



FOODLIT-PRO: FOOD LITERACY PROJECT
FOOD LITERACY CONCEPTUALISATION, ASSESSMENT, AND INTERVENTION
WITH PORTUGUESE ADULTS

Raquel Alexandra Ferreira Rosas

Dissertation submitted in partial fulfilment of the requirements for the degree of
Doctor in Philosophy
Specialty: Health Psychology

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Consegui(mos), Avô.

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*Food is the single strongest lever to optimize
human health and environmental sustainability on Earth.*

EAT-Lancet Commission

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ABSTRACT

Individuals' food-related education and empowerment is crucial not only to transform knowledge, competencies, and behaviours towards healthier and more sustainable food choices, but also to provide for skills that allow consumers to successfully navigate within food systems. The central aim of this dissertation was to contribute to further advancements in the field of food literacy by exploring its conceptual understanding, facilitate its assessment, and developing a theory-supported intervention. To this end, we developed a mixed-methods and sequentially designed project entitled 'FOODLIT-PRO: Food Literacy Project' that comprises three stages described in five chapters. Presented in chapters 2 and 3, Stage 1 demonstrated a wider outlook on the comprehension of food literacy, providing for a conceptual and empirical framework with a multidimensional definition of the construct, a characterisation of its determinants, and the identification of inter-sectorial fields of action. Described in chapter 4, Stage 2 allowed to translate the multifaceted conceptualisation of food literacy into a quantitative assessment tool, providing for an adaptable and validated measure to assess food literacy, its determinants, and influential factors in Portuguese adult samples. Presented in chapter 5 and 6, Stage 3 enabled the first known mapping of food literacy content into digitally delivered behaviour change techniques and allowed to verify the theoretical suitability of the Health Action Process Approach in predicting food literacy outcomes. These findings suggest that a broader approach should be taken when striving to promote food literacy, acknowledging the impact of surrounding areas and identified determinants. Emphasising the synergy between consumers' food literacy and wider fields of action, the FOODLIT-PRO underlines the need to consider multidisciplinary approaches towards global food-related sustainability.

RESUMO

A educação e o empoderamento alimentar dos indivíduos é crucial não só para transformar conhecimentos, competências, e comportamentos com vista a escolhas alimentares mais saudáveis e sustentáveis, mas também para permitir que estes consigam lidar com sucesso com os desafios inerentes aos sistemas alimentares. Esta dissertação teve como principal objectivo contribuir para a expansão do campo da literacia alimentar através da investigação do seu entendimento conceptual, da facilitação da sua mensuração, e do desenvolvimento de intervenção com base na evidência. Para tal, foi delineado um projecto sequencial e de métodos mistos designado ‘FOODLIT-PRO: Food Literacy Project’ que compreendeu três fases descritas em cinco capítulos distintos. Apresentada nos capítulos 2 e 3, a Fase 1 evidenciou uma perspectiva mais ampla do conceito de literacia alimentar, resultando num modelo conceptual e empírico com uma definição multidimensional do constructo, a caracterização dos seus determinants, e a identificação de áreas de actuação relacionadas. Descrita no capítulo 4, a Fase 2 permitiu a operacionalização desta conceptualização multidimensional através do desenvolvimento e validação de um instrumento quantitativo adaptável para mensurar literacia alimentar, os seus determinantes, e factores de influência em amostras de adultos Portugueses. Apresentada nos capítulos 5 e 6, a Fase 3 possibilitou o primeiro mapeamento das dimensões de literacia alimentar em estratégias de mudança comportamental aplicadas em formato digital e permitiu verificar a adequação teórica dos mecanismos do modelo Health Action Process Approach como preditores de literacia alimentar. Estes resultados sugerem a consideração de uma abordagem mais ampla na promoção de literacia alimentar, reconhecendo o impacto dos seus determinantes e das áreas de acção identificadas. Destacando a intersecção entre a literacia alimentar dos consumidores e estas vastas áreas de acção, o projecto FOODLIT-PRO sublinha a necessidade de considerar abordagens multidisciplinares na priorização da sustentabilidade alimentar.

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Publications and Presentations in Support of this Thesis

Published journal articles

- Rosas, R.**, Pimenta, F., Leal, I., & Schwarzer, R. (2019). FOODLIT-PRO: Food literacy domains, influential factors, and determinants - A qualitative study. *Nutrients*, *12*(1), 88. <http://dx.doi.org/10.3390/nu12010088>
- Rosas, R.**, Pimenta, F., Leal, I., & Schwarzer, R. (2021). FOODLIT-PRO: Conceptual and empirical development of the food literacy wheel. *International Journal of Food Sciences & Nutrition*, *72*(1), 99-111. <https://doi.org/10.1080/09637486.2020.1762547>
- Rosas, R.**, Pimenta, F., Leal, I., & Schwarzer, R. (2022a). FOODLIT-Tool: Development and validation of the adaptable food literacy tool towards global sustainability within food systems. *Appetite*, *168*, 105658. <https://doi.org/10.1016/j.appet.2021.105658>
- Rosas, R.**, Pimenta, F., Leal, I., & Schwarzer, R. (2022b). FOODLIT-Trial: Protocol of a randomised controlled digital intervention to promote food literacy and sustainability behaviours in adults using the Health Action Process Approach and the Behaviour Change Techniques Taxonomy during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, *19*, 3529. <https://doi.org/10.3390/ijerph19063529>

Conference presentations

- Rosas, R.**, Pimenta, F., Leal, I., & Schwarzer, R. (2021, August 23-27). *FOODLIT-PRO: Conceptual and empirical development of the Food Literacy Wheel* [Conference presentation]. 35th Annual Conference of the European Health Psychology Society [EHPS], online.
- Rosas, R.**, Pimenta, F., Leal, I., & Schwarzer, R. (2020, September 7). *FOODLIT-PRO: Influential Factors and Determinants of Food Literacy in Portugal* [Conference presentation]. Organization for Economic Cooperation and Development [OECD], 12th Meeting of the Food Chain Analysis Network, online.
- Rosas, R.**, Pimenta, F., Leal, I., & Schwarzer, R. (2020, January 30-1 February). *FOODLIT-PRO: Modelo Conceptual de Literacia Alimentar* [Conference presentation]. 13.º Congresso Nacional de Psicologia da Saúde [CNPS], Covilhã, Portugal.

- Rosas, R.**, Pimenta, F., Leal, I., & Schwarzer, R. (2019, September 3-7). *FOODLIT-PRO: Profiles of eating as needed and associated psychological/behavioural strategies - Portuguese experts' perspectives* [Conference presentation]. 33rd Annual Conference of the EHPS, Dubrovnik, Croatia.
- Rosas, R.**, Mota, J., Pimenta, F., Leal, I., & Schwarzer, R. (2019, September 3-7). *FOODLIT-PRO: "What determines food literacy, what are institutions doing?" Mixed-method analysis on Portuguese experts' perspectives* [Conference poster]. 33rd Annual Conference of the EHPS, Dubrovnik, Croatia.
- Rosas, R.** (2019, May 13). *Intervenções psicológicas com recurso a tecnologia: eHealth e mHealth* [Conference presentation]. Colóquio de Ciberpsicologia: Intervenções psicoterapêuticas online. ISPA - Instituto Universitário, Lisboa, Portugal.
- Pimenta, F., Gaspar, R., **Rosas, R.**, Domingos, S., Albergaria, R. (2018, July 2-6). *Penso, logo como... bem! Literacia e numeracia alimentar* [Conference presentation]. Evento .COME do Centro de Ciência Viva, Lisboa, Portugal.
- Rosas, R.**, Pimenta, F., Leal, I., & Schwarzer, R. (2018, July 2-4). *FOODLIT-PRO: Food Literacy Project* [Conference poster]. Encontro Ciência 2018 da Fundação para a Ciência e a Tecnologia, Lisboa, Portugal.
- Rosas, R.**, Pimenta, F., Leal, I., & Schwarzer, R. (2018, January 25-27). *FOODLIT-PRO: Developing food literacy* [Conference poster]. 12.º CNPS, Lisboa, Portugal.

Book chapters

- Rosas, R.** (2019). *Intervenções Psicológicas com Recurso a Tecnologia: eHealth e mHealth*. In Patrão, I., Leal, I., *Intervenção em Ciberpsicologia* (pp. 115-129). Pactor Editora.
- Rosas, R.** (2021). *Abordagem de Processos de Acção em Saúde*. In Leal, I., Pais-Ribeiro, J., *Manual de Psicologia da Saúde* (pp. 79-84). Pactor Editora.
- Pimenta, F., Queiroz, I. G., & **Rosas, R.** (2021). *Comportamento Alimentar*. In Leal, I., Pais-Ribeiro, J., *Manual de Psicologia da Saúde* (pp. 109-113). Pactor Editora.

Chapter 1

Introduction

As the current most significant global burden of disease, unhealthy eating habits represent a greater risk to mortality than unsafe sex, alcohol, tobacco, and drug use combined (Global Panel on Agriculture and Food Systems for Nutrition [GPAFSN], 2016; Willett et al., 2019). With worldwide obesity having nearly tripled in the last 50 years, the prevalence of diseases associated with high calorie and nutritionally inadequate diets are increasing (World Health Organization [WHO], 2022). Concurrently, undernutrition is also widespread with more than 800 million people being undernourished and micronutrient deficiency rampantly becoming a commonplace (GPAFSN, 2016). Additionally to its impact on human health, unhealthy dietary trends are reported to play a crucial part in environmental degradation, with its unsustainable production leading to the impoverishment of ecosystems and threatening biodiversity (Springmann et al., 2016; Tilman & Clark, 2014; Tilman et al., 2017).

Since much of the global population reports inadequate nourishment and the current food production accounts for the largest cause of planetary environmental change, it is urgent to transform the world's diets. A joining partnership amongst countries and stakeholders developed by the United Nations (UN) has led to a plan for action within the Sustainable Development Goals on the commitment to promote healthier, more equitable, and more sustainable food systems to tackle these food and environmental matters as part of the 2030 Agenda (UN, 2015, 2021a). However, most developed countries continue to demonstrate a poor alignment with the recommendations from international agencies, with empirical research showing that diet-related issues can be associated to consumers' scarce knowledge and competencies on how to navigate within progressively complex food systems (Bifulco & Caruso, 2007; Pendergast et al., 2011; Vidgen & Gallegos, 2014).

Advocating for individuals' education and empowerment to transform knowledge, skills and behaviours towards healthier dietary choices, literature on food literacy emphasises the aim to protect diet quality across the lifespan while focusing on the consumers' relationship with food and its contextual influences (Block et al., 2011; Cullen et al., 2015; Desjardins et al., 2013; Perry et al., 2017; Slater et al., 2018; Thomas et al., 2019; Vettori et al., 2019; Vidgen & Gallegos, 2014). Along with the need for more sustainable food habits, the demand to improve consumers' food patterns and consequent quality of life by tackling food-related knowledge and practical skills has made research on food literacy an emerging field (Vettori et al., 2019; Vidgen & Gallegos, 2014). However, regardless of its growing body of literature, the field of food literacy carries some limitations. Lack of theoretical consensus

on food literacy's conceptualisation and scarce empirical developments — concerning both assessment measures and interventions on how to promote it — have become significant (Krause et al., 2016; Palumbo, 2016).

To help filling in these gaps, in 2017, we designed a mixed-methods, three-staged project entitled 'FOODLIT-PRO: Food Literacy Project' that aimed to contribute by deepen the knowledge on food literacy, broaden the variety of instruments that could assess it, and by developing a theoretically supported intervention to promote food literacy skills. Thus, the Stage 1 of FOODLIT-PRO entailed two sequential studies; the first study featured a qualitative exploration on food literacy's definition, enablers and inhibitors, and adjacent contexts, by conducting interviews with Portuguese food-related experts, and the second study presented a conceptual and empirical framework of food literacy, its determinants, and its influential factors as a result of a mixed methods study, by applying a quantitative methodology to the qualitative outcomes (previously obtained in study 1). The Stage 2 of this project comprehended the psychometric development and validation of a quantitative and adaptable measure to assess food literacy with Portuguese adults. Finally, Stage 3 of FOODLIT-PRO entailed a randomised controlled trial of a digital intervention to promote food literacy targeting Portuguese consumers, theoretically supported by the Health Action Process Approach framework (Schwarzer, 2008), and featuring behaviour change techniques (Michie et al., 2013).

