DeShazo et al., 2010). A meta-analysis of 64 games promoting healthy lifestyles revealed games had stronger and significant effects behaviour determinants, actual behaviour and health outcomes (DeSmet et al., 2014). In the field of nutrition, a systematic literature review of nutritional interventions for adolescents using ICT showed that a stronger significant impact of these interventions. Another, a systematic literature review and meta-analysis of 23 interventions on gamification for the improvement of diet, nutritional habits and body composition in children and adolescents revealed a positive impact on knowledge and nutritional practices (Suleiman-Martos et al., 2021). Moreover, the systematic literature review and meta-analysis conducted as the first study in this PhD thesis also yield stronger significant effects of games (serious games, learning gameplay) over other communication technologies.

Digital games offer a fun component in the learning activity, being able to better engage players and involve them in the goals of the game. This way, games provide enjoyment while encouraging repeated gameplay, promoting planning and action, decision-making, trial and errors, understanding risks and overcoming barriers without immediate personal consequences (Baranowski et al., 2016). While allowing trial and error an experience different actions, games are an effective instrument to promote your self-efficacy and self-confidence and also to decrease limitations and barriers to change. Moreover, games allow to experience the behaviour, applying positive reinforcements to the desired behaviour, which promotes an appeal to changing and adopting the health behaviour (Baranowski et al., 2016).

Limitations of this study include a small sample in one school, not allowing generalization of results; not having a specific digital game developed for the intervention or with the same objectives as the intervention and in the native language of students; not adding a third post-assessment measuring the effects in a more longitudinal period; the age of children, which may have influenced the accuracy of the dietary recalls and the difficulties of answering the instruments prepared for this study. This study was conducted in the year of 2020, in the peak of Covid-19, which diffculted data collection at schools due to health prevention measures in place. Involving parents and school staff was one of the initial objectives of the intervention, aiming for a more ecological approach, which was also not feasible. Qualitative interviews would have been interesting to better explore how children used the posters/ flyers and the digital games shared with them, whether they felt engaged in the intervention and whether they discussed the learning contents in other contexts besides school. In addition, increasing sample size and replicating the study findings would be of great value.

Conclusions

Conclusions

This dissertation falls within the discipline of health communication and the main research question studied lies in the potential of communication, in particular, communication technologies, to support health interventions and promote health BC. Considering the wide scope of this research topic, I focused my research on healthy nutrition behaviours in children, in the school context, using media technologies.

Health communication is a fast-growing field that blends the scientific domains of communication and health with the final aim of enhancing health, empowering individuals and informing policy decisions about health. The steady development and relevance of this field has highlighted the powerful role of communication for promoting individual and public health, calling for a comprehensive understanding of the potential of communication and its tools to effectively promote health, with different target audiences and within various contexts.

For this purpose, the present work dealt with school-based health communication interventions to promote healthy nutrition practices in children, using media communication technologies. Scientific evidence has shown the school context as one of the most successful settings to work with children (Whittemore, Jeon & Grey, 2013; Fertman & Allenworth, 2010; Moore et al, 2009). Additionally, media communication technologies, namely new interactive technologies, have emerged as a promising attractive strategy to engage and motivate audiences, in particular children, to easily tailor and deliver contents, and reduce the high costs and effort of the human-resources involved in health interventions.

Furthermore, this dissertation addresses a significant public health challenge related to obesity and unhealthy nutrition practices (WHO, 2012), which, in turn, is related to the rise of chronic diseases and associated premature deaths (Bandini et al. 2005; Sahoo et al., 2015; Van Cleave, Gortmaker & Perrin, 2010; Chen, 2010). Scientific literature has demonstrated that overweight and obese children are more likely to stay obese into adulthood and to develop health problems at younger ages (Langford et al., 2015; Sahoo et al., 2015; Oude Luttikhuis, 2009; Lobstein 2004). Furthermore, chronic diseases represent one of the largest public health challenges of this century. Nutrition interventions focused on a powerful communication strategy, reinforced by compelling useful and engaging tools, such as media technologies, have been identified as an efficient way to respond to this challenge, to support a healthier society, to inform and empower citizens, and to support a sustainable healthcare system. Scientific and strategic knowledge from communication has been

emphasised as a key element in the planning and implementation of health interventions, to produce meaningful, engaging interventions with robust long-lasting effects.

The research design of this dissertation was planned to include three main stages, representing an evolution from a more theoretical exploratory to a more practical empirical (experimental) approach. Each stage comprised of different but complementary studies with specific objectives that contribute, in a holistic way, to the main research problem. Particularly, I like to envision this organisation and the contribution of each study as a piece of the same puzzle, part of the solution to the main problem. When compiling a puzzle, we like to observe how the pieces evolve together, how they are interconnected and how putting them together will take us to perceive the whole picture, or at least a clearer one. As a researcher, my responsibility was to think about the different pieces and to plan how they fit together, striving to interconnect the pieces in a way that contributes to a stronger understanding of the research problem. In this path, I tried to bring the perspective of different actors in the process, and to approach the problem from different perspectives, using different methodological approaches, in an attempt to colour the pieces of this puzzle. The first steps (pieces) are purely theoretical, followed by more exploratory techniques and closing with an empirical study.

The **first stage**, which was predominantly theoretical, intended to build foundation knowledge for the following stages. This stage explored secondary scientific data and comprised of two studies. The **first study** contributed to a comprehensive understanding of the health behaviour change process and the different models available to guide interventions. This study had as its final aim to reduce complexity in the field by advancing an integrated combined perspective of the central models available in the field. The final outcome of this study was the development of a visual analytical tool for practitioners and researchers, to support the planning of interventions and the decision between the available theories and the most relevant constructs to measure BC. This study was built on the evidence that theory-based health interventions are more effective in promoting health BC, and that the scientific field of BC is very complex and offers a multitude of theories with similar and competing constructs and ideas. This study represents an effort to bring meaning from the whole, merging similarities and using dissimilarities to overcome limitations in the different models.

The **second study** included a systematic literature review of school-based health interventions on nutrition, with children, using media technologies. This study mapped existing interventions on this topic and synthesised the best available evidence on the impact of health promoting programs using media technologies, both qualitatively and quantitatively.

The study followed a rigorous search strategy and inclusion/ exclusion criteria, resulting in 16 studies/ interventions that were analysed regarding their participants, type of intervention, theoretical background, media and communication technologies used, outcome measures, variables and instruments, results and effects of the intervention (meta-analysis). This study offered insights into the most used theoretical models of health behaviour change in health nutrition interventions with children in the school context; the most common health indicators, moderators, and predictors of behaviour; the outcomes and commonly used instruments to measure them; and media technology(ies) used and their effectiveness. The final outcome of this study was to bring together research evidence from recent health nutrition interventions with children and in the school context on how the interventions worked and their effectiveness, offering a final descriptive comparative grid of the relevant aspects and variables for the research problem and a meta-analysis, which combines the results of the different interventions and calculating its effect size (aggregated effect of nutrition interventions using media technologies on health outcomes).

Both studies contributed to a comprehensive understanding of the process of health BC, the available models and theories to guide interventions and previous existing interventions, contributing for the first and second research questions identified in this thesis. This knowledge supported the planning of the next studies, in particular, the empirical study that comprised of a school-based health intervention on nutrition. In more detail, study 1 supported in identifying the models and theories and the relevant variables to measure to understand health BC evolution when planning an intervention. The second study gathered evidence of already existing interventions and their procedure, the variables measured, instruments used, the most used models in nutrition interventions with children, the media technologies used and their impact, among other aspects relevant to the planning of an intervention.

The **second stage** of the project focused on exploratory approaches and brought contributions from the different environments in which the children live in, exploring different perspectives and collecting the views of different stakeholders. The first study of this stage (called **study 3**) included a survey with parents from school-aged children aiming to understand their perspectives regarding their children's nutrition habits in general, and at school, school food practices and policies and the potential of media communication technologies to promote healthier nutrition practices (in an intervention). This study gathered the views of parents about the current situation regarding nutrition at schools, framing the children's closest social level, the family. A survey methodology was used and a statistic descriptive analysis was performed to the data collected. The second study of this stage (**study 4**) comprised of an analysis of news articles that covered the issue of healthy eating

in the school context, at a national level. This study broadened the scope to frame the general social, cultural, and political environment. Similarly to the systematic literature review, this study followed strict inclusion and exclusion criteria to identify the relevant news articles to be analysed, identifying the main topics approached, the policies and regulations, the sources of information, forms of intervention and the location where the news/ events took place. Both studies in this stage followed an exploratory approach using a ground up style, departing from observation to inform data analysis processes, without the preference of a specific theoretical perspective. A content analysis was performed identifying the themes discussed in the articles and their frequency, and further exploring the data. These studies contributed to the third and fourth research questions identified in this thesis.

Results from **study 3** indicated that parents are concerned to their children's diet at school and believe their nutrition behavior is healthier when they are at home, in comparison to when children are at school. Parents considered family and peers as environments with a strong influence on children's food choices and explained that, with age, children tend to be more influenced by their peers and content they watch on TV and social media. Regarding media technologies usage by their children, it was clear that there is an extremely high penetration of media technologies in children's lives and that they have regular access to the Internet, mobile phones, and tablets. Parents were optimistic regarding using these technologies within health interventions aiming at promoting healthy nutrition practices and in the school context and at home. Parents believed that using media technologies could better engage children in the intervention and promote higher satisfaction levels, therefore fostering stronger effects. Parents were hopeful that their children could use these technologies in a constructive way, both for entertainment about also for learning and health promotion. The TV, Internet and digital games were considered as the most appropriate media technologies to work with children. Results indicated that health interventions delivered with the support of media technologies are perceived as positive, and parents stated to be open and supportive to involve their children in an school-based nutrition intervention that included the use of media technologies.

Results from **study 4** were relevant to better understand the topics, concerns, national regulations and policies in place, and how the problem is discussed at a national level. There was a predominance of institutional sources, from official public sources to experts, which seek to influence the media agenda and express guidelines, recommendations and regulations. This indicates that specialised information in the field is being discussed and spoken in generic news articles, making the information easily accessible to the general public and informing citizens about the relevant issues. Involving experts to comment on regulations and guidelines also tend to facilitate and promote

understanding, fostering health literacy and situational awareness in the public. Regulation and policies were, by far, the most discussed topic in the news items, showing a strong concern with the quality of nutrition at schools and a prevalence of political and regulatory developments linked to nutrition at schools in the years of 2018 and 2019. These strong investments in regulation and policies occurred at a time when the numbers of non-communicable diseases and, more specifically, obesity rates among children are high and there is a national and international concern to revert this situation. Moreover, the news articles analysed showed a concern with having (more) nutritionists working at schools, to promote healthier nutrition habits and to guide and supervise food quality, from purchasing to conservation, elaboration and preparation of menus. Policies evolved along the years, from having a higher concern with the presence of health professionals at schools to food inspection and safety, food quality, availability of vegetarian options, reduction of sugar and salt present in food and tax on sugary products, food products available in vending machines, free access to fruit and vegetables at schools, and restrictions on the advertising of unhealthy food products in the school context and its surroundings. In the year of 2019, food policies focused on communication, regulating on advertising aimed at children under 16 of food products and drinks that contain a high energy value, salt, sugar, saturated or processed fat acids, in schools, close to schools and even on television or cinema before, after and during children's programs (Law 30/2019, Diário da República n 79/2019). This regulation seeks to protect children from the effects of publicity and advertisement of foods that, due to the high amount of sugar, salt, or fat, are considered harmful. This implies a clear concern with children's health and nutritional practices, as well as with the impact of media and communication technologies on this audience. Putting this regulation in place was an essential and crucial step towards reinforcing action strategies focused on creating a healthy eating environment in and around schools. This topic also correlates with the previous study, where parents expressed a high concern with the marketing of unhealthy food products on different media channels and the influence of peers, TV (cartoons and characters) and social media in their food choices. These results suggested that both national and international institutions and the school are concerned with nutritional practices and are, therefore, open to initiatives that intend to promote healthy nutrition within the school context, supporting the efforts already in place at school in this regard.