This dissertation is organised in seven chapters. The present chapter provides the general background, including an overview of the literature, the explanation of the project's aims, designs and methods, and data analyses, and an overview of FOODLIT-PRO's empirical studies. The following chapters (Chapters 2, 3, 4, 5, and 6) are based on five empirical articles, either published or submitted to publication, that translate specific contributions towards achieving the project's objectives. Following the empirical chapters, Chapter 7 provides a summary and integrated discussion of the main findings, in addition to this project's contribution for theory and practice, and draws recommendations for future research and policy making.

General Background

Our Plate, Our Health, Our Planet

In the last half century, worldwide food systems and food production went through significant transformations which directly impacted human life. Targeting the increase of crop yields and improving food production practices has led to an improvement on life expectancy, declining of global hunger, decreased poverty, and falling mortality rates (Steffen et al., 2015; Whitmee et al., 2015). Yet, partly driven by quick-paced globalisation, increasing purchasing powers, and needs of convenience, these health benefits were rapidly offset by global unhealthy dietary trends, which can be characterised by the intake of heavily processed, highly caloric, and rich in animal source foods (Willett et al., 2019).

This shift on how we feed ourselves has generated one of the greatest health challenges of the 21st century. The latest global projections from the WHO indicate that at least one in three adults is overweight and close to one in 10 is obese, having body mass indexes marking greater than or equal to 25 for overweight and equal to or exceeding 30 for obesity (WHO, 2013, 2022). Linked to more worldwide deaths than undernutrition, these conditions can lead to serious health consequences such as cardiovascular disease (including stroke and heart disease), type 2 diabetes, musculoskeletal disorders, and some cancers (such as breast, endometrial, and colon), and cause substantial disability and premature death (WHO, 2013). At the same time, multiple low- and middle-income nations are now facing the double burden of malnutrition, with undernutrition and obesity co-existing within the same communities. This unbalanced nutrition reality results in more than 2 billion people suffering from micronutrient deficiency, over 155 million children under the age of five being stunted (meaning, too short for their age) and 45 million estimated to be wasted (that is, too thin for their height) (WHO, 2021; Willett et al., 2019).

Beyond increasing the human health burden, unsustainably produced food and inadequate dietary habits are also stated to jeopardise environmental sustainability. Responsible for the conversion of natural ecosystems into pastures and croplands, current food production practices constitute a major threat for species' extinction (Tilman et al., 2017). Within marine systems, burden caused by food production has translated into about 60% of global fish stocks being fully fished and more than 30% reported to be overfished (Food and Agriculture Organization [FAO], 2016). With unhealthy dietary habits playing a crucial role to environmental sustainability, consumption patterns simultaneously identified as

nutritionally deficient and environmentally unsustainable are acknowledged as lose-lose diets — described as overly caloric, high in saturated fats, sugars, red meats and processed foods (Springmann et al., 2016). In addition to the strain derived by food production practices, environmental effects of lose-lose diets can further augment poor human health — with negative impacts including worsen air quality derived from agriculture to cause premature deaths, depleted food security induced by altered climate conditions, and exacerbated famine caused by extreme weather events (FAO et al., 2018; Koplitz et al., 2016; Springmann et al., 2016).

To tackle these food-related challenges on health and sustainability, the international community has been making the commitment to improve nutrition throughout multiple agendas such as the Sustainable Development Goals (UN Development Programme, 2022), the Decade of Action on Nutrition (UN System Standing Committee on Nutrition, 2022), and the Food Systems Summit (UN, 2021b). Demanding for bolder strategies to attain healthier, more equitable, and more sustainable food systems, universal calls to action aim to reduce harmful effects on both human health and environmental stability, and reverse the current dietary trends. However, transformation is deemed to not be achieved if individuals do not change how they engage and navigate within food-related contexts (Willett et al., 2019).

Global Food Transitions and their Impact on Our Food Skills

Urban food environments have been through a dramatic change in the last few decades, with transformations impacting how, what, where, and with whom we eat. A shift from fundamental, whole food ingredients gathered within traditional, healthy and basic prepared-at-home meals into low nutrient, energy dense, ultra-processed and to-go foods that are mass-produced and shelf-stable for long periods of time has taken place in developed countries (Imamura et al., 2015; Monteiro et al., 2013; Popkin et al., 2012). The fast pace of current societies, the need for convenience and immediate solutions as well as the changes in employment and work demands has pushed modern nations towards this food and nutrition transition (Ronto et al., 2017; Slater, 2013). Nonetheless, this change did not happen without consequences on several domains. Having reduced the amount of time spent with food-related activities, this transition not only meant a disinvestment on turning household food practices (such as cooking and sharing meals) as family time, but also translated into a decrease on tasks such as meal planning and preparation (Pelletier & Laska, 2012; Slater & Mudryj, 2016). Consequently, a widespread decline in culinary skills has been reported, causing

consumers to no longer possess the needed knowledge and skills to prepare healthy and homemade meals (Berge et al., 2011; Jaffe & Gertler, 2006).

Though this transition can be understood as a reflection of progress and efficiency since it has allowed consumers not to invest so much time into food routines, its role has had repercussions in the field of health. The consequent downgrade in food and nutrition competencies has fostered further reliance on pre-prepared or pre-cooked meals, take-aways and fast food, with growing obesity rates and diet-related chronic diseases becoming uniformly experienced as a result (Deer et al., 2014; Lang & Caraher, 2001). To contradict this trend and aiming to a more informed navigation within food systems, dietary gatekeepers' education is required in order to transform food-related knowledge, competencies, and behaviours (Swinburn et al., 2011; Vidgen & Gallegos, 2014).

Food for Thought: Understanding 'Food Literacy'

This perceived decline in food competencies, along with the unprecedented increase in diet-related diseases, has fostered the emergence of the construct 'food literacy' in the last decade. Expressing the idea of proficiency in food-related knowledge, skills and behaviours to ensure a regular food intake consistent with nutrition guidelines, this dynamic term has been increasingly used in research, policy, and practice (Brooks & Begley, 2014; Truman et al., 2017; Vidgen & Gallegos, 2014). Extending beyond nutritional knowledge and cooking skills, food literacy has been linked to concepts such as nutritional literacy and health literacy. However, these are three distinct constructs that, notwithstanding some overlapping content, address discrete competencies. As the vastest concept, health literacy describes individuals' abilities to pursue access to health-related information as well as the cognitive skills needed to further understand and use that information aiming to promote and maintain health (Nutbeam, 2009; Velardo, 2015; Vettori et al., 2019). Rooted in health literacy, both nutrition and food literacy share within their conceptualisations the necessity for people to orient themselves in complex food-related environments through the acquisition of specific knowledge and competencies (e.g., Krause et al., 2016; Velardo, 2015; Vettori et al., 2019; Vidgen & Gallegos, 2014). Yet, these two concepts entail fundamentally different core elements. Broadly understood as a set of knowledge and competencies required to achieve nutritional health, nutrition literacy concerns the proficiency on accessing information and services required to make nutritional decisions, grasping fundamental nutrition indications, and critically analysing nutritional labelling — aiming to surpass barriers to nutritional health

(e.g., Doustmohammadian et al., 2017; Gibbs & Chapman-Novakofski, 2012; Guttersrud et al., 2013; Vettori et al., 2019). Significant distinctions that set apart nutrition from food literacy include the strict focus of the first on nutritional-related content, along with the lack of integration of healthful food habits with objectives outside of the nutrition environment (such as protecting dietary resilience, empowering consumers, enhancing wellbeing), and the exclusion of more extensive aspects from food systems (as agricultural production, sustainability, and social equity) (Vettori et al., 2019).

With a more comprehensive view reaching further on the relation between individuals and their food habits, current literature supports broader definitions of food literacy that encompass both declarative (or critical) and procedural (or functional) knowledge — with the first reflecting the acquisition of theoretical knowledge and the latter concerning practical abilities. This expertise is set to foster crucial connections between food, individuals, human health, and environmental sustainability, with the term being applied at both micro and macro levels, from personal food choices to cultural contexts and food systems (Deer et al., 2014; Palumbo et al., 2019; Truman et al., 2017). However, this variability translates the lack of shared understanding amongst distinct fields of action, with both academics and practitioners struggling to come across a working definition of food literacy (Sumner, 2015; Vidgen & Gallegos, 2014).

According to a recent scoping review, this inconsistency on what is understood as food literacy has resulted in almost 40 different definitions collected throughout the literature (Truman et al., 2017). Amongst these, six common themes were identified as part of the understanding of what is food literacy: Knowledge, describing the ability to understand and search for information about food; Food choices, on actions concerning informed food-related choices; Skills and behaviours, entailing competencies and actions involving food; Food systems, on the comprehension of the complexity on macro levels such as food waste, environmental impact, and food safety; Culture, acknowledging societal factors of food; and Emotions, reporting the influence of motivation and attitudes towards food (Truman et al., 2017). This review portrays how the diversity of these subjects has been covered in varying degrees by current definitions, with a single definition frequently entailing multiple themes. Though highlighting the multidimensional facets of food literacy, the acknowledgment of these themes also mirrors the high variability and lack of consensus within current conceptualisations. With almost half of the contemporary studies that have used the term

‘food literacy’ displaying no clear definition for it, this has contributed to an ongoing opaqueness on further conceptual and empirical developments (Truman et al., 2017). Thus, identifying existing preeminent frameworks and significant empirical contributions is required to complement and expand current knowledge on the field of food literacy.

Theoretical Approaches on Food Literacy

Beyond feeding our bodies, food represents an essential part of our everyday life and has a dynamic role that can affect (and be affected by) our daily routines, social activities, global events, and environmental issues. With an increasing worldwide population, unsettling world economy developments, and an apprehensive climate reality, knowing how to adequately operate within progressively elaborated food systems and assuring that our food habits contribute to our health pose growing necessities (UN Department of Economic and Social Affairs, 2021; Vidgen & Gallegos, 2014). In essence, the construct of food literacy was materialised to address this need. However, numerous authors have proposed models that frame food literacy through distinct conceptual lenses.

As the most acknowledged framework within the literature, Vidgen and Gallegos’ (2014) understanding of food literacy states a set of inter-related knowledge, competencies, and behaviours that empower either individual or collective agents towards dietary quality and resilience over time. The Australian authors have also identified the components of food literacy, reporting them as descriptors with an interrelated and contextually driven nature that mirror the strength of one’s relationship with food. A total of 11 components were assembled, reporting diverse skills — such as prioritising resources for food such as time and money, determine how to properly store and use a food product, applying principles of food safety and hygiene handling, and eating socially. These components were further arranged into four domains, designated as *plan and manage*, *select*, *prepare*, and *eat*. To translate the perspectives of different but complementary realities, this team used a Delphi methodology with both young people responsible for their food routines and food-related experts (working within research, practice, advocacy, and policy, in fields such as nutrition, education, welfare, and food industry). Vidgen and Gallegos’ (2014) conceptualisation emphasises the contextual character of food literacy’s components and how this translated difficulty into reaching for a quantifiable measure.

Derived from an extensive scoping review and including the perspectives from a group of experts (including dietitians, academics, and community food activists), Cullen and

colleagues (2015) assembled the “Food literacy framework for action” and stated food literacy as the ability to understand food by developing a positive relation with it. According to the Canadian authors, this approach comprises knowledge not only about food-related consequences over individual health, but also about food systems and broader contexts including economic, social, cultural, political, and environmental factors. Though referring the ability to make decisions towards both personal health and sustainable food systems, this ecological framework does not specify which particular food-related skills and practices are needed in order to be food literate. Instead, these authors have proposed food literacy as the juncture where individual food skills (such as knowledge, access, and beliefs) and community food security (including factors as policy, programmes, and affordability) come together, implying that individual behaviours and their environmental or social contexts are simultaneously needed to understand food literacy. Also from Canada, Perry, Thomas and co-authors (2017) identified 15 attributes of food literacy (including food and nutrition language, food and cooking self-efficacy, sociocultural influences and eating practices, among others) from a scoping review, categorise them into five domains (*food and nutrition knowledge, food skills, self-efficacy and confidence, ecologic, and food decisions*) and defined their descriptors (such as the ability to distinguish foods and their nutritional characteristics, the belief in one’s ability to prepare a meal, the familial connection with food). This framework was then posteriorly refined by the same team (Thomas et al., 2019) using a Delphi approach with professionals from food-related fields (public health units, academia, community, and non-governmental organisations). The most recent framework presents a total of 11 interconnected attributes that include theoretical food and nutritional knowledge, practical food skills and dietary behaviours, nutrition literacy, food and nutrition self-confidence as well as cooking attitude, social determinants of health, and food systems. Organised within the same five domains, these attributes are distributed across individual and societal perspectives and are recommended to be understood as the foundation for further developments on food literacy conceptualisation and measurement.

In the same year, Slater and colleagues (Slater et al., 2018) developed the framework ‘Food literacy competencies for young adults’, targeting the skills needed for young adults transitioning into independent adults living. Also through a Delphi methodology developed with food and nutrition experts (including dietitians, teachers, and nutrition/culinary students), consensus was reached on 59 competencies categorised within 16 major

competency areas — including nutrition and food safety knowledge, food budgeting and preparation skills, cultural and social aspects surrounding food habits, prioritising local food systems, and understanding aspects of sustainability and social justice within food systems. With a holistic nature and emphasising the interconnectedness between the diverse skills, this framework presents three domains of competencies that nest all the achieved content: *functional competencies* (entailing the knowledge about nutrition and food, the application of safety practices, and the skills of budgeting, planning, and preparing), *relational competencies* (including cultural and emotional skills, focusing on positive food-related relationships), and *systems competencies* (highlighting social justice, environmental impacts and corporate interests as factors that influence food systems). With a framework that also goes beyond the individual scope, these authors accentuate the need for a more comprehensive approach to food-related education particularly for a younger population within school curricula (Slater et al., 2018).

With increasing outlooks on the meaning of food literacy, the exploration of potential determinants — including either barriers or facilitators — has recently emerged. Posteriorly to the identification of the six common patterns on the understanding of the construct (Truman et al., 2017), Truman and Elliott (2018) looked for factors that challenged the acquisition of food-related knowledge, skills, and behaviours. Listing over 80 different barriers to food literacy proficiency, the authors identified the lack of time for learning purposes and the home environment as the most frequent challenges at an individual level, the absence of motivated and trained teachers and the undermining of healthy food choices by schools at the educational context, and the lack of adequate funding and the risk of food insecurity at a community level. More recently, Vettori and colleagues (2019) screened over 80 articles and presented, among other subjects, acknowledged factors that could impact individuals' food literacy. Identified determinants included major systems linked to food-related knowledge and skills, such as public health policies and their application aiming health promotion, schools environment and their curriculum, being close to agricultural realities and food producers, but also individuals' socioeconomic status and the existence of close role models, such as parents or teachers (Vettori et al., 2019).

These recent works by Truman and Elliott (2018) and by Vettori and co-authors (2019) portray the scarce take on food literacy's enablers and inhibitors within the literature. As a pathway to the construct's operationalisation, identifying these determinants and develop

approaches to tackle food literacy's barriers and facilitators is crucial to further expand the field. Thought prompting theoretical advancements, these recent and diverse conceptualisations also echo the lack of agreement towards the understanding of food literacy and corresponding domains of action. This heterogeneity of the construct, along with its connection with multiple adjacent areas (such as nutrition and food systems), unveils the assessment of food literacy to be a greater challenge.

Assessing and Promoting Adults' Food Literacy

Reflecting an increased interest in this field of research, attempts to develop comprehensive measurement tools to assess food literacy have gradually been made in the past few years. Aiming to identify measures that explicitly assess adults' food literacy, Amouzandeh, Fingland, and Vidgen (2019) recently conducted a scoping review of published measures, outlining their psychometric properties, and comparing them with Vidgen's and Gallegos' framework (2014). Enlightening the existing literature and assisting on further advancements within this scope, the authors presented and summarised a total of 12 instruments with distinct purposes, from measuring food literacy or some of its components to evaluating the effectiveness of food literacy interventions (Amouzandeh et al., 2019). With nine out of the 12 instruments being supported by a conceptual framework and half of them addressing all four domains of food literacy according to Vidgen's and Gallegos' model, the tools developed by the Australian teams of Begley and co-authors (2018) and Wijayaratne and colleagues (2018), as well as those created by the American authors Lahne and colleagues (2017), the Italian team of Palumbo and co-authors (2017), and the Dutch team of Poelman and co-authors (2018) were considered the most comprehensive by addressing at least seven of the 11 food literacy components established by Vidgen and Gallegos (2014). In a general overview, the domains concerning preparation, selection, and eating were the most commonly assessed, with the components regarding the skills needed to make tasty meals out of available resources and to use recipes and proper kitchen equipment was the most frequently included in the reviewed measures; on the contrary, behaviours concerning the application of food hygiene practices and eating in a social way were the less addressed throughout the reviewed tools (Amouzandeh et al., 2019). With all the reviewed measures being published from 2016 on, the authors highlight the fast-paced expansion of the field along with the increased multidimensionality of the presented instruments; this diversity of the construct's

domains represented within measurement tools reflects the previously mentioned variety of emerging theories that continue to define and explore the concept of food literacy.

Taking the measurement development a step further, two teams lead by Vidgen (Fingland et al., 2021; Thompson et al., 2021) have recently taken the initial steps on the construction of an international measure with the purpose of assessing food literacy in adults, communities, and populations, as well as providing for a tool to evaluate interventions within this field and increasing the understanding of the connection between food literacy and dietary intake. The first work presented a content validity study with 85 experts across 20 countries aiming to reach consensus on more than 150 items based on Vidgen's and Gallegos' conceptualisation (Fingland et al., 2021; Vidgen & Gallegos, 2014). Though partial consensus was achieved and almost 120 items were retained, the authors referred that content regarding planning and selecting skills when eating outside the home environment was insufficiently mentioned by comparison to its significant contribution within research (Fingland et al., 2021). As so, building up on the first study, a second work was carried with the purpose to capture additional information about food literacy practices that was considered crucial for the development of a robust questionnaire (Thompson et al., 2022). This following article involved cognitive interviews and thematic analysis to ensure that all domains and components of the theoretical framework were effectively captured; resulting in a final pool of more than 170 items that fully mirror the aimed conceptualisation, further steps on the process of developing this food literacy measure are awaited.

Since the review conducted by Amouzandeh and colleagues (2019), other publications have shed a light on diverse and broader ways to assess food literacy. Also with a theoretical background supported by the conceptualisation of Vidgen and Gallegos (2014), Hemmer and co-authors have developed and revised the Food Literacy Assessment Tool, aiming to assess food literacy in low-income adult populations in the United States (Hemmer et al., 2021). Entailing a total of 75 items, this tool provides for a different perspective on the dimensions to be measured by distinguishing *food consumption frequency*, *knowledge*, *behaviour* and *self-efficacy* as its four sub-scales, and further categorising the items of the last two dimensions into the Vidgen's and Gallegos' (2014) domains (plan and manage, select, prepare, and eat). This double categorisation allows, in an innovative way, for these theoretical domains to be understood within the perspectives of practical action (*behaviour*) and psychological beliefs of capabilities about one's own behaviour (*self-efficacy*).

Taiwanese authors Teng and Chih (2022) recently developed and validated a food literacy measure that emphasises the impact of food-related behaviours on both environmental sustainability and global food systems, which have been greatly overlooked in past instruments. This proposed sustainable food literacy tool contains 26 items distributed into the dimensions of *sustainable food knowledge*, *food skills*, *attitudes*, and *action intent and action strategies*, focusing not only the required knowledge, attitudes and competencies to achieve a healthy intake but also the willingness to make and act for a sustainable diet (Teng & Chih, 2022). Though not including neither social or cultural influences on individuals' food-related knowledge, skills and behaviours, this instrument promotes a significant advance on the field by triggering the connection between adults' food choices, health, and sustainability within the context of food literacy assessment and operationalisation.

Based on a conceptual revision that led to the integration of wider contextual aspects, a South Korean team has recently created a food literacy assessment measure that, similarly to Teng's and Chih's (2022) work, considers environmental and ecological aspects related to food practices, along with social and cultural factors (Yoo et al., 2022). With 14 questions distributed across the domains of *nutrition and safety*, *cultural and relational*, and *socio-ecological*, this measure entails future-oriented values linked to social issues (e.g., food driven inequality) and ecological-environmental concerns (e.g., food and packaging waste, climate-related consequences) that aim to assist on prospective education and policy developments (Yoo et al., 2022).

These increasingly broader approaches on operationalising food literacy and the resulting attempts to measure its defining knowledge, competencies, and behaviours reflect the complexity of the concept and its connection with surrounding fields of action, such as sustainability and socio-cultural contexts. However, these recent developments regarding food literacy's wider scope within conceptualisation and measurement are still missing in the ambit of evidence-based programs and interventions. Aiming to achieve a greater quality on food intake, food literacy programs and interventions primarily include cooking skills as the foundation to address concerns about declining of skills and consequent poor diet quality (e.g., Begley et al., 2017; Reicks et al., 2018; Thomas & Irwin, 2011). Furthermore, a clear predominance of food literacy studies targeting younger populations — from elementary schoolers to adolescents — denotes a trend in current literature (e.g., Elsborg et al., 2022; Kelly & Nash, 2021; Vaughan, et al., 2022; Wickham & Carbone, 2018).

With a notorious growing body of research that is beginning to translate the developments achieved within food literacy's conceptualisation and assessment, West and colleagues (2020) have recently published the results of applying a food literacy programme named Nutrition Education and Skills Training towards the improvement of both food literacy and food security. Underpinned by a social cognitive theory and focusing on promoting participants' self-efficacy, this programme entailed sessions aiming the increase of fruits and vegetables intake, achieving a varied diet with healthy but affordable choices, applying hygiene strategies and storage safety measures, among others (West et al., 2020). Integrating broader factors within food systems as food security (Cullen et al., 2015), this programme demonstrated significant impact on the improvement of cooking confidence, nutrition knowledge, preparation competencies, fruit and vegetables consumption as well as salt and sugar intakes, and food security status (West et al., 2020). However, assessing cooking confidence, nutritional-related knowledge, and awareness on fruit and vegetables intake, with multiple tools and presenting these competencies as food literacy greatly portrays the lack of connection between current broader theoretical understandings of the construct and the recent advances on its operationalisation.

Efforts to tackle this gap have been recently made by Begley and colleagues (2019) and Ng and co-authors (2022). The first work concerns a food literacy program targeting Australian adults from low-to-middle income households, delivered face to face with videoconferencing as option to reach further regions to individuals who aim to improve their food-related knowledge, competencies, and behaviours (Begley et al., 2019). With the program's content entirely aligned with Vidgen and Gallegos (2014) framework, this intervention demonstrated a significant increase on adults' competencies of planning and management, selection, and preparation. Stating the program as guided by the Health Belief Model (Janz & Becker, 1984), strategies to build self-efficacy and motivation, as well as to tackle perceived barriers are affirmed to be included in the developed program. However, these are not specified or further addressed on how they may have impacted the program's effectiveness (Begley et al., 2019). The second publication presents an exclusively online intervention on food literacy and fruit and vegetable intake, delivered through social media to Australian adults using infographics, informational videos and recipes based on the Mediterranean Diet (Ng et al., 2022). Highlighting social media's potential to promote healthier food-related behaviours, this digital intervention demonstrated an improvement of

participants' food literacy across all components. Besides their effectiveness, these two studies share the theoretical backdrop on Vidgen and Gallegos (2014) conceptualisation and the application of the tool developed by the Australians Begley, Paynter, and Dhaliwal (2018) — reflecting an advancement on theoretically supported programs within this scarce literature. Nevertheless, along with the lack of interventions and randomised controlled trials aiming the improvement of food-related knowledge and competencies, the scarce theoretical grounding concerning behaviour change appears to be critical when aiming towards food-related behaviour change.