The **third stage** of this dissertation included a school-based intervention aimed at increasing F&V and decreasing SSB consumption in children aged 8 to 12 years (**study 5**). This study follows a quasi-experimental methodology, comparing the impact of different media technologies to convey the message and promote the relevant skills to achieve the aimed goal. The experiment included a control group, a treatment group 1 (using posters and

flyers) and a treatment group 2 (using digital learning games). The relevant outcome variables assessed were nutrition knowledge, food label literacy, actual behaviour (frequency of F&V and of SSB consumption and 24-hour recall) barriers to change, self-efficacy, nutrition self-care. Both the aim of this study, the outcome variables measured as well as the instruments used, and the planning of the intervention, were developed based on lessons learned from the previous studies conducted in this PhD. This study contributed to the research questions four and five.

Results from the intervention revealed a strong effect of school-based nutrition interventions to promote healthier nutrition habits in children. Statistically significant differences were found in all groups, including the control group, for the outcome variables of nutrition knowledge and food label literacy, meaning that all children that participated in the intervention, independently of their experimental group, achieved better scores at baseline, showing a significant stronger knowledge about nutrition. On a health BC perspective, and following the indications from the visual analytical tool developed in study 1 of this dissertation (which guided the planning of this intervention), these outcome variables are relevant for the first phases of health BC – the awareness and contemplation phases.

On the other hand, results also evidenced that communication strategies and media technologies are powerful tools to deliver a nutrition intervention with children as both treatment groups (posters and flyers group and digital games group) performed better in the outcome variables of self-efficacy, self-care and barriers to nutrition change, showing a significant improvement from baseline to baseline. The use of communication and media technologies within a nutrition intervention promoted a stronger impact in the path to health BC, considering that these outcome variables are associated with intermedium phases of the process of BC – preparation phase.

Regarding actual behaviour (F& V and SSB consumption), which was measured following two complementary approaches, using both a frequency questionnaire and a 24-hour recall, although all groups have shown some increase, only the digital games group revealed statistically significant differences from baseline to baseline assessment. These results indicated a superior effect of digital games to promote healthy nutrition habits among children, considering it was the experimental group with better results overall, and especially with a stronger and steady impact in all phases of the BC process, from awareness and contemplation, to preparation, and finally to action (actual behaviour). These results reinforce previous studies that indicated a positive impact of serious gameplay in health outcomes, in nutrition knowledge and behaviour (Ferrari, et al., 2022; Baranowsk et al., 2016; Arnab, 2015; Pakarinen et al., 2017), and the results from the systematic literature review conducted under

this PhD work. In fact, both monitoring and participant observation during the intervention indicated an increasing enthusiasm in the activities, from the control group to the posters and flyers and, lastly, to the digital games group, which was commonly more motivated for the sessions. The digital games offered a fun component in the learning activity, being able to better engage children and involve them, while encouraging repeated gameplay, promoting planning, decision-making, action, trial and errors, applying positive reinforcements, understanding risks and overcoming barriers.

A summary of the specific aims of each study, the key findings and conclusions are presented in the following table (Table 29).

Table 30. Summary table

Study	Aims	Main findings	Conclusions/ outcomes
1	To better understand models and theories in the field of health BC. To reduce the complexity in the field by reviewing and integrating theories. To support the planning of an intervention.	TTM, HAPA, HBM, TPB and SCT identified as central theories in the field. Health BC progresses from motivational to volition phases, and from pre-intenders, intenders and actors (profiles). Identification of the main constructs that contribute for progressing between stages.	Similarities between models were identified, along with relevant constructs to promote health BC. Dissimilarities and gaps in the models were identified, as well as ways to overcome those limitations, mainly based on combining with other theories. Development of an operational framework that offers an overview of the main theories in the field and the related constructs. Development of a visual analytical tool to guide interventions.
2	To identify and explore previous school-based health nutrition interventions using media technologies. To synthesise and aggregate evidence on the impact of these interventions on children's nutrition habits. To understand theories, outcome variables, instruments, media technologies most commonly used, intervention planning and	Identification of the type of study, location, participants, type of intervention, duration of the interventions, theoretical models used, media technologies used, outcome variables, measured variables, instruments used, and effect of the interventions.	School-based health interventions fostered healthy eating among children aged 6 to 14. Data indicated positive outcomes, demonstrating significant low to moderate increases in nutrition knowledge and intake of healthy food, decreases of unhealthy food, decrease of anthropometric measures. Identification of relevant elements (duration, models, technologies, outcome variables, instruments, session, structure of the intervention) to plan a new school-based health intervention using media technologies.

	structure.		
3	To better understand the perspective of parents and the family about children's nutrition practices at home and at school To explore parent's perspective and acceptance of a school-based nutrition intervention that uses media communication technologies	Parents were well informed about nutrition in general and were concerned about their children's nutrition. Parents believed their children have enough daily intake of F&V. Parents were concerned with the impact of media technologies (TV, internet, etc) and peers in their children's nutrition habits. There is a high penetration of media technologies on children's daily activities.	Positive and enthusiastic perspective of parents in relation to a school-based nutrition intervention with their children.
4	To explore the situation of nutrition in the school context at a national level To better understand the macro perspective, focusing on the social, cultural and political environment by analysing news coverage about the topic	Nutrition at school (guidelines, recommendations and implementation of regulation) is in the media agenda. National regulation and policies were the most discussed topic. Identified concern with having a safe and healthy food environment, having more nutritionists, the impact of communication and marketing on children's food choices.	Strong concern with children's nutrition at school, the food environment (food accessibility) and school nutrition practices and policies. Strong recent regulating efforts and policies implemented, from food inspection and safety to healthy eating promotion, and the restriction of specific foods and its advertisement in schools or in the surroundings, based on food nutritional qualities.
5	To promote the increase of F&V and the decrease of SSB consumption in the school context To operationalise the knowledge acquire from previous studies to plan and implement a school-based nutrition	Statistically significant differences were found: - In all groups for nutrition knowledge and food label literacy. - In experimental groups for self-efficacy, self-care and barriers to nutrition change	Communication technologies were powerful tools to deliver the intervention. Significant effect of the school-based nutrition intervention to promote healthier nutrition habits in children, favoring the experimental groups using media technologies, in particular, the group using digital games to promote healthier

	intervention	- In digital games group for actual behaviour (F& V and SSB consumption). -	nutrition habits.
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Source: Own elaboration

Implications for theory and practice and future directions

The work conducted in this dissertation underlines the critical role of strategic and effective communication in public health. The realisation that communication and its knowledge, strategies, theory, techniques and technologies are essential to promote health was a major milestone in the discipline of health communication. Initially being recognised more as a skill than actually a science, nowadays, health communication is a prominent scientific field in great expansion, reinforcing its vital role in influencing, supporting and empowering individuals, communities, practitioners and policymakers to adopt and maintain health behaviours, at micro-individual or macro-ecological levels. From both a theoretical and practical perspective, studies in this field are valuable contributions to ensure a healthier society and to promote healthier habits and a more sustainable healthcare system focused on prevention and health promotion, and less on disease treatment.

Furthermore, promoting healthy behaviours early in childhood, in a consistent and effective way, is of great relevance to advance the health of the public. As previously discussed in this dissertation, childhood experiences have a strong influence in the adult life. Evidence has shown that health behaviours and attitudes can be maintained into adulthood and have an impact on health later in life. Considering that children spend a large part of their lives at school, these locations were identified as powerful settings to work with children and promote health in its various forms. Considering these assumptions, health promotion since childhood is a vital strategy to ensure a healthier society, and one ideal setting to intervene is the school. These inferences are valuable for practice and research, indicating both the target audience and the location where to act. Both according to the literature review conducted, as well as with the studies developed under this dissertation, school-based health interventions are indeed powerful activities with the potential to transform behaviours and promote health. More science-based interventions on health behaviour change are needed to effectively promote health at different levels, from a more individual level, for instance tailoring messages, to targeted messages at group level, marketing at community level,

regulations at policy level or national campaigns at population level. The possibilities are endless and the benefits crucial to ensure a stronger, empowered, well-informed and healthier society. These interventions can act at different stages of the process of BC and promote awareness, increase knowledge, shape attitudes and impact behaviours.

In turn, obesity and unhealthy nutrition habits represent an actual and great public health challenge, which affects individuals but also the society and its institutions. Access to food and food quality are key issues of human development and have deep implications in public health. In a world of demographic growth, the increase of chronic diseases and premature deaths, rapidly changing habits, sedentary lifestyles, growing scarcity of resources, economic and political instabilities, the future of nutrition and how to best communicate about food and eating habits, brings relevant challenges to science, technology and public policies, which call for further research and practice. Furthermore, given the global health challenges posed, not only more efforts in research and practice are still necessary, but also more investment in theoretical studies to better understand human behaviour and how to shift from a treatment approach to a prevention-based focus in public health. Questions related to how communication is relevant in health promotion and prevention, how to best communicate about health, how to maintain health behaviours through time are still unanswered. Even though the relevance of health communication has never been greater, this field will most certainly continue to develop, along with continued scientific and technological innovations, stronger dissemination, research and business initiatives. Research, theory and practice in this field is still necessary to inform on different health topics, intervention stages and using different communication channels and media technologies, from mass and broadcast media to new media, and targeting different audiences, from children, to adults and elderly, to group-specific populations.

More specifically focusing on the studies conducted in this dissertation, **study 1** highlighted the importance of looking at a vast number of theories and models in an integrative way, attempting to bring value from the whole. Considering the complexity of the field, focusing on very specific models or developing new models may not be the best approach in an already complex and dense field. Bringing value from complementariness and overcoming barriers based on dissimilarities seem to be a valuable approach, however more studies are needed that apply confirmatory and analytical techniques to reach this result, to develop solutions that support the planning of interventions and clearly identify the relevant processes of health BC and significant constructs at each stage. Considering **study 2**, systematic literature reviews are a rigorous process that enables one to explore a group of interventions and understand their main characteristics and effectiveness. It would be interesting to explore interventions' effectiveness based on communication technologies

used, to better investigate the impact of different technologies to deliver health interventions and associating it with target audiences.