Changing (Food-related) Behaviour

Health behaviour theories are vital to gain knowledge, understand processes and psychological mechanisms, and accumulate evidence when studying health-related behaviours — however, behaviour change interventions are often design without a theoretical background (Prestwich et al., 2013). For instance, a meta-analysis showed that only 53 out of 235 implementation studies were explicitly supported by behaviour change theories (Davies et al., 2010). With unhealthy habits having the potential to be transformed by self-regulatory efforts, it is essential to link food literacy promotion to a health behaviour change theoretical basis in order to aim for theory-informed food-related behavioural change.

Entailing a variety of emotional, cognitive, and social factors, a plethora of health behaviour change models or theories were developed within the field of health and social psychology and, despite their overlapping on some indispensable factors, there are significant distinctions among these that underly their understanding (Davis et al., 2015; Schwarzer, 2008). A relevant distinction is whether these theories conceptualise behaviour change as a *continuum* or as a *staged* process. In continuum models, all the predicting factors are acknowledged and combined in a single equation, and individuals are differentiated by their place along the continuum of action likelihood — thus, the goal of implementation studies based on continuum theories is to move individuals through this path towards action (Schwarzer, 2008; Schwarzer & Luszczynska, 2015). Conceptualising intention as the most proximal predictor of behaviour, continuum models focus on identifying a set of beliefs and attitudes (such as perceived barriers, social norms, or perceived self-efficacy) and combined them into an explanatory equation for behavioural intention and, consequently, behaviour change (Armitage & Conner, 2001; Fishbein & Ajzen, 1977; Schwarzer, 2008). Prominent examples of continuum models are, among others, the Theory of Reasoned Action (Fishbein

& Ajzen, 1977) and the later developed Theory of Planned Behaviour (Ajzen, 1991), the Protection Motivation Theory (Rogers & Prentice-Dunn, 1997), the Health Belief Model (Janz & Becker, 1984), and the Social Cognitive Theory (Bandura, 1986). Though helping to map relevant predictors of intention formation, limitations regarding continuum models have been recognised. Particularly, the linear and ‘one-size-fits-all’ approach provided by the single prediction equation of these models. Postulating that no specific order of intervention components is understood as more or less effective, these theories posit that all individuals will benefit from the same type of intervention and exclude potential qualitative changes during the behaviour change process (Schwarzer, 2008). Furthermore, typically missing a post-intentional phase in which behavioural goals translate into action is also a limitation of continuum models. With people commonly not behaving according to their own intentions — either due to unforeseen challenges, for giving into impulses, or other — this breach between intention and behaviour has been designated as the intention-behaviour gap (Schwarzer, 2008; Sheeran, 2002).

To overcome these limitations, stage models have addressed the idea of distinct processes, phases or stages of behaviour change. These qualitative discontinuities during the behavioural change journey reflect the several different mindsets people may go through, entailing particular cognitive and behavioural specificities. Understanding that similar barriers might be faced by individuals within the same stage, and that different barriers must be surpassed by people at different stages, stage models theorise that specific predictors are relevant for particular stage transitions. Assuming, at least, two processes within behaviour change — with the first depicting a motivational stage leading to intention formation, and the second portraying a volitional stage ending with a successful behavioural action — transitioning between stages is considered progress and can stand as a valid goal in health behaviour change (Schwarzer, 2008; Weinstein et al., 1998). Distinguished stage models include the Transtheoretical Model of Change (Prochaska & Velicer, 1997; Prochaska et al., 1993) and the Precaution Adoption Process Model (Weinstein, 1988; Weinstein & Sandman, 1992).

Assuming that health behaviours can change continuously in a quantitative mode but also be described in terms of qualitative phases, the Health Action Process Approach (HAPA; Schwarzer, 2008; Schwarzer & Luszczynska, 2015) can be identified as a hybrid model with both a stage layer and a continuum layer, depending on whether the purpose entails predicting

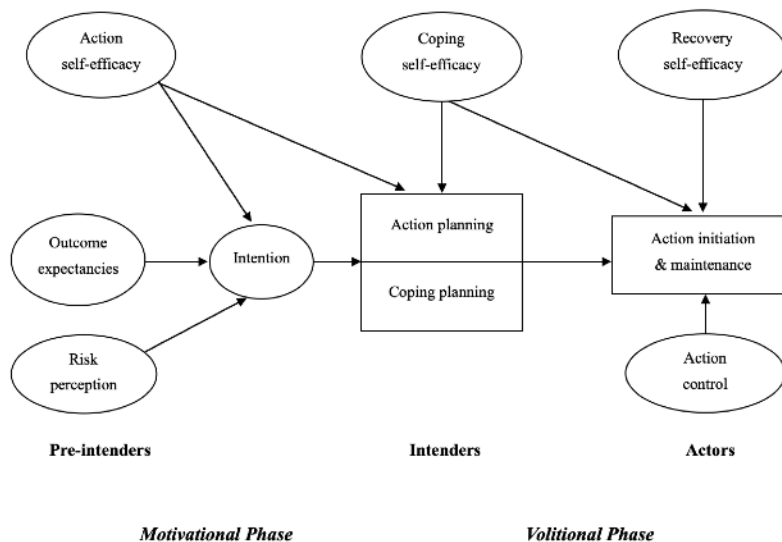
behavioural change or guiding interventions. Developed as an open architecture framework, HAPA approaches behavioural change as a two-phased self-regulatory process that comprises both motivational factors, as considered by continuum models, and volitional factors, aiming to overcome the previously identified intention-behaviour gap.

Health Action Process Approach

Based on general principles, the HAPA postulates the existence of two distinct yet sequentially related phases or set of processes: a pre-intentional motivation phase, that leads to behavioural intention formation, and a post-intentional volitional phase, that guides towards the targeted health-related behaviour (Figure 1). As HAPA's first principle, these two phases reflect the change of mindsets people go through when moving from deliberation, when they develop their intentions, into action.

Figure 1

The Health Action Process Approach (adapted from Schwarzer, 2008 and Schwarzer and Luszczynska, 2015)



According to the framework's second principle, the volitional phase can be further segmented into pre-action and post-action phase, making reference to those who have not yet turned their intentions into action and those who have. However, these two sub-categories allow for the distinction of three qualitatively different mindsets that individuals experience during behavioural change: (i) the pre-intenders, referring to those who have not yet

developed an intention to change their behaviour, (ii) the intenders, mentioning the individuals who are situated within the post-intention and have entered the volitional phase, but still have not initiated action, and (iii) the actors, illustrating those who are already acting upon their intentions. This particular segmentation has the purpose of enabling matching interventions according to the prior profiling of its target population thus providing for an enhanced outlook when comparing to the previous one-size-fits-all approach (Schwarzer & Luszczynska, 2015).

Given that distinguished patterns of cognitive predictors emerge in each of these phases, its explanation is essential to the framework's comprehension. In the motivational phase, though the perception of a health threat might instigate thoughts about change and lead to a contemplation process, developing risk perception may not be sufficient to prompt intention formation thus making it a distal predictor in this stage. Reflecting on the pros and cons of taking action and developing positive expectations about changing, along with believing that one will be able to perform the desired action are crucial for the motivational phase. Respectively designated as outcome expectancies and action self-efficacy, these cognitive constructs are set as the main predictors of intention formation. Having developed an initial inclination towards a specific health behaviour, it is necessary to transform the behavioural intention into detailed instructions on how to perform the aimed behaviour. As so, when entering the volitional phase and as set in HAPA's third principle, planning the implementation of the desired action is a key strategy for behavioural action, guiding individuals' mindset from intenders towards actors. As an alterable variable and constituting the fourth principle of HAPA, planning covers both action and coping planning; the first reports to the mental simulation of setting up when, where, and how the behaviour will be performed, and the latter refers to anticipating potential barriers to the behavioural performance and generating alternative solutions to overcome these. In addition to planning, self-efficacy not only translates an important predictor in the motivational phase but also depicts a significant variable within the volitional phase. Phase-specific self-efficacy is the fifth and final principle of HAPA and, in the volitional phase, both maintenance and recovery self-efficacy are required in the behavioural change process. While maintenance self-efficacy pertains to the optimistic belief about one's ability to manage barriers that may emerge in the maintenance period, recovery self-efficacy concerns one's conviction on having the ability to resume the behaviour after facing a setback or failure. Considered as behaviour change most

proximal determinant, action control is a concurrent self-regulatory strategy taking place during both action initiation and maintenance. In order to continuously evaluate the ongoing behaviour, action control encompasses three facets related to being attentive of the intended aims (designated as awareness of standards), frequently monitoring one's behaviour (entitled as self-monitoring) and comparing it to the desired standards while making the effort to strive for the behavioural goals (understood as self-regulatory effort).

Characterised by an open architecture, HAPA's main path analytic design has been applied in a multitude of research subjects throughout the years to explain and predict health-related behaviours. Either using a specific subset of constructs or the framework in its entirety, experimental and longitudinal studies in the areas of physical activity (e.g., Bösch & Inauen, 2022; Hardcastle et al., 2021; Zeidi et al., 2021), vaccination (e.g., Ernsting et al., 2013; Vayisoglu & Zincir, 2019; Yu et al., 2022), smoking cessation (e.g., Joveini et al., 2020; Radtke et al., 2012), among others. Food-related behaviours, such as healthy eating (e.g., Rohani et al., 2018), food hygiene (e.g., Chow & Mullan, 2010), and fruit and vegetable intake (e.g., Godinho et al., 2013; Godinho et al., 2015; Lin et al., 2017), are no exception. As so, HAPA's valuable contribution and advancement on health-related behaviour change research, its record of application in food-related studies, as well as the overlap of constructs from food literacy literature — such as self-efficacy (e.g., Cullen et al., 2015; Perry et al., 2017; Thomas et al., 2018) and planning skills (e.g., Slater et al., 2018; Vidgen & Gallegos, 2014) — make it a promising candidate for further use as a theoretical backdrop to instigate the exploration on predictors of food-related behaviours within food literacy frameworks.

Behaviour Change Techniques

The development of a behaviour change intervention is a complex process. A theoretical foundation provides for guidance on the identification of potential targets for intervention in the same way it helps making sense of the behaviour's complexity by informing on varying degrees of specification for the behavioural change — from *how* and *why* the behaviour happens, to under what circumstances and for whom it may occur. Additionally to the election of a particular theory-based rationale, behaviour change interventions often require the alignment between the mechanisms of action that must be targeted to promote behaviour change and the corresponding intervention techniques to address them and elicit the desired changes (Bohlen et al., 2020). These techniques are understood as key intervention components, and acknowledged as the active ingredients that

set behavioural change in motion — i.e., the *what* of interventions (e.g., self-monitoring, feedback, reinforcement; Michie et al., 2013).

A paramount work entailing a series of consensus exercises with international experts from diverse disciplines has been conducted in order to synthesise these observable, replicable, and irreducible behaviour change techniques (BCTs) that are designed to modify or redirect causal processes responsible for behavioural regulation (Michie et al., 2013; Michie et al., 2015). Resulting in a comprehensive and cross-context taxonomy with the potential to strengthen interventions' efficacy, the BCT Taxonomy v1 is hierarchically organised according to an inductive 'bottom-up' method based on the similarity of these techniques, and gathers a total of 93 BCTs that were assessed based on whether they conformed to the definition of a BCT, their comprehensibility as an individual BCT, and their individuality as to avoid overlapping or redundancy among techniques (Cane et al., 2015). Categorised into 16 distinct sets, this taxonomy presents a specific label for each technique, a definition for each BCT, and one or two exemplifications of its use on a health-related context — providing for a useful format in the reliable reporting of interventions.

Increasing their easiness of use and practicality, the following 16 higher-order sets of BCTs group these active ingredients according to their comparability (the total number of BCTs in each grouping, as well as some examples of BCTs belonging to these sets, are presented in brackets): Goals and planning (9; behavioural goal setting, action planning, review of outcome goals), Feedback and monitoring (7; self-monitoring of behaviour, monitoring of outcomes of behaviour without feedback, biofeedback), Social support (3; unspecified, practical, and emotional forms of social support), Shaping knowledge (4; instruction on how to perform the behaviour, information about antecedents, re-attribution), Natural consequences (6; information about health consequences, monitoring of emotional consequences, anticipated regret), Comparison of behaviour (3; demonstration of the behaviour, social comparison, information about others' approval), Associations (8; prompts and cues, remove aversive stimulus, associative learning), Repetition and substitution (7; habit formation, generalisation of target behaviour, graded tasks), Comparison of outcomes (3; credible source, pros and cons, comparative imagining of future outcomes), Reward and threat (11; social reward, self-incentive, self-reward), Regulation (4; reduce negative emotions, conserving mental resources, paradoxical instructions), Antecedents (6; restructuring the physical environment, distraction, body changes), Identity (5; identification

of self as role model, valued self-identity, identity associated with changed behaviour), Scheduled consequences (10; behaviour cost, reward approximation, situation-specific reward), Self-belief (4; verbal persuasion about capability, focus on past success, self-talk), and Covert learning (3; imaginary punishment and reward, vicarious consequences).

Additionally to provide for a comprehensive list of BCTs that can ease the report and replication of behavioural interventions, this taxonomy facilitates primary research since intervention developers can draw on a wider, structured, and reliable range of techniques to support behaviour change (Michie et al., 2015). An example of the use of BCTs would be ‘self-monitoring of behaviour’, defined as the instruction to self-record specified behaviour(s), materialised on keeping a daily diary of one’s food intake. This degree of precision not only allows for a more reliable replication of further implementation studies, but also assists on the development and evaluation of complex interventions. Though the single use of BCTs will not necessarily lead to effective behaviour change interventions, the combined use of BCTs with a behaviour change theory has been associated with increased intervention effectiveness (e.g., Dombrowski et al., 2012; Prestwich et al., 2016; Prestwich et al., 2014). While behaviour change theories provide for the understanding of psychological mechanisms, they often do not address specifically how to change behaviour in terms of what techniques are necessary to be applied. With some links between mechanisms of action and BCTs already identified, mapping BCTs into theoretical constructs conceptualised in behaviour change frameworks becomes a possibility (Bohlen et al., 2020; Carey et al., 2019). For example, BCTs that may apply to the HAPA framework include *pros and cons* (from taxonomic set Comparison of outcomes) for outcome expectancies, *problem solving* (from grouping Goals and planning) and *verbal persuasion about capability* (from set Self-belief) for the self-efficacy constructs (e.g., Asgari et al., 2021; Martinez-Brockman et al., 2017). Nonetheless, the exploration on the efficacy of single or combined BCTs within implementation studies is still scarce (Peters et al., 2015; Schroé et al., 2020).

FOODLIT-PRO: Food Literacy Project

Project Objectives

Considering the relevance of food literacy research and its current conceptual and empirical limitations, the FOODLIT-PRO: Food Literacy Project aimed to provide for theoretical, evaluative, and implementation resources that could contribute to further advancements in this field. Its ultimate goals were to contribute to the conceptual

understanding of food literacy, to facilitate its assessment, and to set significant evidence-based foundations for the development of theory-supported interventions. To that end, FOODLIT-PRO was designed with three distinct and sequentially driven Stages that lead to different, yet intertwined and complementary, purposes. Stage 1 entailed two complementary steps. The first step comprehended the investigation of food literacy's definition, enablers and barriers, as well as the impactful fields of action that relate to the construct (Objective 1, Chapter 2). This second step culminated with the construction of a conceptual and empirical framework that illustrated the formerly explored food literacy domains, determinants, and influential factors (Objective 2, Chapter 3). Stage 2 aimed at the development and validation of an instrument that allowed the assessment of all the investigated aspects of food literacy (Objective 3, Chapter 4). Stage 3 aimed to enhance food literacy's defining knowledge, skills, and behaviours of a targeted sample (Objective 4, Chapters 5 and 6) and to explore the potential impact of theory-based cognitive mechanisms on food literacy outcomes (Objective 5, Chapters 5 and 6).

Designs

Stage 1 was designed as an exploratory and cross-sectional phase with mixed methodologies. Allowing for a detailed comprehension of a particular concept and in-depth data collection, a qualitative methodology comprising semi-structured interviews was chosen for the first step of this Stage (Elo & Kyngäs, 2008). On the second step, a quantitative approach was taken by performing a multivariate descriptive data analytic technique to maximise the previously collected qualitative data and to assist on the development of the conceptual and empirical framework of food literacy.

Stage 2 entailed an exclusively quantitative and cross-sectional study for the development and validation of a quantitative measure to assess food literacy, as well as food literacy's determinants and the impact of its influential factors. Entailing sequential psychometric analyses required to develop and validate an assessment measure, the methodology of this stage was divided into three steps: item development and content validity, instrument development, and instrument validation.

Stage 3 was designed as a longitudinal, two-arm, parallel, experimental, and single-blinded randomised controlled trial. Aiming to promote adults' food literacy, this web-based intervention was designed based on the content of the previously developed conceptual and empirical framework. All its time points (baseline, post-intervention, and follow-up times at 3,

6, and 9 months after the intervention) comprised the assessment of perceived food literacy with the formerly developed and validated measure, as well as the measurement of HAPA's cognitive mechanisms with previously adapted items (Sniehotta et al., 2005) that were adjusted to the current project.

Approval for the development and implementation of the FOODLIT-PRO was received from Ispa - Instituto Universitário's Ethics Committee (ref. D/002/03/2018). The protocol for the third stage of the project was approved and registered by ClinicalTrials.gov (NCT04806074), and the trial was developed according to the Declaration of Helsinki, adhered to General Data Protection Regulation (Lei da Proteção de Dados Pessoais n.º 58/2019, 2019), and was guided by the ethical principles and deontological norms of the Order of Portuguese Psychologists (Order of Portuguese Psychologists, 2011).

Methods

Participants and Procedures

Participants from Stage 1 were 30 Portuguese food-related experts (20 women and 10 men) aged between 23 and 57 years ($M = 38.4$; $SD = 8.6$) and working in diverse food-related areas and distinct organisations (comprising governmental and nongovernmental as well as profit and nonprofit entities). Areas where participants worked were grouped into five different domains (education, health, food policy, agricultural industry, and commercial industry) and participants were recruited through direct contact with their respective work institutions (convenience sampling). Institutions were deliberately selected to reach diverse fields not only within food systems but also within related ambits (e.g., education, policy-making, human and environmental health). Inclusion criteria entailed being 18 years old or older, having minimum literacy to be able to answer an extensive audio recorded interview, working (in)directly in food-related fields, and being responsible for at least one out of four tasks in their food routine (including choice and decision, selection and acquisition, preparation, and cooking; according to Vidgen and Gallegos, 2014). The recruitment process of Stage 1 took place between February and June 2018, and interviews were held from March to June of the same year. The 30 semi-structured interviews (21 in person and nine by telephone) lasted more than 50 minutes on average. All interviews were conducted until saturation was reached, were audio recorded, and fully transcribed. Qualitative analysis was conducted and, posteriorly, a quantitative approach was performed with the qualitative-derived data.

Participants from Stage 2 integrated three different samples collected at two points in time, given the purposes of instrument development and validation. The first two samples were simultaneously collected between May and July 2019 and integrated the analyses for the instrument development. The third sample was collected in August 2020 and integrated the analyses for the instrument validation. In total, the three samples (Samples 1, 2, and 3) represented a total of 2,406 participants (2,206 women and 200 men), with ages between 18 and 69 years ($M_{\text{Sample 1}} = 28.2$; $SD_{\text{Sample 1}} = 7.9$; $M_{\text{Sample 2}} = 27.9$; $SD_{\text{Sample 2}} = 7.8$; $M_{\text{Sample 3}} = 30.1$; $SD_{\text{Sample 3}} = 7.8$). All data were collected online using Typeform and SurveyHero. Participants were recruited through social media platforms and by reaching out to health-related accounts (convenience and community sample). Inclusion criteria were being 18 years old or older, having minimum literacy and being able to access a digital and online questionnaire. Psychometric analyses required for instrument development and validation were conducted.

Participants from Stage 3 were recruited between July and September 2020 with an identical recruitment approach as the one conducted for the Stage 2 of the project. Potential participants were invited to take part in a food literacy program, filled an eligibility screener, and stated their interest in participating as well as a form of contact to be reached later for enrolment. Eligibility screener filtered inclusion criteria (being 18 years or older, minimum literacy, availability and internet access to engage in the 11-week trial, and be responsible for a minimum of one out of four tasks in their food routine; Vidgen and Gallegos, 2014), informed of trial's randomised nature and of both conditions (experimental and comparison arms), and stated the forms of compensation to be featured at the trial. A total of 204 adults (196 women and 8 men) aged from 18 to 64 years ($M = 30.3$; $SD = 7.8$) integrated the experimental arm ($n = 99$) and the comparison arm ($n = 105$). The experimental condition received weekly, digital, and themed content (including customised evidence-based information on international nutritional guidelines, and BCTs in form of challenging tasks to be accomplished), and were randomly assigned to groups within a digital platform to allow for experience sharing. No engagement or form of participation was made by the research team. The comparison condition received a single-time delivery of similar information on nutritional guidelines but in its original format, and no theoretical or evidence-based behaviour change approach was taken. Digital notifications were made to both arms in order to inform on questionnaire reception and respective deadline for completion.

Delivered over 11 weeks, this implementation study was theoretically grounded on the HAPA framework and used BCTs to prompt food-related knowledge, competencies, and behaviours. It was hypothesised that the web-based intervention entailing the weekly delivery of digital content, using BCTs suited to food literacy content, and theoretically anchored in the HAPA framework (experimental arm), would be more effective in promoting food literacy than the single-time delivery of non-customised nutritional guidelines deprived of any theoretical support and evidence-based behaviour change approaches (comparison arm). It was also hypothesised that HAPA-derived cognitive mechanisms would significantly mediate the outcomes on food literacy. Following the intention-to-treat principle, quantitative analyses with explorative approaches were conducted.

Prior to data collection at all stages of the project, participants were informed about the study aims and the voluntary nature of their partaking. Confidentiality of their disclosed information was guaranteed. The author assured all participants that their identities would not be revealed and provided, when requested, additional clarification concerning the study purpose and its dissemination plans. At all Stages, participants provided for their verbal and written consent to take part in the respective study.

Materials

The interview protocol used at Stage 1 (Appendix 1) was informed by the state of the art on food literacy at the time of the study, developed by the author and revised by this research team. The protocol entailed predominantly open-ended questions to explore components, determinants and influential factors of food literacy. Flexible questions were followed by more leading ones, targeting subjects not so proximal to food literacy concerns — such as food-related policies, environmental concerns, and social characteristics. The top-bottom approach (from more general questions to specific inquiries) aimed to provide for theme-related guidance to the participants.

Adapted from Sniehotta and colleagues (2005), the measures to assess HAPA-related cognitive mechanisms at Stage 3 were specifically modified to portray *eating according to one's needs* as the aimed behaviour (Appendix 2). This alteration was based on the literature's insight on how one's adequate and healthy food intake portrays one of the most agreed outcome of food literacy proficiency. The mechanisms assessed included outcome expectancies (9 items; e.g., 'If I ate according to my needs, I would improve my health'), risk perception (3 items; e.g., 'If I don't eat according to my needs, then I risk getting

cardiovascular diseases'), action self-efficacy (5 items; e.g., 'I believe I can regularly eat according to my needs, even if others who surround me don't do it'), intention (3 items; e.g., 'I intend to eat according to my needs on a daily basis'), action planning (5 items; e.g., 'I already have concrete plans on what foods to eat in order to have a diet suited to my needs'), maintenance self-efficacy (6 items; e.g., 'I believe I can maintain a diet suited to my needs, even if I need a lot of time to develop the necessary routines'), coping planning (6 items; e.g., 'To deal with situations that may hinder the maintenance of a diet adequate to my needs, I have concrete plans how to deal with a relapse, that is, how to act if I fail to have an adequate diet for some time'), recovery self-efficacy (3 items; e.g., 'I believe that I can go back to eating according to my needs, even if I had gone a few weeks without doing so'), and action control (3 items; e.g., 'I evaluate my behaviour on a daily basis to see if I am having a diet suited to my needs').