Regarding **study 3** and **study 4**, these emphasised the relevance of involving other levels and perspectives in the analysis and preferably, in the intervention. Health is not only an individual trait, it is also affected by the social groups, communities, society and the different environments in which we live. In future studies, it would be beneficial to have a stronger relationship between these studies and the school-based intervention, involving school staff, the family, and the surrounding community. Correlating results from the community and family perspectives and the behaviour of children would be an interesting approach to explore the data and understand the impact of the different levels in the awareness, attitudes, and behaviours. Following an ecological approach, action at multiple levels will be more efficient. This implies, not only intervening at multiple levels, involving multiple agents and stakeholders, and multiple contexts, but also understanding how these levels relate, depend on and influence each other. Theoretically, there is an interdependence between individuals and social, cultural and political spaces. And thus, enabling one to analyse that interdependence at a practical level would be very interesting, being able to correlate and explore the path and progress (in health BC) for each individual considering the environments in which the individual is involved in and the resources available, the beliefs, the cultural aspects, the knowledge, and the behaviour that is naturally present in those environments.

Finally, the last study of this dissertation (**study 5**) was a school-based nutrition intervention that evidenced the positive impact of using media communication technologies to deliver an intervention with children, in particular with digital games. Considering the high cost of health interventions, computer-tailored interventions and interventions using media communication technologies have emerged as a promising cost-effective and attractive strategy to overcome barriers related to engagement, motivation, high costs and human resources. More health interventions are needed to explore the potential of communication technologies to deliver health interventions and its relationship and impact on different health disparities and target audiences. The intervention conducted in this dissertation, as well as study 3 and study 4, took place during the covid-19 pandemic, which limited many aspects of the intervention, from collaborative work between students to the presence and participation of parents in the intervention. Moreover, another experimental group using SMS was initially planned which ended-up not happening due to technological aspects, school policies, data protection issues, which were not possible to overcome promptly. For these reasons, and also to confirm the results achieved, more electronic health interventions are deemed

relevant and necessary to offer a clearer picture of the potential of communication technologies to promote health and to impact health prevention efforts.

How to best communicate information about health, in particular nutrition but also other health topics, and promote a healthy lifestyle is a current health, political and societal challenge that calls for more research efforts, original and innovational perspectives, stronger investment and a continuous commitment for action. The meaningful role of communication in this process, combining theory and practice to understand human behaviour change through communication, is of paramount importance, offering the opportunity to contribute to saving lives and promoting a healthier world.

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ANNEXES

ANNEX I

School-based nutrition intervention – booklet

(own elaboration)



COMER BEM PARA CRESCER BEM



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01 A ALIMENTAÇÃO SAUDÁVEL

A alimentação saudável é uma alimentação completa, variada e equilibrada, que proporciona energia adequada e bem-estar físico ao longo do dia.

Completa porque deve incluir todos os grupos alimentares da roda dos alimentos;

Variada porque deve incluir diferentes alimentos de cada grupo, variando esses alimentos todos os dias;

Equilibrada porque deve incluir os diferentes grupos alimentares de acordo com as quantidades adequadas.

Assim, quanto mais completa, variada e equilibrada for a alimentação, melhor!

O consumo de diferentes alimentos, com diferentes nutrientes, enriquece o dia alimentar e contribui para que sejamos saudáveis.

A alimentação é o que nos dá energia para correr, saltar, brincar, mas também para estudar, ler, escrever e até para pensar! Sim, pensar gasta energia e até dormir gasta energia. Portanto, para fazermos todas essas atividades, e para crescermos fortes e saudáveis, devemos comer bem, ou seja, devemos ter uma alimentação saudável!





É importante percebermos que não devemos consumir mais energia do que aquela que gastamos, caso contrário podemos começar a ganhar peso ou podemos vir a ter, no futuro, doenças crónicas que estão ligadas à má alimentação

É importante percebermos que a alimentação:

- Assegura a sobrevivência do ser humano;
- **Fornece energia e nutrientes** necessários ao bom funcionamento do organismo;
- Contribui para a manutenção do nosso **estado de saúde** física e mental;
- Desempenha um papel fundamental na **prevenção de certas doenças**;
- Contribui para o adequado **crescimento e desenvolvimento**.

02 MACRO E MICRONUTRIENTES

Os alimentos, quando são ingeridos, oferecem energia ao nosso corpo. Essa energia está dependente das propriedades e características dos alimentos que se podem dividir entre - **Macronutrientes e Micronutrientes.**

Macronutrientes são:

- Hidratos de carbono,
- Proteínas
- Gorduras (Lípidos)

Servem para fornecer energia (quilocalorias)

Hidratos de carbono:

Pão
Cereais integrais
Massa
Arroz
Batatas
Farinhas



Proteínas:

Carne
Peixe
Ovos
Leite
Queijo
Iogurte



Gorduras:

Monoinsaturadas:

Azeite

Polinsaturadas:

Óleos de origem vegetal

Gordura do peixe

Saturadas:

Manteiga

Gordura da carne

Salchichas

Charcutaria



Micronutrientes são:

- Vitaminas
- Minerais.

Micronutrientes são alimentos reguladores, ou seja, envolvidos em processos metabólicos do nosso organismo, como o sistema imunitário, formação de tecidos e órgãos, transferência e armazenamento de energia, sendo, por isso, igualmente indispensáveis.

Vitaminas:

Que se dissolvem em gordura:

Lipossolúveis – A, D, E e K;

Que se dissolvem em água:

Hidrossolúveis – B1, B2, B6, B12, C.



Minerais:

Sódio,
Cálcio,
Potássio,
Magnésio,
Fósforo,
Ferro,
Flúor,
Iodo,
Cloro

Crômio,
Molibdênio,
Enxofre,
Zinco,
Cobre,
Manganésio,
Cobalto,
Selênio



Mas existem mais nutrientes importantes:

FIBRAS

São substâncias existentes nos alimentos de origem vegetal, que o organismo não consegue digerir, e que, por isso, não são absorvidas. Atuam principalmente na digestão e contribuem para um bom funcionamento intestinal.

ÁGUA

É fundamental para a nossa sobrevivência e para a manutenção da saúde. Cerca de 70% do nosso corpo é constituído por água. Por isso, precisamos de beber muita água.

AÇÚCAR

É um dos alimentos que não pertence à roda dos alimentos. Existem alimentos que naturalmente têm açúcar presente, como as frutas, e esse açúcar é o suficiente para o nosso organismo.

O açúcar está presente nos refrigerantes, bolos, chocolates, compotas, rebuçados, gomas, bolachas, cereais infantis, etc.

É o principal responsável pela obesidade.
Deve ser consumido raramente e em doses pequenas.

Se aprenderes a ler os rótulos das embalagens vais saber distinguir os alimentos com mais e menos açúcar. Mas atenção, às vezes nas embalagens o açúcar aparece com outros nomes: glucose, glicose, dextrose, sacarose, caldo/ calda, frutose, maltose, lactose, açúcar invertido, melaço, xarope.

SAL

É designado cientificamente por cloreto de sódio. Deve ser ingerido em doses pequenas (menos de 5g por dia). Mas é muito difícil percebermos a quantidade de sal que comemos, pois, o sal está misturado nos alimentos e não o conseguimos ver. Assim, a melhor sugestão é comer o menos possível.

Produtos com muito sal são batatas fritas, salchicharia, charcutaria, aperitivos.

O sal pode ser substituído por ervas aromáticas, especiarias ou outros produtos menos perigosos como a salicórnia.

Muito sal faz mal ao coração!

BEBIDAS

ÁGUA - É a melhor bebida que devemos beber, mas podemos também beber outras bebidas que não tenham adição de açúcar, álcool ou cafeína. São exemplos os sumos de fruta ou chás.

REFRIGERANTES- Ou sumos de lata, garrafa ou plástico que têm adição de açúcares e de conservantes devemos beber apenas em dias de festa, ou seja, poucas vezes.

03 A RODA DOS ALIMENTOS

A **roda dos alimentos** é um instrumento desenvolvido por profissionais que ajuda a escolher e combinar os alimentos que devemos ingerir na nossa alimentação diária.

Tal como o próprio nome diz, é uma roda, ou um círculo, como se fosse um prato que se encontra dividido em grupos – grupos de alimentos.

Os grupos juntam alimentos que são parecidos nas suas características nutricionais.

A roda dos alimentos tem **7 grupos de alimentos**.

Cada grupo tem um tamanho diferente que indica a quantidade que se deve comer desse grupo.

- 1) Hidratos de carbono (cereais, derivados e tubérculos) – 28%
- 2) Hortícolas (legumes) – 23%
- 3) Fruta – 20%
- 4) Lacticínios – 18%
- 5) Proteínas / Carne, pescado e ovos – 5%
- 6) Leguminosas – 4%
- 7) Gorduras e óleos – 2%

A **água** não possui um grupo próprio, mas encontra-se no centro da roda dos alimentos.

Está representada em todos os grupos, pois todos os alimentos têm água na sua constituição e também porque a água é imprescindível à vida. Devemos beber muita água todos os dias (entre 1,5 a 3 litros por dia).

A RODA DOS ALIMENTOS



Fonte da imagem: Observador.pt

"Roda da Alimentação Mediterrânica" desenvolvida pelo PNPAS/DCS, Faculdade de Ciências da Nutrição e Alimentação da Universidade do Porto e Direção-Geral Consumidor.

04 PORÇÕES

Cereais e derivados, tubérculos – 28%



1 pão (90g)
1 fatia fina de broa (70g)
1 e 1/2 batata – tamanho médio (120g)
1 fatia fina de broa (70g)
3 colheres de sopa de cereais de pequeno-almoço (15g)
6 bolachas – tipo Maria / água e sal (35g)
2 colheres de sopa de arroz / massa crua (30g)
4 colheres de sopa de arroz / massa cozinhados (110g)

4 a 11
porções/dia

Hortícolas – 23%



2 chaves almofadas de hortícolas crás (100g)
1 chave almofada de hortícolas cozinhadas (140g)

—
porções/dia

Fruta – 20%



1 peça de fruta – tamanho médio (100g)
--

1 a 3
porções/dia

Gorduras e óleos – 2%



1 colher de sopa de azeite / óleo (10g)
1 colher de chá de manteiga (10g)
4 colheres de sopa de nata (80g)
1 colher de sobremesa de manteiga / margarina (15g)

1 a 3
porções/dia

Lacteínas – 10%



1 chave almofada de leite (200ml)
1 iogurte líquido ou 1 e 1/2 iogurte sólido (200g)
2 fatias finas de queijo (40g)
1/4 de queijo fresco – tamanho médio (50g)
1/2 requeijão – tamanho médio (100g)

2 a 3
porções/dia

Carnes, peixe e ovos – 8%



Carnes / peixe cru (30g)
Carnes / peixe cozinhados (35g)
1 ovo – tamanho médio (55g)

1,5 a 4,5
porções/dia

Leguminosas – 4%



1 colher de sopa de leguminosas secas cruas (ex: grão de bico, feijão, lentilhas) (25g)
2 colheres de sopa de leguminosas frescas cruas (ex: ervilhas, feijão) (80g)
3 colheres de sopa de leguminosas secas / frescas cozinhadas (80g)

1 a 2
porções/dia

Fonte: DGS

05 A PIRÂMIDE DOS ALIMENTOS

A pirâmide dos alimentos é também um instrumento construído para orientar as pessoas para uma alimentação saudável. Como um guia.

É mais antiga que a roda dos alimentos. Hoje em dia a roda dos alimentos é mais usada e os profissionais sugerem que funciona melhor porque se assemelha a um prato.

Ainda assim, vamos conhecer a pirâmide dos alimentos.