For each stage of the project, (i) written information was provided at the beginning of the corresponding study with a description of its aims, procedures, research team, participants' rights, and confidentiality; (ii) a consent form was made available to be signed (when in person) or digitally checked (when by phone or online) by each participant (Appendices 3, 4, 5, and 6); (iii) a sociodemographic questionnaire was constructed according to the purposes of the study and designed to collect relevant individual and health-related data, including age, education level, alcohol and tobacco consumption (Appendix 7).

Data Analysis

Stage 1 involved both qualitative and quantitative data analysis. On its first step, a deductive-dominant content analysis was conducted between April 2018 and January 2019, using MAXQDA Software (version 18), and aiming an in-depth exploration on the construct's understanding (Objective 1, Chapter 2). On the second step, a quantitative approach was taken. A multiple correspondence analysis was conducted with IBM SPSS Statistics (version 25), aiming to maximise the qualitative data by generating an exploratory model from the intrinsic associations between the qualitative attributes (Costa et al., 2013; Di Franco, 2016) and contributing for the development of the conceptual and empirical framework (Objective 2, Chapter 3).

Stage 2 statistical plan entailed three distinct steps that were conducted using both IBM SPSS Statistics (version 27) and IBM SPSS AMOS Software (version 26): (i) item development and content validity, based on the previously conducted qualitative research

(Objective 1, Chapter 2) and the developed conceptual and empirical framework of food literacy (Objective 2, Chapter 3), (ii) psychometric analyses for the instrument development, comprising item reduction strategies, factor extraction methodologies and sensitivity testing, and (iii) the required processes for instrument validation, namely tests of dimensionality, reliability and validity, and measure invariance testing.

On Stage 3 intervention effects were explored using a linear mixed models with the SPSS 27 MIXED procedure. Longitudinal mediation analyses were also conducted on IBM SPSS Statistics (version 27) to explore the HAPA-related assumptions.

Empirical Studies

The next section (from Chapter 2 through 6) is based on published or submitted articles that provide for distinct contributions on the attainment of FOODLIT-PRO's objectives. Therefore, Chapter 2 uses qualitative methodology to make an in-depth exploration of the perspective of Portuguese food-related experts on the understanding of food literacy, what may enable or hinder food literacy proficiency, and which other macro systems may both impact individuals' food literacy and be influenced by others' food literacy expertise (Stage 1, first step). Chapter 3 integrates the formerly gathered data into a quantitative approach and presents a conceptual and empirical framework of food literacy that unifies definition, determinants, and influential factors (Stage 1, second step). Chapter 4 presents an extensive psychometric approach towards the development and validation of an innovative food literacy instrument capable to not only assess adults' food literacy, identify its determinants, and understand its influential factors, but also able to be tailored to the purpose of its use and contexts of application (Stage 2). Chapter 5 presents the protocol of an exclusively digital and theory-grounded randomised controlled trial that aims to promote food literacy, using the HAPA framework as a theoretical background and applying BCTs to prompt food-related knowledge, competencies, and behaviours (Stage 3). Chapter 6 assesses the intervention effects of the aforementioned implementation study and explores the impact of HAPA-derived psychological mechanisms on food literacy outcomes (Stage 3).

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Chapter 2

Exploring food literacy domains, influential factors, and determinants:
A qualitative study

This chapter is based on the paper

Rosas, R., Pimenta, F., Leal, I., & Schwarzer, R. (2019). FOODLIT-PRO: Food literacy domains, influential factors, and determinants - A qualitative study. *Nutrients*, 12(1), 88. <http://dx.doi.org/10.3390/nu12010088>

Abstract

Poor eating habits are increasing the prevalence of weight-related issues, such as diabetes and cardiovascular diseases. Given the demand to improve individuals' food knowledge and competencies aiming at healthier behaviours, the current investigation explores the concept of food literacy. Considering the lack of a shared understanding of food literacy, this study aims to explore food literacy's domains, influential factors and determinants. Using a qualitative deductive-dominant content analysis, 30 experts from food-related fields were interviewed. The obtained outcomes were compared to available food literacy frameworks. Agreement among inter-raters was nearly perfect ($k = .8$). Yielding a total of 184 codes nested within 19 categories, identified domains were Origin, Safety, Choice and Decision, Select and Acquire, Plan, Preserve, Prepare, Cook, and Knowledge; influential factors included Nutrition, Psychological, Health, Learning Contexts, Policy, Industry, Sustainability, and Social and Cultural; External determinants were "Access to Food-Related Information", "Perishable and/or Unreliable Food-Related Information", "Family Dynamic and/or Identity", and "Professionals' Unpreparedness on Food-Related Expertise", and Internal determinants included "Prioritise Food", "Convenience and Practicality", "Time and Financial Management", "Previous Food-Related Habits", and "Innate and Learned Flavour Preferences". In conclusion, more than half of the identified attributes (62.5%) are corroborated by the current literature. However, the manifested content unmatched with the current frameworks of food literacy literature express food-literacy-related fields of action, knowledge, competencies, and determinants that have not yet been explored. As such, this study provides new and useful information concerning food literacy definition and development, by identifying its domains, factors of influence, and potential determinants. Moreover, this work paves the way for new measurements and interventions within this field.

Keywords: Food literacy; Qualitative; Definition; Influential factors; Determinants

Introduction

With rising rates of overweight over the last decades, the Food and Nutrition Action Plan 2015–2020 from the WHO reports more than 50% of European adults with excessive body weight (WHO Regional Office for Europe, 2014). This call for action also highlights that poor eating habits are major risk factors directly linked to overweight issues and related to other noncommunicable diseases – such as cardiovascular diseases, diabetes, and some cancers. As such, healthy dietary habits are key not only to prevent and manage these diseases, but also to enhance quality of life (WHO Regional Office for Europe, 2014). With the eating patterns in developed countries poorly aligned with health-related recommendations, this increment of diet-related problems has been connected to the lack of both knowledge and skills on how to operate within a progressively intricate food system (Bifuco & Caruso, 2007; Pendergast et al., 2011; Vidgen & Gallegos, 2014). Given that most industrialised food environments are currently characterised by highly processed, ready-to-eat, low-cost foods with deficient nutritional value, individuals' education and empowerment are needed to transform competencies and behaviours to navigate within these food systems towards healthier dietary choices (Swinburn et al., 2011; Vidgen & Gallegos, 2014).

In light of these issues, current investigation has been exploring the recently emerged concept of food literacy (Krause et al., 2016; Palumbo, 2016; Perry et al., 2017; Slater, 2013; Slater et al., 2018; Sumner, 2015; Thomas et al., 2019; Velardo, 2015; Vidgen & Gallegos, 2014). Despite being an increasingly recognised term, there is not yet a shared understanding of the construct's meaning and its components, resulting in a lack of theoretical consensus (Krause et al., 2016; Palumbo, 2016). Most acknowledged empirical conceptualisations of food literacy include (i) the framework of Vidgen and Gallegos from Australia (Krause et al., 2018; Palumbo et al., 2019; Poelman et al., 2018; Ronto et al., 2017; Slater et al., 2018; Sumner, 2015; Truman et al., 2017; Truman et al., 2019; Vidgen & Gallegos, 2014; Wijayaratne et al., 2018), and (ii) the work of Desjardins and colleagues from Canada (Desjardins et al., 2013), which was later on revised by Thomas and co-authors (Krause, 2018; Perry et al., 2017; Thomas et al., 2019). Also from Canada, conceptualisations from (iii) Slater and co-authors (Krause et al., 2018; Palumbo et al., 2019; Slater et al., 2018), and from (iv) Cullen and colleagues (Cullen et al., 2015; Krause et al., 2018; Palumbo et al., 2019; Ronto et al., 2016; Slater et al., 2018) are considerably mentioned within the literature.

Overviewing these conceptualisations, (i) Vidgen and Gallegos (Vidgen & Gallegos, 2014) developed their framework through the qualitative analysis of both young adults' and food experts' perspectives (Delphi process with researchers and practitioners from education, community and health sectors), describing food literacy as “the scaffolding that empowers individuals, households, communities or nations to protect diet quality through change and support dietary resilience” (p. 54). Thus, the authors created a model concerning food literacy “inter-related knowledge, skills and behaviours” (p. 54) within the four domains — Plan and Manage, Select, Prepare, and Eat — that represent and determine food intake. Similarly, the work of (ii) Desjardins and co-authors (Desjardins et al., 2013) started with a thematic analysis of perspectives from at-risk teens, young parents and pregnant women to understand food literacy; from this qualitative study, a framework with two models (A and B) emerged — model A comprising personal dimensions of food literacy (food preparation skills and experience, organisational, food and nutritional knowledge, and psycho-social factors), and model B integrating external determinants of food literacy (social-cultural environment, food and facilities, living conditions, and learning environment). Also, the authors provided the definition of being food literate as “being knowledgeable and confident that one can regularly prepare meals that taste good and make one feel good, as well as having the organisational skills to find and use resources (human, financial, informational, material, time) to optimally make this happen” (p.68). Subsequently, Perry, Thomas and their colleagues (Perry et al., 2017) conducted a scoping review of the literature that led to the identification of five main themes— Food and Nutrition Knowledge, Food Skills, Self-efficacy and Confidence, Ecologic, and Food Decisions. Later on, this team conducted a Delphi process with food-related professionals (researchers, practitioners, policy and decision makers within academia, community, health and non-governmental sectors) to build consensus on these attributes, resulting in a final framework with the same five main themes but re-arranged content within these themes.

Likewise, (iii) Slater and co-authors (Slater et al., 2018) applied a Delphi technique with food and nutrition experts (dietitians, teachers, and nutrition/culinary students); however, this work intended to achieve consensus on food literacy-related competencies specifically required by youth transitioning to an independent living through adulthood. As so, Slater and colleagues (Slater et al., 2018) developed a framework of food literacy competencies for young adults, which comprises three domains — 1) Functional

Competencies: Confidence and Empowerment with Food, 2) Relational Competencies: Joy and Meaning through Food, and 3) Systems Competencies: Equity and Sustainability for Food Systems — that accentuate the diversity within food literacy-related competencies. Differently, (iv) Cullen's and colleagues' "Food Literacy Framework for Action" (Cullen et al., 2015) was solely driven by a scoping review of past literature. In this work, the authors propose a definition of food literacy as the conjuncture amidst community food security and individual food-related skills, highlighting the influence of one's social, cultural and environmental contexts in order to be food literate.

Most of these frameworks present multiple similarities concerning food literacy's domains and definitions, as shown in the work of Truman, Lane and Elliot (Truman et al., 2017); though not including the recent studies by (ii) Thomas and colleagues (Thomas et al., 2019) and (iv) Slater (Slater et al., 2018), this scoping review identifies how food-related skills and behaviours, choices, knowledge, emotions, cultural and social aspects, and food systems are frequently identified as themes concerning the definition of food literacy. However, the lack of consistency among these frameworks — for example, the absence of cultural aspects within the frameworks of both (i) Vidgen and Gallegos (Vidgen & Gallegos, 2014) and (ii) Desjardins and co-authors (Desjardins et al., 2013), the lack of knowledge as a theme in (iv) Cullen's framework (Cullen et al., 2015), and the poorly explored theme of attitudes, motivation and other psychological and emotional factors within current literature — appears to be significant (Truman et al., 2017). In fact, across contemporary literature, food/nutrition knowledge and practical skills/competencies are the most common aspects incorporated by food literacy definitions, with limited manifestation of surrounding contexts (such as social, cultural, political, and environmental contexts) as part of food literacy, despite their identification as influential aspects in order to be food literate (Cullen et al., 2015; Ronto et al., 2016).