Tal como na roda dos alimentos, a pirâmide tem 7 grupos alimentares (ou 8 – porque inclui os doces) e o tamanho dado a cada grupo alimentar indica a quantidade que se deve comer desse grupo. Ou seja, neste caso, devemos comer mais dos grupos alimentares na base da pirâmide e menos dos grupos alimentares no topo da pirâmide.

Aqui fica uma imagem:



06 ALIMENTOS DE VERDADE

Sim, existem **alimentos de verdade** e outros que **não são de verdade**.
E os que devemos comer são os alimentos de verdade.

Os alimentos de verdade são os que vêm da natureza, das plantas, das árvores, dos animais da terra ou do mar, sem aditivos químicos.

Esses são os que mais devemos comer e são os que aparecem na roda dos alimentos. Podem vir naturais, mas também podem vir empacotados, refrigerados, congelados, moídos, cortados, etc.



Temos também os **alimentos processados** como o pão, queijo, iogurtes, conservas, enlatados, arroz, massa. São alimentos que provêm de alimentos de verdade, mas sofreram algumas transformações. Estes alimentos não devem substituir os alimentos de verdade, mas podem acompanhar e ser incluídos na alimentação.



O que não é comida de verdade e que não deve entrar na alimentação são os **alimentos ultraprocessados**.

São **produtos industrializados, processados, que tentam substituir a comida de verdade e que incluem químicos na sua composição e muitas vezes incluem também açúcar e sal adicionado.**

São maioritariamente produtos **prontos a consumir, em embalagens, com grande validade, com aspeto saboroso.**

Por exemplo, os refrigerantes, batatas fritas de pacote, alguns cereais ou bolachas, chocolates, etc.

A forma mais fácil de identificar estes produtos é pensar:

- 1) Este produto existe na natureza?
- 2) Este produto é feito com produtos químicos (ver no rótulo se parecem nomes estranhos que não conhecemos e que não existem na natureza)?



Alimentos de mentira são alimentos ultraprocessados que contêm substâncias de uso industrial que não existem na natureza.





07 COMO LER UM RÓTULO

Ler os rótulos dos alimentos embalados é muito importante para sabermos o que contém o alimento e fazermos escolhas mais conscientes.

Quando vamos às compras ou quando escolhemos produtos alimentares devemos ler os rótulos.

O que é importante procurar e ler:

- **Lista dos ingredientes:**

São os ingredientes que fazem parte do produto. São escritos por **ordem decrescente em termos da quantidade** que o produto tem. Ou seja, o que o produto tem em maior quantidade aparece primeiro.

- 1) Verificar se os ingredientes são naturais
- 2) Verificar se tem aditivos, conservantes, emulciantes, etc (normalmente começam pela letra E (ex. antioxidante E300), o ideal é não ter
- 4) Verificar alergénicos (no caso de se ter alguma alergia)

- **Informação nutricional:**

Devemos ter atenção à quantidade, de preferência olhar para as calorias/ gramas por porção ou por cada 100g do produto.

Devemos encontrar:

- 1) **Valor energético em Kj/Kcal:** a energia que o produto oferece quando consumido
- 2) **Proteínas**
- 3) **Hidratos de carbono/ Glícidos** e dentro destes verificar a quantidade de açúcar (polióis, amido, dextrose, frutose, maltose, etc) deve ser reduzida
- 4) **Lípidos** e dentro destes verificar se tem poucos lípidos saturados ou trans, são os que menos devemos comer
- 5) **Fibras**
- 6) **Sódio** (é o sal) deve ser reduzido.

Devemos optar por uma lista de ingredientes simples e reduzida, de preferência com alimentos naturais, com poucos aditivos, conservantes, reguladores de acidez, corantes, etc.

Algumas marcas incluem nos seus rótulos um código de cores que ajuda a analisar rapidamente os lípidos saturados, o açúcar e o sal. Devemos preferir alimentos com baixas quantidades destes produtos, portanto a verde ou no máximo a amarelo.

Por porção de 30g

542kJ 128kcal 6% DR*	0,7g LÍPIDOS 1% DR*	0,1g SATURADOS 1% DR*	7,8g AÇÚCARES 9% DR*	0,23g SAL 4% DR*
-------------------------------	------------------------------	--------------------------------	-------------------------------	---------------------------

Energia por 100g: 1807kJ/ 427kcal

Este é um decodificador dos rótulos, podes usar para ver se as quantidades de cada nutriente são baixas, médias ou elevadas. Já sabes, numa alimentação é importante que o açúcar, o sal e as gorduras saturadas sejam reduzidas nos produtos que comemos diariamente.

DESCODIFICADOR DE RÓTULOS		ALIMENTOS por 100g			
		GORDURA (Líquida)	GORDURA SATURADA	AÇÚCARES	SAL
ALTO		mais de 17,5g	mais de 5g	mais de 22,5g	mais de 1,5g
MÉDIO		entre 3 - 17,5g	entre 1,5 - 5g	entre 5 - 22,5g	entre 0,3 - 1,5g
BAIXO		3g ou menos	1,5g ou menos	5g ou menos	0,3g ou menos

Mais informações consulte www.alimentacao Saudavel.dgs.pt

DESCODIFICADOR DE RÓTULOS		BEBIDAS por 100ml			
		GORDURA (Líquida)	GORDURA SATURADA	AÇÚCARES	SAL
ALTO		mais de 8,75g	mais de 2,5g	mais de 11,25g	mais de 0,75g
MÉDIO		entre 1,5 - 8,75g	entre 0,75 - 2,5g	entre 2,5 - 11,25g	entre 0,3 - 0,75g
BAIXO		1,5g ou menos	0,75g ou menos	2,5g ou menos	0,3g ou menos

Mais informações consulte www.alimentacao Saudavel.dgs.pt
Fonte: DGS - PNPAS

08 DOENÇAS LIGADAS À MÁ NUTRIÇÃO

Atualmente, os hábitos alimentares inadequados são um dos maiores fatores de risco para doenças crônicas não-transmissíveis.

Algumas das doenças resultantes de uma má alimentação são:

Obesidade - causada por uma alimentação com muito açúcar e gorduras saturadas

Diabetes - causada por um elevado ou descontrolado consumo de açúcar e de hidratos de carbono (farinha, pão, bolos, massas).

Hipertensão arterial - deve-se essencialmente ao consumo elevado de sal

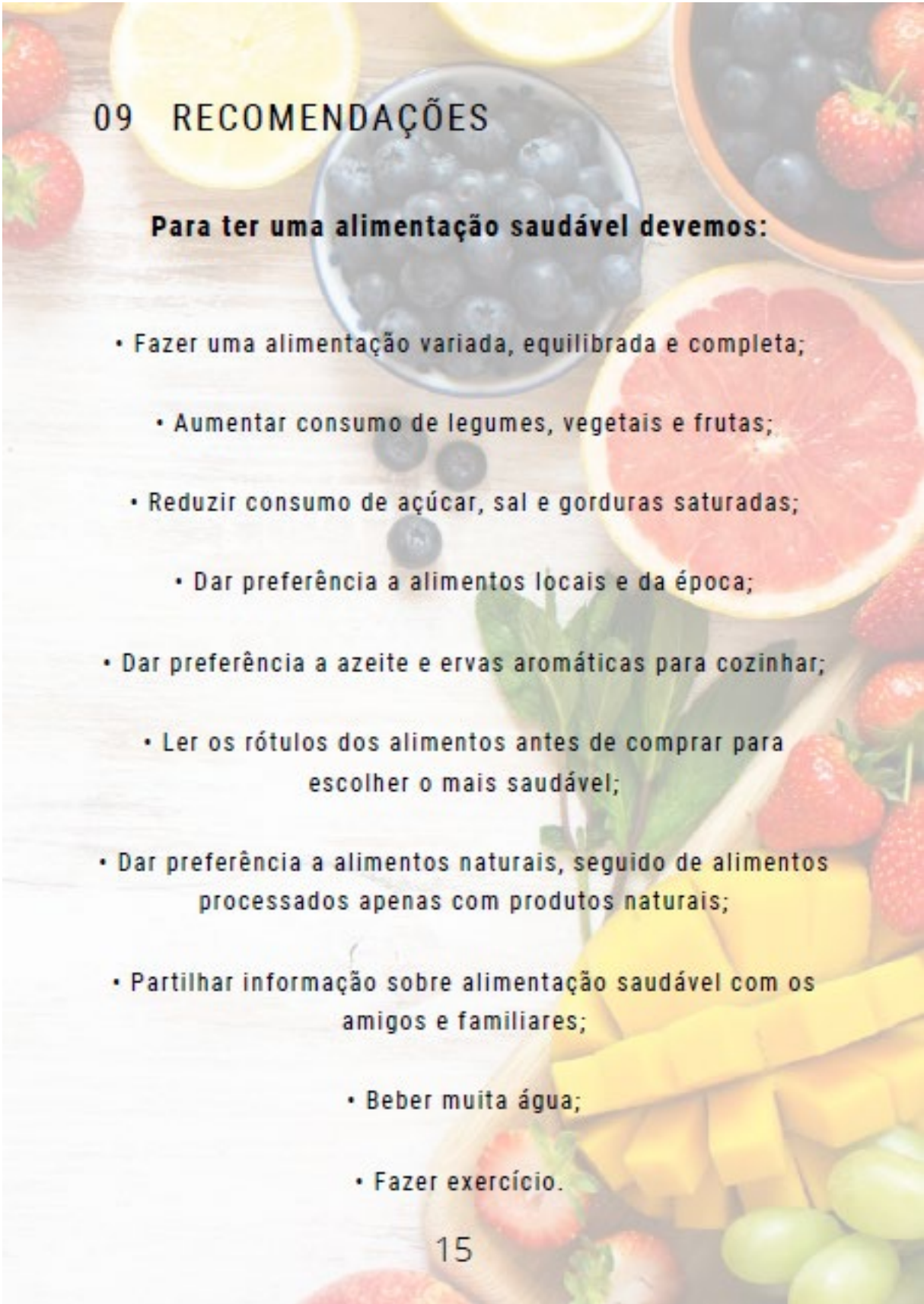
Colesterol elevado - deve-se ao elevado consumo de gorduras saturadas que entram na circulação sanguínea

Problemas cardiovasculares (no coração) - devem-se principalmente ao consumo de alimentos com muito sal e açúcar

Doenças degenerativas – associado a uma alimentação elevada em gorduras saturadas e calorias

Anemia - deve-se à falta de consumo de alimentos ricos em ferro e ácido fólico como as verduras e alguns legumes

Desnutrição – deve-se a uma alimentação reduzida, com poucas calorias e nutrientes (comer pouco também é perigoso)



09 RECOMENDAÇÕES

Para ter uma alimentação saudável devemos:

- Fazer uma alimentação variada, equilibrada e completa;
- Aumentar consumo de legumes, vegetais e frutas;
- Reduzir consumo de açúcar, sal e gorduras saturadas;
- Dar preferência a alimentos locais e da época;
- Dar preferência a azeite e ervas aromáticas para cozinhar;
- Ler os rótulos dos alimentos antes de comprar para escolher o mais saudável;
- Dar preferência a alimentos naturais, seguido de alimentos processados apenas com produtos naturais;
- Partilhar informação sobre alimentação saudável com os amigos e familiares;
- Beber muita água;
- Fazer exercício.

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Associação Portuguesa de Nutrição - <https://www.apn.org.pt/>

COMER
PARA **SER**
SAUDÁVEL



Manual desenvolvido no âmbito de uma tese de doutoramento em Comunicação em Saúde
Curso de doutoramento em Ciências da Comunicação da Universidade Lusófona de Humanidades e Tecnologias

ANNEX II

Instruments used in the intervention

O que comes?

1. Bebes leite ou iogurtes todos os dias?

- ☐ Sim
☐ Não

1.1. Se sim, quantos num dia?

- ☐ 1 ou 2
☐ 3 ou 4
☐ Mais de 4 copos

1.2. Se não, quantos numa semana?

- ☐ Nunca
☐ Menos de 1 vez por semana
☐ Entre 1 a 2 vezes por semana
☐ Entre 3 a 4 vezes por semana
☐ Mais de 4 vezes por semana

2. Comes fruta todos os dias?

- ☐ Sim
☐ Não

2.1. Se sim, quantas vezes por dia?

- ☐ 1 ou 2 vezes
☐ 3 ou 4
☐ Mais de 4 vezes

2.2. Se não, quantas vezes numa semana?

- ☐ Nunca como
☐ Menos de 1 vez por semana
☐ Entre 1 a 2 vezes por semana
☐ Entre 3 a 4 vezes por semana
☐ Mais de 4 vezes por semana

3. Comes legumes ou vegetais todos os dias?

- ☐ Sim
☐ Não

2.1. Se sim, quantas vezes por dia?

- ☐ 1 ou 2 vezes
☐ 3 ou 4
☐ Mais de 4 vezes

2.2. Se não, quantas vezes numa semana?

- ☐ Nunca como
☐ Menos de 1 vez por semana
☐ Entre 1 a 2 vezes por semana
☐ Entre 3 a 4 vezes por semana
☐ Mais de 4 vezes por semana

4. Bebes refrigerantes todos os dias?

- ☐ Sim
☐ Não

1.1. Se sim, quantos num dia?

- ☐ 1 ou 2
☐ 3 ou 4
☐ Mais de 4 copos

1.2. Se não, quantos numa semana?

- ☐ Nunca
☐ Menos de 1 vez por semana
☐ Entre 1 a 2 vezes por semana
☐ Entre 3 a 4 vezes por semana
☐ Mais de 4 vezes por semana

5. Comes *fast-food* (hamburguers, cachorros, batatas fritas) todos os dias?

- ☐ Sim
☐ Não

2.1. Se sim, quantas vezes por dia?

- ☐ 1 ou 2 vezes
☐ 3 ou 4
☐ Mais de 4 vezes

2.2. Se não, quantas vezes numa semana?

- ☐ Nunca como
☐ Menos de 1 vez por semana
☐ Entre 1 a 2 vezes por semana
☐ Entre 3 a 4 vezes por semana
☐ Mais de 4 vezes por semana

6. Comes doces (chocolates, rebuçados, pastilhas, sugos) todos os dias?

- ☐ Sim
☐ Não

2.1. Se sim, quantas vezes por dia?

- ☐ 1 ou 2 vezes
☐ 3 ou 4
☐ Mais de 4 vezes

2.2. Se não, quantas vezes numa semana?

- ☐ Nunca como
☐ Menos de 1 vez por semana
☐ Entre 1 a 2 vezes por semana
☐ Entre 3 a 4 vezes por semana
☐ Mais de 4 vezes por semana

Lembras-te do que comeste?

Tenta lembrar-te o que comeste **ontem**...

1. Quantas frutas comeste ontem? Escreve o número e os nomes.
2. Quantos legumes ou vegetais comeste ontem? Escreve o número e os nomes.
3. Quantos sumos de garrafa ou lata bebeste ontem? Escreve o número e os nomes.

Tenta lembrar-te o que comeste no **sábado**...

1. Quantas frutas comeste? Escreve o número e os nomes.
2. Quantos legumes ou vegetais comeste? Escreve o número e os nomes.
3. Quantos sumos de garrafa ou lata bebeste sábado? Escreve o número e os nomes.

Sentes-te capaz?

Lê as frases e usa a escala para responder. Coloca uma cruz (x) por cada frase/ linha.

	Nunca	Raramente	Às vezes	Muitas vezes	Sempre
1. Sentes-te capaz de escolher alimentos saudáveis?					
2. Sentes-te capaz de perceber conselhos sobre como comer de forma saudável?					
3. Sentes-te capaz de alterar os teus hábitos alimentares se for necessário?					
4. Achas que és capaz de ganhar ou perder peso, se tu quiseres?					
5. Sentes-te capaz de seguir conselhos sobre como ser mais saudável?					
6. Achas que sabes como comer de forma saudável?					
7. Sentes-te capaz de praticar exercício físico que se faça sentir bem?					
8. Sabes como te alimentar de forma a melhorar o teu aspeto visual?					
9. Tens influência na preparação da comida em casa?					
10. Sabes que alimentos não deves comer para reduzir gordura e colesterol?					
11. Sabes que alimentos não deves comer para reduzir o açúcar?					
12. Sabes que alimentos deves comer para aumentar o consumo de fibras?					
13. Sabes quais os benefícios de praticar uma alimentação saudável?					
14. Sabes como melhorar a tua alimentação?					
15. Sabes qual a quantidade de energia que deves consumir diariamente?					
16. Sabes que alimentos deves comer para aumentar o consumo de vitaminas?					
17. Achas que a tua família te apoia na escolha de uma alimentação saudável?					

Lês os rótulos?

Lê cada um dos rótulos de produtos alimentares e diz qual é a escolha mais saudável para a tua alimentação.

Coloca uma cruz na opção que consideras mais saudável para ti.
Se não souberes, podes escolher a opção "não sei".

1. Bolachas

A.

BOLACHA COM RECHEIO COM SABOR A CHOCOLATE

INGREDIENTES: Bolacha (58%) (farinha de trigo, açúcar, matéria gorda vegetal de palma, xarope de glucose e frutose, derivado lácteo em pó (proteínas do leite, leite magro em pó), levedantes (E500ii, E503ii), sal, emulsionantes (E322 (contém soja)), aroma de baunilha, antioxidante (E223 (contém sulfitos))), recheio com sabor a chocolate (42%) (açúcar, matéria gorda vegetal (palma e palmiste), cacau em pó (15%), amido de trigo, emulsionante (E322 (contém soja))).

DECLARAÇÃO NUTRICIONAL	POR 100g DE PRODUTO	POR PORÇÃO (25g - 1 bolacha) %DR*	DR*
ENERGIA	2023kJ 482kcal	506kJ 121kcal	6 8400 kJ 2000kcal
LÍPIDOS DOS QUAIS: ÁCIDOS GORDOS SATURADOS	19g 11g	4,8g 2,8g	7 20g
HIDRATOS DE CARBONO DOS QUAIS: AÇÚCARES	70g 33g	18g 8,3g	7 90g
FIBRA	3,5g	0,9g	
PROTEÍNAS	6,0g	1,5g	3 50g
SAL	0,50g	0,13g	2 6g

* Dose de Referência (DR) - Doses de referência para um adulto médio (8 400 kJ/ 2 000 kcal).

Esta embalagem contém aproximadamente 20 porções.

SIGA AS CORES

Ópte por escolher alimentos que apresentem mais nutrientes a verde e laranja do que a vermelho

Por porção de 25g

506kJ 121kcal	4,8g	2,8g	8,3g	0,13g
6% DR*	7% DR*	14% DR*	9% DR*	2% DR*

Energia por 100g: 2023kJ/ 482kcal

B.

PT | BOLACHA MARIA INTEGRAL

INGREDIENTES: Cereais (farinha de trigo (38,3%), farinha de trigo integral (29,9%)), açúcar, óleo vegetal (girassol), xarope de glucose, Levedantes (E500ii, E503ii), sal, soro de leite pó, corante (E150c), mel, emulsionante (E322), antioxidantes (E223 (contém sulfitos), E306).
Pode conter vestígios de soja e sementes de sésamo.

Conservar em local seco e fresco.
Depois de aberto, manter nas mesmas condições e fechar após cada utilização.

DECLARAÇÃO NUTRICIONAL	POR 100g DE PRODUTO/ PER 100g OF PRODUCT	POR PORÇÃO/ PER PORCION (27g) %DR*/ RI*	%DR*/ RI*
ENERGIA/ ENERGY	1779kJ 422kcal	480kJ 114kcal	6 8400kJ 2000kcal
LÍPIDOS/ FAT DOS QUAIS/ OF WHICH: SATURADOS/ SATURATES	10g 1,0g	2,7g 0,3g	4 20g
HIDRATOS DE CARBONO/ CARBOHYDRATE DOS QUAIS/ OF WHICH: AÇÚCARES/ SUGARS	74g 17g	20g 4,6g	8 90g
FIBRA/ FIBRE	4,0g	1,1g	
PROTEÍNAS/ PROTEIN	7,0g	1,9g	4 50g
SAL/ SALT	1,20g	0,32g	5 6g

* DOSE DE REFERÊNCIA (DR) - DOSE DE REFERÊNCIA PARA UM ADULTO MÉDIO (8400KJ/ 2000KCAL).
* REFERENCE INTAKE (RI) - REFERENCE INTAKE OF AN AVERAGE ADULT (8400KJ/ 2000KCAL).

ESTA EMBALAGEM CONTÉM APROXIMADAMENTE 22 PORÇÕES.
THIS PACKAGE CONTAINS APPROXIMATELY 22 PORTIONS.

Por porção de/
Per portion of
27g

480kJ

114kcal

6% DR/RI*

2,7g

LÍPIDOS FAT

4% DR/RI*

0,3g

SATURADOS SATURATES

1% DR/RI*

4,6g

AÇÚCARES SUGARS

5% DR/RI*

0,32g

SAL SALT

5% DR/RI*

Energia/ Energy 100g: 1779kJ/ 422kcal

Qual é a opção mais saudável para ti?

A. ☐ B. ☐ Não sei ☐

2. Cereais

A.

CEREAIS DE AVEIA, ARROZ E TRIGO COM CHOCOLATE NEGRO, CHOCOLATE DE LEITE E CHOCOLATE BRANCO.

INGREDIENTES: Cereais (61%) (flocos de aveia, farinha de aveia, cereais extrudidos (farinha de arroz, farinha de trigo, sal, açúcar, farinha de malte de trigo, sal, açúcar caramelizado em pó)), palitos de chocolate negro e branco (13%) (açúcar, manteiga de cacau, pasta de cacau, leite gordo em pó, gordura anidra do leite, cacau em pó, emulsionante (fosfatídicos de amônio)), açúcar, óleo de girassol (óleo de girassol, antioxidante (extrato rico em tocoferóis)), chocolate de leite (6,7%) (açúcar, leite gordo em pó, manteiga de cacau, pasta de cacau, soro de leite em pó, leite magro em pó, emulsionante (lecitina de soja), aroma), mel, cacau em pó magro, maltodextrina, sal, aroma.