Moreover, in addition to the majority of research originating from Canada and Australia, European studies focusing on food literacy are still scarce (Truman et al., 2017). Northern and central Europe countries — specifically in the United Kingdom, Italy, France, Netherlands, Switzerland, and Denmark — recently started to develop food literacy-related research (Amouzandeh et al., 2019; Truman et al., 2017). Particularly in Portugal, the ministry of health designated the National Program for the Promotion of Healthy Eating as one of the priority programs to be developed by governmental actions; this aims to improve the

population's nutritional status by encouraging the availability and consumption of foods that integrate a healthy eating regime (Programa Nacional para a Promoção da Alimentação Saudável [PNPAS], 2018). Nonetheless, evidence-based research that provides an understanding of food literacy's domains, determinants and influential factors, in order to contribute for the development of food-related knowledge, behaviours, skills and general food systems for the Portuguese population and context is yet to be conducted.

Therefore, this study integrates a project designated as FOODLIT-PRO: Food Literacy Project and aims to explore food literacy (1) domains, which can be understood as components that integrate food literacy, (2) its influential factors, perceived as contextual and surrounding spheres of action that can impact and be impacted by food literacy, and (3) its determinants, illustrating what can limit one's food literacy.

To provide a clear perspective on the outcomes of this study concerning the current state of art, a comparison with current food literacy's frameworks is presented along with these obtained results. Given the similarities between the current study's methodological approaches and sample characteristics with frameworks (i) and (ii), considering the absence of the tailoring to a specific population like as characterised in the framework (iii) and the vulnerability of the framework (iv) by being uniquely based on a literature review, the obtained outcomes of this research are compared to the frameworks of (i) Vidgen and Gallegos (Vidgen & Gallegos, 2014) and (ii) the revised work of Thomas, Perry, and colleagues (Thomas et al., 2019). By doing so, it is intended to identify in which aspects the lack of consistency emerges and if new content arises, which may complement and expand previous ones within food-literacy-related current literature.

Materials and Methods

Study Design and Approach

In order to gather detailed data and to allow for a profound understanding of a particular concept or phenomenon of interest, qualitative methodology was chosen (Elo & Kyngäs, 2008). Particularly, this exploratory and cross-sectional study employed a deductive-dominant content analysis; this dominantly directed (both designations "deductive" and "directed" describe the use of previous findings for the analysis process) qualitative approach aims (i) to extend or corroborate an already existent theoretical framework that may benefit from further description, and/or (ii) to assess the (dis)similarity of a construct's meaning in a

distinct context (Hsieh & Shannon, 2005). Therefore, content analysis with a deductive-dominant approach was used to explore what defines food literacy and its domains, influential factors, and its determinants from the perspective of Portuguese experts from multiple food-related fields.

Recruitment and Sampling

Potential participants were recruited through direct contact (via email or telephone) with the institutions in which they were currently employed. Institutions were deliberately selected aiming to reach diverse organisations from across the (I) food-system and (II) other related fields — including (I - food system) food production, processing, distribution, marketing, consumption and disposing, but also (II - related fields) policy-making, education, association with human and environmental health, and sustainability. Participant's referencing (snow-ball sampling, non-probabilistic convenience sampling) was also accepted as a recruitment strategy.

In total, 30 Portuguese experts (10 men and 20 women; Table 1) working in diverse food-related areas, with ages between 23 and 57 years ($M = 38.4$; $SD = 8.6$) from 26 different organisations — either governmental or non-governmental, and profit or non-profit — were interviewed. Participants' professions included nutritionist, public health doctor, researcher, director of politics' development, psychologist, teacher, farmer, agronomist engineer, cooker, among others. The established contact with the participants took place between February and June 2018.

Table 1. *Participants' socio-demographic characteristics.*

Socio-demographic characteristics	Frequency (<i>n</i>)	Percentage (%)
Affective-sexual relationship		
Yes	27	90
No	3	10
Educational level		
Middle school	1	3.3
High school	2	6.7
Bachelor	19	63.3

Master	6	20
Doctorate	2	6.7
<hr/>		
Professional status		
Active	29	96.7
Unemployed	1	3.3
<hr/>		
Professional area		
Education	7	23.3
Health	6	20
Agricultural Industry	5	16.7
Commercial Industry	8	26.7
Food Policy	4	13.3
<hr/>		
Annual household income		
10.000 EUR	5	16.7
10.001 EUR – 20.000 EUR	7	23.3
20.001 EUR – 37.500 EUR	12	40
37.501 EUR – 70.000 EUR	6	20
<hr/>		

Inclusion criteria were (a) being 18 years or older, (b) minimum literacy and being able to answer to an extensive audio recorded interview, (c) working in fields (in)directly related with food, and (d) being responsible for feeding themselves. The criterion for (d) being responsible for one's own feeding was evaluated through the minimum presence of one out of four possible items: holding responsibility over their food (i) choice and decision, (ii) selection and acquisition, (iii) preparation, and/or (iv) cooking (based on the model of Vidgen and Gallegos; Vidgen & Gallegos, 2014).

The food-related fields in which the experts worked were grouped in five different ambits: Education (E), encompassing Basic Education, High School, and Environmental Education; Health (H), including Nutrition, Psychology, Medicine; Food Policy (FP), with the establishment of food-related policies, development of national/international priority programs, among others; Agricultural Industry (AI), encompassing agricultural production and consulting; and Commercial Industry (CI), including Marketing, Brand Management, Product Innovation.

Ethical Considerations

This study was approved by the Ethics Committee of ISPA – Instituto Universitário (ref. D/002/03/2018). Concerning the consent process prior to data collection, all participants were informed about the aim and methods of the study, as well as about the voluntary and confidential nature of their participation. The leading researcher assured to all participants that their identities would not be revealed and provided, when requested, additional clarification concerning the study purpose. All participants provided oral and written consent for the interview, along with written authorisation for the audio recording (Appendices 3 and 4). Confidentiality of the gathered data was guaranteed.

Data Collection

Prior to the interview, participants had access to written information about this project's stage (Appendix 3) filled a socio-demographic questionnaire (Appendix 7). Interviews were conducted both in the institutions that employed the participants and in the William James Center for Research (WJCR) facilities; in both contexts, a private setting with an individual room behind closed doors was provided. A total of 30 semi-structured interviews were conducted by the first author in person ($n = 21$) and by telephone ($n = 9$) from March to June 2018. Interviews lasted from 25 to 120 minutes ($M = 56.6$) and were continued until data saturation was reached, meaning that no new contents were being added or explored. All interviews were audio recorded and fully transcribed; identifying information was edited by the time of the transcription. Randomised revisions were made to verify transcriptions' accuracy.

Interview Protocol

The protocol for the semistructured qualitative interview was developed by the first author (a registered psychologist) and reviewed by this research team. The interview protocol used mostly open-ended questions, along with some leading and verifying questions; this allowed for further exploration of the subject and provided richness to the manifested content. The formulated questions were informed by food literacy-related research published at the time of data collection, and aimed to explore food literacy's domains, influential factors and potential determinants (Thomas et al., 2019; Vidgen & Gallegos, 2014). Further specific leading questions were formulated considering other food-related areas and influential factors, not yet thoroughly related to food literacy (e.g., food policy, and environmental concerns).

The protocol (Appendix 1) initiated with the following open-ended questions: (i) “What do you think is necessary for someone to eat according to one’s needs?”, (ii) “What do you understand by food literacy?”, and (iii) “In your opinion, what domains or components integrate food literacy?”. The current domains identified by previous research were explored subsequently, in form of leading questions – such as “What about knowledge (that is, facts and information gained through experience or education), what do you think people need to know to feed themselves according to their own needs?”, “What about skills (that is, practical techniques and skills), what do you think people have to know how to feed themselves according to their own needs?”, and “What about confidence and self-efficacy (that is, one’s belief about being efficacious), what do you think people have to master or feel in order to feed themselves according to their own needs?”, among others. A question concerning potential food literacy’s determinants — “In your opinion, which potential barriers or obstacles may arise when concerning people feeding themselves according to their own needs?” — was also inquired. Leading questions concerning topics not yet explored in-depth by current research were inserted with influencing fields-related questions — “Which food policies do you think enable people to feed themselves according to their own needs?” and “Which environmental and sustainability-related aspects do you think endorse people to feed themselves according to their own needs?”.

This technique demonstrated to be the most suited concerning the protocol development in order to provide theme-related guidance to the participant, by starting with more general subjects and progressing to more specific content. Furthermore, the methodological approach chosen (deductive-dominant content analysis) affirms that targeted questions should follow general and flexible ones – which may help to identify initial coding categories (Hseih & Shannon, 2005).

Data Analysis

All interviews were analysed using the MAXQDA Software (version 2018), the entire process of data analysis (including initial data analysis, secondary data analysis, and data verification) took place between April 2018 and January 2019.

The qualitative analysis process began with an initial reading of the transcriptions, occasionally making use of the correspondent audio record for further understanding. Given that previous theory of food literacy (Thomas et al., 2019; Vidgen & Gallegos, 2014) informed the initial data analysis, some segments that appeared to be related with earlier

theory were highlighted during the primary reading of the text. Therefore, the identification of those segments was possible through the use of pre-determined codes derived by food literacy conceptual models – such as planning and management, selection, and preparation (Vidgen & Gallegos, 2014); nutrition language, food techniques, food attitude, and sociocultural influences (Perry et al., 2017; Thomas et al., 2019). These pre-determined codes created a matrix of categories and correspondence codes, given its origin anchored in previous research. While developing the matrix, theoretical-based operational definitions of those categories and codes were accurately and objectively attributed. Despite the dominant deductive mode of reasoning applied in the beginning of the qualitative analysis – with existing theory informing the categorisation matrix – this was not the exclusive approach taken regarding the data analysis. When certain segments did not show a proper match to the codes and categories of the theory-informed matrix, new codes and categories inductively emerged (Elo & Kyngäs, 2008)

After the development of the matrix and the coding process, all the data were reviewed independently by the leading researcher and a second member of this team. The constant comparison and reflection amid theory-informed and inductively-created codes and categories made along the coding process culminated in the development of a conceptual link between the existing theory and the added information from the present results.

Strategies for Trustworthiness

Given the importance of consistency in the coding process, the agreement among inter-raters is used as an indicator of the reliability among a given characterisation of a subject identified between researchers (Warrens et al., 2014). As so, to assess reliability, two researchers coded three transcribed interviews independently with the final coding matrix. The coefficient of Cohen's kappa was used, because it is adapted for two coders and nominal categories (Cohen, 1960; McHugh, 2012), in this case the presence or absence of each code. Based on both researchers' ratings, Cohen's kappa indicated a nearly perfect agreement ($k=0.8$).

Results

The final qualitative analysis yielded a total of 184 codes, which were coded across 5.981 text segments. For feasibility reasons concerning the results' presentation, inclusion criteria of codes mentioned by a minimum of 10% of the sample (that is, three participants)

was applied. Thus, a total of 3.578 segments were coded by a revised total of 80 codes nested across 19 categories and their respective themes concerning food literacy domains (Table 2) comprising nine categories, its influential factors (Table 3) incorporating eight categories, and its determinants (Table 4) integrating two categories.

The following display of the study findings includes the contrast against current literature reported by Vidgen and Gallegos (Framework A, adapted from Amouzandeh et al., 2019 and Vidgen and Gallegos, 2014; Appendix 8), Thomas and colleagues (Framework B, adapted from Perry et al., 2017 and Thomas et al., 2019; Appendix 9), and Truman and Elliott (Framework C, adapted from Truman and Elliot, 2018; Appendix 10). To provide a clearer reading of the results, the components of these theoretical frameworks were numbered, as done previously by Amouzandeh and colleagues (2019). The inventory of the frameworks' categories and its respective attributes are detailed in the Appendices.