DECLARAÇÃO NUTRICIONAL	POR 100g DE PRODUTO	POR PORÇÃO (45g)	%DR*	DR*
ENERGIA	1980kJ 472kcal	891kJ 212kcal	11	8400kJ 2000kcal
LÍPIDOS	19,0g	8,6g	12	70g
DOS QUAIS:				
ÁCIDOS GORDOS SATURADOS	5,0g	2,3g	11	20g
HIDRATOS DE CARBONO	64,0g	29g	11	260g
DOS QUAIS:				
AÇÚCARES	21,0g	9,5g	11	90g
FIBRA	4,5g	2,0g		
PROTEÍNAS	9,0g	4,1g	8	50g
SAL	0,35g	0,16g	3	6g

Por porção de 45g

891kJ 212kcal	8,6g	2,3g	9,5g	0,16g
11% DR*	12% DR*	11% DR*	11% DR*	3% DR*

Energia por 100g: 1980kJ / 472kcal

B.

ARGOLAS DE CEREAIS COM MEL. ALTO TEOR EM FERRO E VITAMINAS D, C, B1, B2, B3, B6, B9, B12, BIOTINA e B5.

INGREDIENTES: Farinhas (trigo, milho, arroz, aveia) (61%), açúcar, sênea de trigo, mel (4,4%), amido de milho, xarope de glucose, sal, levedante (carbonato de cálcio), corante (betacaroteno e aneto), tiamina (B1), riboflavina (B2), ácido pantotênico (B5), vitamina B6, folacina (B9).

DECLARAÇÃO NUTRICIONAL	POR 100g DE PRODUTO	POR PORÇÃO (30g)	%DR*	DR*
ENERGIA	1807kJ 427kcal	542kJ 128kcal	6	8400kJ 2000kcal
LÍPIDOS	2,3g	0,7g	1	70g
DOS QUAIS:				
ÁCIDOS GORDOS SATURADOS	0,4g	0,1g	1	20g
HIDRATOS DE CARBONO	92g	28g	11	260g
DOS QUAIS:				
AÇÚCARES	26g	7,8g	9	90g
FIBRA	5,3g	1,6g		
PROTEÍNAS	6,8g	2,0g	4	50g
SAL	0,75g	0,23g	4	6g

Por porção de 30g

542kJ 128kcal	0,7g	0,1g	7,8g	0,23g
6% DR*	1% DR*	1% DR*	9% DR*	4% DR*

Energia por 100g: 1807kJ / 427kcal

Qual é a opção mais saudável para ti?

A. ☐ B. ☐ Não sei ☐

3. Barrinhas de cereais

A.

INGREDIENTES: Farinhas (milho, trigo e aveia) (59%), açúcar, mel (1,7%), sal, óleo de girassol, emulsionante (mono e diglicerídeos de ácidos gordos), levedante químico (carbonato de cálcio), corante (B- caroteno), tiamina (B1), riboflavina (B2), ácido pantotênico (B5), vitamina B6, folacina (B9), vitamina B12, biotina (H), niacina (PP), vitamina C, vitamina D e ferro.

DECLARAÇÃO NUTRICIONAL	POR 100g DE PRODUTO	POR PORÇÃO (30g)	%DR*	DR*
ENERGIA	1645kJ 388kcal	494kJ 116kcal	6	2000kJ 480kcal
LÍPIDOS	2,0g	0,6g	1	70g
DOS QUAIS:				
ÁCIDOS GORDOS SATURADOS	1,3g	0,4g	2	20g
HIDRATOS DE CARBONO	85g	26g	10	260g
DOS QUAIS:				
AÇÚCARES	30g	9,0g	10	90g
FIBRA	2,8g	0,8g		
PROTEÍNAS	6,1g	1,8g	4	50g
SAL	0,75g	0,23g	4	6g

Por porção de 30g

494kJ 116kcal	0,6g	0,4g	9,0g	0,23g
6% DR*	1% DR*	2% DR*	10% DR*	4% DR*

Energia por 100g: 1645kJ / 388kcal

B.

BARRAS DE CHOCOLATE DE LEITE COM RECHEIO DE CREME DE LEITE

INGREDIENTES: Açúcar, leite em pó (25%), gorduras vegetais (palma, palmiste), manteiga de cacau, massa de cacau, leite em pó desnatado, emulsionante (E322) e aroma. Pode conter vestígios de glúten, frutos de casca rija, amendoins e ovos. Cacau: 30% mínimo.

DECLARAÇÃO NUTRICIONAL	POR 100g DE PRODUTO	POR PORÇÃO (12,5g=1 BARRINHA)	%DR*	DR*
ENERGIA	2317kJ 555kcal	290kJ 69kcal	3	8400kJ 2000kcal
LÍPIDOS	34g	4,3g	6	70g
DOS QUAIS: SATURADOS	21g	2,6g	13	20g
HIDRATOS DE CARBONO	54g	6,8g	3	260g
DOS QUAIS: AÇÚCARES	53g	6,6g	7	90g
FIBRA	0,8g	0,1g		
PROTEÍNAS	7,9g	1g	2	50g
SAL	0,25g	0,03g	1	6g

Por porção de 12,5g

290kJ 69kcal	4,3g	2,6g	6,6g	0,03g
3% DR*	6% DR*	13% DR*	7% DR*	1% DR*

Energia por 100g: 2317kJ / 555kcal

Qual é a opção mais saudável para ti?

A. ☐ B. ☐ Não sei ☐

4. Iogurte

A. CONTINENTE
IOGURTE LÍQUIDO MAGRO AROMATIZADO COM MORANGO. CONTÉM AÇÚCARES NATURALMENTE PRESENTES.
INGREDIENTES: Leite pasteurizado desnatado (Origem: Portugal), sólidos lácteos reconstituídos, puré de morango (2,5%), amido modificado de milho, aroma, edulcorantes (E955, E950), conservante (E202), corantes (E160a(i), E120) e fermentos lácteos. **MODO DE CONSERVAÇÃO:** Refrigerado (entre 0-6°C). **CONSUMIR ATÉ:** (ver tempo)

DECLARAÇÃO NUTRICIONAL	Por 100 g	Por porção (160 g)	%DR*
ENERGIA	126 kJ 30 kcal	202 kJ 48 kcal	2
LÍPIDOS	0,1 g	0,2 g	<1
DOS QUAIS SATURADOS	0,1 g	0,2 g	1
HIDRATOS DE CARBONO	4,9 g	7,8 g	3
DOS QUAIS AÇÚCARES	4,8 g	7,7 g	9
PROTEÍNAS	2,3 g	3,7 g	7
SAL	0,15 g	0,24 g	4

*Dose de Referência (DR): Dose de referência para um adulto médio (8 400 kJ / 2 000 kcal).
Esta embalagem contém 4 porções de 160g.

Por porção de 160g

202 kJ 48 kcal	0,2g LÍPIDOS	0,2g SATURADOS	7,7g AÇÚCARES	0,24g SAL
2% DR*	<1% DR*	1% DR*	9% DR*	4% DR*

Energia por 100g: 126 kJ / 30 kcal

B. CONTINENTE
IOGURTE BATIDO NATURAL.
INGREDIENTES: Leite gordo pasteurizado, nata (contém leite), leite em pó magro, fermentos lácteos.
MODO DE CONSERVAÇÃO: Conservar entre 0°C e 6°C.
CONSUMIR ATÉ/LOTE: (ver parte superior da embalagem)

DECLARAÇÃO NUTRICIONAL	Por 100 g	Por porção (125g)	%DR*
ENERGIA	496 kJ 120 kcal	620 kJ 150 kcal	8
LÍPIDOS	10 g	13 g	18
DOS QUAIS SATURADOS	7,3 g	8,9 g	45
HIDRATOS DE CARBONO	3,7 g	4,6 g	2
DOS QUAIS AÇÚCARES	3,7 g	4,6 g	5
PROTEÍNAS	3,7 g	4,6 g	9
SAL	0,10 g	0,13 g	2

*Dose de Referência (DR): Dose de referência para um adulto médio (8 400 kJ / 2 000 kcal).
Esta embalagem contém aproximadamente 8 porções de 125g.

PRODUTO CONTROLADO POR TESTES EM LABORATÓRIO. SERVIÇO DE INFORMAÇÃO AO CONSUMIDOR:
apoio@contente.pt
DISTRIBUÍDO POR:
Modelo Continente Hipermercados, S.A.
Rua João Mendonça, 505
4464-503 Senhora da Hora, Portugal.

SONAE 1Kg e

ISO 9001

Plástico

Recicla

Qual é a opção mais saudável para ti?

A. ☐ B. ☐ Não sei ☐

5. Bebidas

A. PRODUTO CONTROLADO POR TESTES EM LABORATÓRIO.
REFRIGERANTE GASEIFICADO AROMATIZADO A LIMA-LIMÃO. CONTÉM AÇÚCAR E EDULCORANTE.
INGREDIENTES: ÁGUA GASEIFICADA, AÇÚCAR, REGULADORES DE ACIDEZ (E330, E296 E E331), AROMA, CONSERVANTE (E202) E EDULCORANTE (E955).
SERVIÇO DE INFORMAÇÃO AO CONSUMIDOR: APARTADO 40111, 2201-999 ANADÓRIA E-MAIL: SIGA.AS.CORES@SONAE.MC.COM
DISTRIBUÍDO POR: MODELO CONTINENTE HIPERMERCADOS, S.A.
Rua João Mendonça, 505 4464-503 SENHORA DA HORA
CONSERVAR EM LOCAL FRESCO E SECO. AO ABRIR DA LATA, SOLAR, DEPOIS DE ABERTO CONSERVAR NO FRIGORÍFICO E CONSUMIR NO PRZO MÁXIMO DE 3 DIAS. DEVE BEBER-SE FRESCO.

SIGA AS CORES - Opte por escolher alimentos que apresentem mais nutrientes a verde e laranja do que a vermelho.

REFRIGERANTE GASEIFICADO AROMATIZADO A LIMA-LIMÃO. CONTÉM AÇÚCAR E EDULCORANTE. CONSUMIR DE PREFERÊNCIA ANTES DE: (VER TAMPA) LOTE: (VER TAMPA)

DECLARAÇÃO NUTRICIONAL	Por 100 ml	Por porção (200ml)	%DR*
ENERGIA	135 kJ 32 kcal	269 kJ 63 kcal	3
LÍPIDOS	0	0	0
DOS QUAIS SATURADOS	0	0	0
HIDRATOS DE CARBONO	7,9g	14g	6
DOS QUAIS AÇÚCARES	7,9g	14g	18
FIBRA	0	0	0
PROTEÍNAS	0	0	0
SAL	0,08	0,16	2,7

Energia por 100ml: 135 kJ / 32 kcal

B. CONTINENTE
REFRIGERANTE GASEIFICADO AROMATIZADO A LIMA-LIMÃO. CONTÉM AÇÚCAR E EDULCORANTE.
INGREDIENTES: ÁGUA GASEIFICADA, AÇÚCAR, REGULADORES DE ACIDEZ (E330, E296 E E331), AROMA, CONSERVANTE (E202) E EDULCORANTE (E955).
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REFRIGERANTE GASEIFICADO AROMATIZADO A LIMA-LIMÃO. CONTÉM AÇÚCAR E EDULCORANTE. CONSUMIR DE PREFERÊNCIA ANTES DE: (VER TAMPA) LOTE: (VER TAMPA)

DECLARAÇÃO NUTRICIONAL	Por 100 ml	Por porção (200ml)	%DR*
ENERGIA	135 kJ 32 kcal	269 kJ 63 kcal	3
LÍPIDOS	0	0	0
DOS QUAIS SATURADOS	0	0	0
HIDRATOS DE CARBONO	7,9g	14g	6
DOS QUAIS AÇÚCARES	7,9g	14g	18
FIBRA	0	0	0
PROTEÍNAS	0	0	0
SAL	0,08	0,16	2,7

Energia por 100ml: 135 kJ / 32 kcal

Qual é a opção mais saudável para ti?

A. ☐ B. ☐ Não sei ☐

O que já sabes?

PARTE A: Conselhos

Segundo os especialistas devemos...

1. Comer mais, a mesma quantidade, menos dos seguintes alimentos?

	Mais	A mesma quantidade	Menos	Não sei
Fruta	☐	☐	☐	☐
Refrigerantes	☐	☐	☐	☐
Gorduras	☐	☐	☐	☐
Bolachas	☐	☐	☐	☐
Salgados	☐	☐	☐	☐
Água	☐	☐	☐	☐

2. Qual a quantidade de frutas que devemos comer?

1	☐
2	☐
3	☐
4 ou mais	☐
Não sei	☐

3. Quais destas gorduras devemos comer menos? Podes escolher uma, duas ou todas.

Gorduras insaturadas	☐
Gorduras saturadas	☐
Gorduras transformadas	☐
Não sei	☐

4. Quantas vezes por semana devemos comer pequeno-almoço?

Todos os dias	☐
Dia sim, dia não	☐
3 vezes por semana	☐
Não sei	☐

5. A quanta fruta equivalem dois copos de sumo natural?

Uma peça de fruta/ 1 porção	☐
Duas peças de fruta/ 2 porções	☐
Três peças de fruta/ 3 porções	☐
Não sei	☐

6. Quantos legumes ou vegetais devemos comer por dia?

1	☐
2	☐
3	☐
4 ou mais	☐
Não sei	☐

PARTE B: Grupos de alimentos

Na tua opinião, dos alimentos seguintes...

1. Quais têm mais ou menos açúcar?

	Mais	Menos	Não sei
Coca-cola	☐	☐	☐
iogurte natural	☐	☐	☐
Ketchup	☐	☐	☐
Banana	☐	☐	☐

2. Quais têm mais ou menos sal?

	Mais	Menos	Não sei
Cereais de pequeno almoço	☐	☐	☐
Vegetais	☐	☐	☐
Pão	☐	☐	☐
Salchichas embaladas	☐	☐	☐

3. Quais têm mais ou menos fibra?

	Mais	Menos	Não sei
Cereais integrais	☐	☐	☐
Banana	☐	☐	☐
Arroz branco	☐	☐	☐
Arroz integral	☐	☐	☐

4. Quais têm mais ou menos proteína?

	Mais	Menos	Não sei
Frango	☐	☐	☐
Leite	☐	☐	☐
Fruta	☐	☐	☐
Feijões	☐	☐	☐

5. Quais têm mais ou menos hidratos de carbono?

	Mais	Menos	Não sei
Queijo	☐	☐	☐
Massa	☐	☐	☐
Batatas	☐	☐	☐
Pão	☐	☐	☐

6. Quais têm mais ou menos calorias?

	Mais	Menos	Não sei
Pão integral	☐	☐	☐
Fruta	☐	☐	☐
Cereais estrelistas	☐	☐	☐
Batatas fritas	☐	☐	☐

O que já sabes?

PARTE C: Geral

1. Qual destes nutrientes deves consumir mais?

Hidratos de carbono ☐

Proteínas ☐

Legumes ☐

Lacticínios ☐

2. Para que servem as vitaminas e minerais na alimentação?

Para ganhar músculo ☐

Para perder gordura ☐

Para regular o organismo ☐

Para dar energia ☐

3. O que é uma alimentação saudável?

Uma alimentação rica em proteínas ☐

Uma alimentação variada ☐

Uma alimentação com pouca gordura ☐

Uma alimentação com poucos hidratos de carbono ☐

4. O que são macronutrientes?

Vitaminas e minerais ☐

Vitaminas, minerais e proteínas ☐

Vitaminas, hidratos de carbono e lacticínios ☐

Hidratos de carbono, proteínas e gorduras ☐

5. Qual destes nutrientes não entra na roda dos alimentos?

Proteínas ☐

Hidratos de carbono ☐

Gorduras ☐

Açúcar ☐

6. O que são alimentos de verdade?

Alimentos processados ☐

Alimentos da natureza sem químicos ☐

Alimentos produzidos em fábricas ☐

Alimentos empacotados ☐

Que cuidados tens?

N	Items	Nunca	Raramente	Às vezes	Muitas vezes	Sempre
1	Eu planeio as minhas refeições para que sejam saudáveis					
2	Eu leio sobre alimentação saudável em livros					
3	Bebo mais refrigerantes do que água					
4	Eu leio os rótulos dos produtos alimentares para saber que nutrientes têm					
5	Aprendo sobre alimentação saudável na televisão					
6	Eu peço à minha família para comprar alimentos saudáveis					
7	Como alguns alimentos que não gosto muito porque sei que me fazem bem					
8	Gosto de experimentar comidas novas					
9	Pergunto ao meu professor informações sobre alimentação saudável					
10	Como alimentos que contêm ferro					
11	Escolho comer alimentos que sei que têm vitaminas					
12	Se eu achar que estou a ficar gordo, como menos doces/ açúcar					
13	Pergunto à minha família informação sobre alimentação saudável					
14	Prefiro beber um refrigerante do que comer uma fruta ao lanche					
15	Gosto de colocar muito sal na minha comida					
16	Não gosto de variar os alimentos que como					
17	Aprendi mais sobre alimentação saudável com o médico					
18	Bebo muita água durante o dia					
19	Aprendi sobre alimentação saudável na escola					
20	Costumo perguntar aos meus pais que alimentos são saudáveis e quais não são					

Que cuidados tens?

21	Como alimentos ricos em vitamina C					
22	Lavo a fruta antes de a comer					
23	Prefiro comer carnes brancas a carnes vermelhas					
24	Converso com os meus amigos sobre quais alimentos são mais saudáveis					
25	Como proteína em todas as refeições					
26	Tento beber bebidas com cálcio					
27	Como alimentos ricos em vitamina A					
28	Verifico se as minhas refeições têm nutrientes bons e suficientes para mim					
29	Tomo o pequeno almoço todos os dias					
30	Costumo beber refrigerantes e não tanto sumos de fruta natural					
31	Prefiro comer doces do que comer fruta					
32	Costumo pensar sobre se estou a comer comida saudável					
33	Às refeições bebo refrigerantes					
34	Escolho comer alimentos com pouca gordura					
35	Procuro informação sobre alimentação saudável na internet					
36	Vejo anúncios sobre alimentação/ produtos alimentares					
37	Como uma grande variedade de alimentos					
38	Bebo 8 copos de água por dia					
39	Costumo comer batatas fritas ao lanche					
40	Leio informação sobre alimentação saudável em revistas e jornais					
41	Ajudo a minha família a escolher alimentos saudáveis para comprar					
42	Faço perguntas a adultos sobre alimentação saudável					
43	Como fruta todos os dias					
44	Como vegetais verdes todos os dias					
45	Como outros vegetais todos os dias					
46	Como carne ou produtos que substituem a carne (se for vegetariano)					
47	Bebo leite todos os dias					
48	Como doces todos os dias					
49	Como pão e cereais todos os dias					
50	Como produtos embalados todos os dias					

 *Obrigado!*

ANNEX III

Systematic Literature review - Comparative table

Citation	Purpose of the study	Research design	Participants (n, age, gender, country)	Intervention	Teoretical models	Measures	Outcomes	Media used
Banos et al, 2013	To study the efficacy and acceptability of an online game called ETIOBE Mates designed to improve children's nutritional knowledge	Quasi-experimental	N (intervention): 73 N (control): 155 School-setting: 4 th to 6 th grade Age: 10-13; (mean=11,2) Sex: Male and female Country: Valencia, Spain	Intervention: videogame ETIOBE Mates Treatment: play the ETIOBE Mates Control: traditional paper and pencil mode of information (pamphlet called 'balanced diet') Type: Diet Duration: 2 weeks Topics: Nutritional knowledge – nutritional terms, awareness of dietary recommendations, nutrients contained in food, practical food choices,, awareness of diet disease associations.	Not reported	- BMI - Internet and game-playing habits (6 item questionnaire) - Nutritional Knowledge Questionnaire for children (35 items) - Acceptability-playability questionnaire: 26 items	Anthropometry (height, weight BMI) Internet and game playing habits Nutritional Knowledge	Online video game
Baranowski et al., 2012	To evaluate the outcome of playing 2 videogames on children's diet, physical exercise and adiposity.	RCT	N (intervention): 103 N (control): 50 School-setting: middle school Age: 10-12 Sex: Male and female Country: North Carolina and Texas, U.S.	Intervention: Videogames: <i>Escape from Diab</i> and <i>Nanoswarm; Invasion from inner space</i> Treatment: Played both videogames in sequence during 9 sessions of +-40minutes (total of ~6h play) Control: played diet and PA knowledge based games. Type: Diet + PA	Serious videogames Game-based learning	3 nonconsecutive days of 24h dietary recalls 5 consecutive days of PA using accelerometers - Height and weight - Waist circumference, triceps skinfold.	Serving of FV and water Minutes of moderate PA	Online video games

				Topics: diet, FV, adiposity, physical activity				
Bech-Larsen & Gronhoj, 2013	Feedback intervention aimed at increasing consumption of FV.	RCT	N (intervention): 169 N (control): 87 School-setting: Age:12 Sex: Male and female Country: Denmark	Intervention: Mobile-phone based SMS system Treatment: Nutrition education lessons with a dietician and 4 weeks of SMS diary Control: Only nutrition classes with a dietician Type: Diet Duration: 4 weeks Topics: FV, goals, planning, how to count units/portions	Social cognitive theory Goal theory (goal setting strategy)	FV consumption	FV	SMS
Cullen et al, 2016	To increase FV consumption.	RCT	N (intervention): 290 N (control): 97 School-setting: 4 th and 5 th grade Age (mean): 9-11 Sex: Male and female Country: Houston, U.S.	Intervention: "Squire's Quest! II: Saving the Kingdom of Fivealot!" 4 experimental groups based on the type of implementation intentions used:1) Control (none); 2) Action; 3) Coping; 4) Action+Coping. Treatment: Play the game and implementation intentions (action, coping, action+coping) Control: none Type: Diet Duration: 6 months Topics: setting meal-specific goals for eating	Implementation intention, action plans, coping plans.	- Children completed 3 24-hour dietary recalls (2 week days, 1 weekend day) via phone (breakfast, lunch, snack, dinner intakes). - FV intake in those 3 days were averaged to estimate the amount of VF consumption.	FV consumption	Online video game

				FV (breakfast, lunch, snacks, and dinner). Setting a personal plan to eat 5 FV daily.				
Ezendam, Brug, Oenema, 2012	To evaluate the short and long-term results of FATaintPHAT, a web-based computer-tailored intervention aiming to increase physical activity and healthy eating.	Cluster Randomised Controlled Trial	N (intervention): 485 N (control): 398 School-setting: secondary education schools Age: 12-13 Sex: Male and female Country: Netherlands	Intervention: FATaintPHAT - a web-based computer-tailored intervention. Treatment: a web-based computer-tailored intervention Control: regular curriculum Type: Diet + PA Duration: 8 lessons online (internet) over 10 weeks/2 year follow-up Topics: weight management and energy balance-related behaviors.	Theory of Planned behavior Precaution Adoption Process Model Implementation intentions	• Self-reported behaviors: • Food frequency questionnaire, • 24h recall for snacks and FV • Flemish validated questionnaire for PA • Number of days with moderate to vigorous PA - Pedometers • Anthropometric measures using digital scales	Self-reported behaviors for diet, PA and sedentary behavior; Pedometer count. Anthropometry (BMI, waist circumference)	Computer/internet
Fassnacht et al., 2015	To examine the efficacy, satisfaction and adherence of a mobile phone SMS service to promote health behaviors.	RCT	N (intervention): 22 N (control): 27 School-setting: 4 th grade Age: 8-10 (mean=9,6; SD=0,4) Sex: Male and female Country: Portugal	Intervention: SMS-based monitoring and feedback system Treatment: SMS intervention Control: No SMS Type: Diet + PA Duration: 8 weeks–follow-up (4months later) Topics: diet, physical activity, screen time	Social cognitive theory and behavioral models	• Food frequency questionnaire (FV) • PA and screen time – Family eating and activity questionnaire • Anthropometric measures (height, weight, BMI) • Pedometer • Satisfaction	FV PA Screen time	SMS

						questionnaire		
Jones, Madden & Wengren, 2014	To explore a low-cost, game-based Intervention to increase FV consumption.	Alternating-treatment design trial	N (intervention): 251 N (control): 251 School-setting: 5 th grade Age: 10-11 Sex: male and female Country: Utah, U.S.	Intervention: Game-based intervention: FIT Game. The whole school played the game. At baseline, 15 days to measure FV consumption using FV waste (weight-based measure). FV were target each day for increasing consumption. A story with heroes and villains was told to students and they were asked to help by eating more of the target food during lunch. Reinforcement was done when students meet the goal. Type: Diet Duration: 1,5 months (44 days) Topics: story with heroes and villains, FV, healthy eating.	Incentives model to increase target behavior; gamification, competition/collaboration	FV weighted (plate-waste measure technique)	FV intake	Game (collaborative, competitive game)
Joyner et al, 2017	To analyse whether FIT Game can be administered and keep its efficacy	Alternating-treatment design trial	N (intervention): 572 N (control): 572 School-setting: 5 th grade Age: 6 -11 Sex: Male and	Intervention: Game-based intervention: FIT Game. The whole school played the game. At baseline, 15 days to measure FV consumption using FV waste (weight-	Incentives model to increase target behavior; gamification, competition/	FV weighted (plate-waste measure technique)	FV intake	Game (collaborative, competitive)

	without teachers work, presenting all materials on visual displays at the school cafeteria.		female Country: Utah, U.S.	based measure). FV were target each day for increasing consumption. A story with heroes and villains was showed to students in screens at cafeteria to students and they were asked to help by eating more of the target food during lunch. Reinforcement was done when students meet the goal. No teacher intervention. Type: Diet Duration: 1,5 months (44 days) Topics: story with heroes and villains, FV, healthy eating.	collaboration			e game)
Moore et al, 2009	To improve children's nutrition related self-care operations.	Quasi-experimental	N (intervention): 64 N (control): 62 School-setting: 5 th grade Age: 9 - 11 Sex: Male n=46, Female n=80 Country: Washington DC, U.S.	Intervention: COLOUR MY PYRAMID Treatment: Education and activity content + experiential learning with digital game MyPyramid Blast Off Game Control: Education and activity content + experiential learning using individual computers to evaluate their diets in small groups Type: Diet + PA	Self-care deficit nursing theory (Orem, 2001)	• Nutrition knowledge questionnaire (28 items) • Adolescent nutrition self-care questionnaire (50 items, likert scale)(Moore et al, 2005) • Student Physical activity - Recall of minutes of physical activity per	Nutrition knowledge Nutrition self-care practices PA, Anthropometry (blood pressure, height, weight, BMI)	Online video game

				Duration: 6 classes – 3 months Topics: Nutrition concepts, moderation, variety, portion sizes, exercise.		day • Nutritional Status – research anthropometric Form (RA) (7 items) – record of height, weight, blood pressure		
Nollen et al. 2013	To test the feasibility and efficacy of mobile technology intervention to promote FV consumption and decrease sweetened beverages.	RCT	N (intervention): 26 N (control): 25 School-setting: After school-program Age (mean): 9–14 Sex: Female only Country: Kansas, U.S.	Intervention: Mobile technology Treatment: mobile technology use with real time setting prompts, self-monitoring, tips, feedback, positive reinforcement related to target behaviors Control: written manual with same content, no prompting messages Type: Diet Duration: 12 weeks Topics: FV, sugar sweetened beverages, screen-time	Behavioral weight control principles	• 2 day 24h dietary recall (1 week day and weekend day) • Screen time was assessed using Brief Questionnaire of Television Viewing and Computer Use • Weight and height	Device use Effect sizes of FV, sugar-sweetened beverages, screen-time, BMI	Mobile app with prompting SMS
Pedersen, Gronhoj & Thogersen, 2016	To examine the effects of a feedback intervention employing text messaging on	RCT	N (intervention): 489 + 497 N (control): 502 School-setting: Age: 11-16 (mean=12,9) Sex: Male and female Country:	Intervention: Feedback intervention with text-messaging Treatment: 1) text messaging 2) text messaging + educational group class. Control: No text messaging	Self-efficacy – Social Cognitive Theory	• Participants' behavior: Survey with intake frequency items and FV • Self-efficacy: 9 items adapted from Perry et al, (2008) Physical Activity and Healthy Food	FV intake Self-efficacy Outcome expectations	SMS

	adolescent s' behavior, self- efficacy and outcome expectation s regarding FV		Denmark	Type: Diet Duration: 11 weeks(week 1 and 11 to pre and post- tests) Topics: fruit and vegetable intake		Efficacy Scale for Children (PAHFE). • Outcome expectations: instrument adapted from Thogersen & Gronhoj 2010. Engagement: measured by participants' total SMS sent.		
Rees & Baker, 2010	To evaluate the effectivene ss of a computer- generated tailored intervention leaflet aimed at increasing brown bread, wholegrain cereal, FV	Clustered RCT	N (intervention): 323 N (control): 314 School-setting: secondary schools Age (mean): 12- 16 (mean=14) Sex: Female only Country: London and West Midlands, UK	Intervention: computer- generated tailored intervention leaflet Treatment: Tailored leaflet made by using a computer program that automatically considered and analysed questionnaire responses and produced a leaflet using a standard template. Control: traditional leaflet using national guidelines of intake recommendations. Type: Diet Duration: 4,5 months (3 months intervention + 3 weeks for baseline + 3 weeks for endline dietary recalls) Topics: Fruit and	Theory of Planned Behavior	• Dietary intake was accessed via 3 24h dietary recalls (previous day/ 3 different days at baseline and then at follow-up again). • Psychological questionnaire (beliefs)(30 items for each food)	Brown bread, wholegrai n cereals, fruit, vegetable s. Psycholo gical outcomes Frequenc y measure of target food consumpt ion	Com puter - gener ated leafle t tailor ed

				vegetables intake, portions, planning and implementation.				
Silva, et al, 2015	To evaluate the effectiveness of the program to increase FV consumption and physical activity.	RCT	N (intervention): 69 N (control): 70 School-setting: Elementary school Age (mean): 8-10 (mean=9,9) Sex: Male and female Country: Braga, Portugal	Intervention: Text-messaging SMS Intervention: 2x 60 minutes psycho-educational sessions + SMS program (monitor their behavior for 8 weeks providing information at the end of the day, by SMS: How many FV they have eaten; How many steps they have walked, How many minutes they have spent in front of a screen) Control: Only 2x 60 minutes psycho-educational sessions Type: Diet + PA Duration: 8 weeks + follow-up (4 weeks later) Topics: FV, Screen time, physical activity	Social cognitive theory and behavioral models	• Food frequency and physical activity questionnaire • Food Frequency Questionnaire (Vereecken & Maes, 2003) • Family Eating and Activity Habits Questionnaire (Golan & Weizman, 1998) • Pedometers (to count steps per day) • BMI (height and weight) • Self-report satisfaction questionnaire (after the intervention for intervention group) •	BMI FV intake Exercise Screen time	SMS
Sharma et al., 2015	Evaluate the effects of the Quest to Lava Mountain	Quasi-experimental	N (intervention): 44 N (control): 50 School-setting: 4 th and 5 th grade Age:9-10	Intervention: Quest to Lava Mountain – game in which players must create an avatar and make it eat healthy and stay active. Treatment: Play the game	Social cognitive theory, Theory of Reasoned Action	• Two random 24-hour recalls and self-report surveys	Diet (FV, sugar, fiber, fat, carbohydrates, protein,	Computer - based educ

	(QTLM) computer game on dietary behaviors and physical activity.		Sex: Male and female Country: Texas, U.S.	Control: Don't play the game Type: Diet + PA Duration: Recommended exposure duration was 90min/ week for 6 weeks. Topics: food, food and exercise are related, healthy food and beverages, whole grains, low. fat dairy, water, healthy diet based on variety and moderation, physically active lifestyle helps maintain health.			calcium) PA Psychoso cial factors	ation al game s
Struemp ler et al (2014)	To increase FV consumptio n in youth	Quasi- experime ntal	N (intervention):1,6 74 N (control):803 School-setting: 3rd grade students Age: 8 to 9 Sex:51% male, 49% female Country: Alabama (U.S.)	Intervention: BODY QUEST Food of the warrior Experimental: 6 traditional educator-led lessons + 1 week of non-traditional lesson with iPad apps + FV tasting + take-home activities Control: No intervention. Type: Diet Duration: 17 weeks/ 45min classes Topics: Trying new foods, food groups, balanced meals, food nutrients, healthy snacks, extending FV message to others.	Experiential Learning Theory	- Checklist developed for the study: "what's for lunch(W4L)?" checklist - Students self-report	Weekly FV consume d in school lunch	IPad apps

Yang et al, 2017	To identify the effectiveness of an obesity prevention program focused on motivating environments	Quasi-experimental	N (intervention): 418 N (control): 350 Education level: 4 th and 7 th grade Age: 9 to 10 and 12 to 13 Sex: Male and female Country: Chungju, Korea	Intervention: Environmental intervention. Treatment: Diet and exercise related educational video content provided by internet protocol TV – IPTV during rest time + design materials/ publicity exposed in school. Control: usual school curriculum/ traditional learning Type: Diet + PA Duration: 1 year Topics: educational dietary, daily lunch menu, exercise.	Not reported	• Anthropometry measures • Student Physical Activity Questionnaire about physical activity, sleeping, dietary, nutritional knowledge, self-image, self-respect, life quality, depression. • Parental questionnaire (9 items about the child and 11 items about the child's family)	Anthropometry (height, weight, BMI, Waist size, blood pressure) PA Nutritional behavior	IPTV – TV video content; printed posters