Manifested Content and Sample Characteristics

Considering the diverse age range and to explore potential differences in the manifested content given by the participants, a Wilcoxon-Mann-Whitney non-parametric test was performed to compare the frequency of the manifested codes among the participants under 40 (Group 1, aged until 39 years) and aged 40 and over (Group 2). Within the 184 manifested attributes, only the attribute information seeking belonging to the influential factor (iv) Learning Contexts differed significantly among participants under and over 40 years ($U = 57$; $W = 228$; $Z = -2.67$; $p = .03$; Mean rank Group 1 = 12.7; Mean rank Group 2 = 19.8). This difference can be interpreted by the easy connection with diverse sources of knowledge (such as online platforms and social networks) that younger generations are more prompt to have nowadays, since these platforms may act as delivers of constant notifications of information; as so, young participants would not manifest the need to actively look for food-related information as much as older participants.

Domains of Food Literacy

From the construct's exploration, a total of nine categories emerged as identified domains of food literacy: (i) Origin, (ii) Safety, (iii) Choice and Decision, (iv) Select and Acquire, (v) Plan, (vi) Preserve, (vii) Prepare, (viii) Cook, and (ix) Knowledge. These domains incorporated a total of 22 codes (Table 2), which are interpreted as the attributes that define the content of each of the food literacy's domains.

Table 2

Representation of the theme Definition of Food Literacy, its domains (categories) and respective attributes (codes), the coding against conceptual frameworks (of Amouzandeh et al., 2019 and Viágen and Gallegos, 2014), an exemplifying quote and its respective author's professional and demographic characteristics

Category	Code	Frameworks		Example	Participant
		A	B		
Origin	Knowing Origin	2.2	1.1	"(...) to see this in an integrated perspective, like <i>from the farm to the fork</i> . From the primary production on how vegetables and fruits are produced, to... everything, everything, everything, CI (W,38) everything."	CI (W,38)
	Food Additives	2.2	1.1	"(...) about everything that is added to food (...) that is indispensable, for example dyes, preservatives, emulsifiers, etc." E (W,36)	E (W,36)
	How Origin Relates to Quality	2.3		"(...) to combine the agricultural production method to the final food's quality (...)" AI (M,53)	AI (M,53)
	Seasonality			"(...) to have knowledge concerning the food's season, (...) to buy seasonal products." E (W,36)	E (W,36)
Safety	Bio/Organic: Definition and Impact		4.1	"(...) in the sense of <i>what is biological food</i> and <i>what is biological/food culture, biological production</i> - it is not a massified production, it does not contemplate the use of pesticides. Then, of course, you will need a lot more space [for a biological production] than for a massified and systematical production. Which means that you will cut more trees to be able to plant your cabbages, to have your biological products..." CI (W,36)	CI (W,36)
	Hygiene and Safety Practices	3.2	2.1	"(...) safe foods because, from a hygiene-and-food-safety point of view, there was no contamination. It is all right." E (W,41)	E (W,41)
Choice and Decision	Pesticides and Herbicides		4.1	"(...) because there is a kind of information that I consider very important and which is not usually indicated in the label, nor will it come so quickly... which is the level of pesticide residues, the presence of pesticides in the food." AI (M,53)	AI (M,53)
	Choice and Decision Skills	1.3; 2.1	5.1	"(...) the ability to make informed choices that ends up in reflecting in a better decision!" FP (W,28)	FP (W,28)
Select and Acquire	Selection and Acquisition Skills	2.1	3.2	"(...) when they go shopping they must know what to bring home and what they should leave behind." E (W,36)	E (W,36)
	Nutritionally Equivalent Foods		1.2	"I think that what we find harder to learn is how we can replace (...) we must know that there are other ways of replacing a particular ingredient or product." H (W,34)	H (W,34)

Definition of Food Literacy				Participant	
Category	Code	Frameworks		Example	Area (Sex, Age)
		A	B		
Plan	Planning Skills	1.2		"This kind of [food-related] planning and organisation is important."	AI (W,43)
	Plan Food Intake Ahead	1.2		"This ends up being part of my weekend: having to spend hours, a couple of hours in the kitchen to make the rest of my snacks or my meals [for the following week]"	H (W,28)
	Preservation Skills	2.2	2.1	"(...) and also conservation, [because] food can become tainted during the process between harvesting and consumption. The part of conservation is also important."	AI (M,53)
	Preparation Skills	3.1	2.1	"(...) you have to wash the food, you have to, ... I do not know, to peel off the skin or to do some kind of specific treatment."	H (M,39)
Cook	Cooking Skills	3.1	2.1	"Knowing how to cook - that's another problem we've been watching!, people can not cook!"	FP (W,28)
	Using Different Cooking Techniques	3.1	2.1	"(...) [ways of] cooking: whether it is steam, whether it is in the oven, whether it is boiled, ... Whatever, it can be a competence."	CI (W,28)
	Matching Ingredients	3.1	2.1	"(...) basic notions of what should be the matching of foods, for example, (...) one has to know how to combine, know what ingredients should not be mixed with others."	E (W,57)
	Using Recipes	3.1	2.1	"(...) recipes books have everything standardised with measures, why is that? So that anyone is able to do that [recipe] and that it ends up, at least, similar to what is in the book, right?"	CI (M,46)
Knowledge	Matching Techniques to Ingredients; Nutritional Value			"Methods to know how to adapt the [cooking] method to what you want to do, [and know] how to make the most of a food, right? Depending on the different cooking methods."	E (W,28)
	Cooking Motivation/Attitude	3.3;	3.4	"But there was really a... a boost in the interest of people in wanting to cook, to experiment, to go to the kitchen."	CI (W,44)
	Declarative			"(...) is a set of skills, that one must have in order to be able to understand a certain concept."	CI (W,38)
	Procedural			"(...) it's the knowledge that would get me to go from <i>theory</i> to <i>action</i> (...) I may know the <i>theory</i> but if I do not know how to apply it..."	FP (W,28)

The majority of these domains and its attributes (meaning, categories and its respective codes) are sustained by current conceptual frameworks — such as the attributes of cooking skills, matching ingredients and using recipes within the domain (viii) Cook, which are supported by both frameworks, and planning skills and plan food intake ahead from (v) Plan, being validated from one of the frameworks. More precisely, 11 (50%) out of the 22 emerged attributes are corroborated by both conceptual frameworks and seven (31.8%) attributes are supported by at least one theoretical model. However, four (18.2%) of the total attributes are not mentioned by these food literacy frameworks in any extent; for example, the attributes of seasonality within the domain (i) Origin and matching cooking techniques to ingredients' nutritional value from (viii) Cook. Particularly, and although neither of the frameworks against which these findings were compared refer declarative (also designated as critical) or procedural (or functional) knowledge, these attributes from the domain (ix) Knowledge were considered in past food literacy-related studies (Cullen et al., 2015; Truman et al., 2017).

Influential Factors of Food Literacy

Regarding the analysis of food literacy-related fields of influence, eight categories were identified as influential factors: (i) Nutrition, (ii) Psychological, (iii) Health, (iv) Learning Contexts, (v) Policy, (vi) Industry, (vii) Sustainability, and (viii) Social and Cultural. In total, 46 codes emanated from this analysis, defining the content and being interpreted as the influential factors' attributes (Table 3).

Table 3

Representation of the theme Influential Factors of Food Literacy (categories) and respective attributes (codes), the coding against conceptual frameworks (Thomas et al., 2019; Vidgen & Gallegos, 2014), an exemplifying quote and its respective author's professional and demographic characteristics.

Influential Factors of Food Literacy				
Category	Code	Frameworks		Participant Area (Sex, Age)
		A	B	
Nutrition	Awareness Nutrients	Food 3.2	1.2	E (W,57)
	Awareness Nutritional Needs	1.3; 4.1; 4.2	1.2	E (W,41)
	Tracking Intake	Food 4.2		CI (W,38)
Nutrition	Interpret Nutritional Labels	2.2	3.1	H (W,36)
	Language		1.3	CI (W,41)
	Creativity			H (M,39)
Psychological	Critical Analysis of Food Information		3.1	H (W,23)
	Sense Empowerment	Construct of Definition		H (M,27)
	Health Behaviour Change	Behaviour		H (M,27)
Psychological	Identity Associated with Changed Behaviour			H (M,27)
	Habit Formation			CI (M,40) H (M,39)

Influential Factors of Food Literacy				
Category	Code	Frameworks		Participant Area (Sex, Age)
		A	B	
	Emotional Eating	“(…) most people recognise that they eat other kind of foods when they feel frustrated or in a lower emotional state.”		AI (W,43)
	Manage Emotions to Manage Food Intake	“(…) it is very much about the mental state, and people need to start managing their emotions first and only after to manage what is on the plate. This is so important.”		H (W,23)
	Positive Sensorial and Psychological Consequences	“The food has to be good, it has to be tasty. People have to enjoy eating. We are programmed to enjoy eating.”		E (W,41)
	Indulgence as Part of the Balance	“(…) I think we need to find (….) our own happiness to eat.”		H (W,28)
	Emotionally Nurture Through Food	“(…) of course we all like to eat foods that are unhealthy and unnecessary to our diet, they are made for that... they are designed for that: to satisfy our taste buds, to satisfy our gluttony. (….) they must also exist (….) they will be the exception to the rule.”		E (W,36)
	Food Impacts Health	“(…) because it's so important, when we make food for someone - in this case for our family - is a proof of love, isn't it?”		CI (W,38)
Health	Information Seeking	1.2;	“(…) not even medicine is as important to health as agriculture.”	AI (M,53)
		4.1	“(…) obesity and overweight, because they don't know how to eat.”	FP (W,31)
Learning Contexts	Schools	3.1	“What we can do as consumers, and I always come back to this, is to look for information. We have to search, to search a way to know, to seek knowledge.”	FP (M,47)
		4.2	“Education in school should include training in this area, so that everyone could learn about this in public and mandatory schooling.”	AI (M,53)
Policy	Professional Support to Educate Consumers	4.2	“To have people receiving support, feedback, external reinforcement from health technicians (….) for implementation and initiation [in changing health behaviours] when it is not yet automatic - there has to be some external support.”	H (M,39)
			“(…) an evidence-based national campaign that has to be carried out and it has to be led by public administration (….) a really consolidated campaign to increase food literacy - that is, to provide consumers with tools to allow them to understand these concepts, ... which for us are simple but not so simple [for others], right?”	CI (W,38)

Influential Factors of Food Literacy				
Category	Code	Frameworks		Participant
		A	B	
	Display Products Information		“(…) ensuring that what is being made available [to the consumer] in consumption is informing enough. ... If it is nutritional, it is nutritional. If it is about the price, it is about the price. If it is about the origin, it is about the origin. If it is about the way it was done, or about environmental issues, or about other concerns... whatever it is, it should be able to inform and, above all, not being able to deceive the consumer. This is our major concern. Transparent, clear, objective, VALID and added-value information.”	FP (M,47)
	Regulation Prior to Consumption		“I see the importance of these legislative measures as means for changing one's habits, particularly at the palate level (...) I just focused on salt and sugar (...) there are certainties there [concerning salt and sugar] and, therefore, I consider that legislation is the best way to change the habits of society.”	H (M,39)
	Tailored Interventions		“(…) the approach to be conducted needs to put the person at the center of the intervention and interaction. That is the paradigm that needs to exist.”	FP (M,38)
	Food in All Policies: Inter-sectoral Policies		“The sustainability of those measures and interventions has to be taken care of and ensured by different policy approaches - meaning, health policies and agricultural policies must go hand-in-hand. A clear multi-sectoral approach - health, agriculture, industry, economics, everything.”	FP (M,38)
	Flavour' Intensifiers for Consumers' Loyalty		“Food additives that are used in the food industry aim to get the consumer to be flavour-anchored in that product.”	E (W,41)
	Appeal Consumers' Emotions	to	“We sell empathy along with the products. I always give this example, wherever I am going to talk: products don't sell themselves to you (...) for example, a famous soda brand sells happiness. It does not sell itself. And selling happiness is an emotional condition.”	FP (M,38)
Industry	Marketing's Influence		“I think marketing helps a lot! (...) We turn on our tv and we are seeing food-related advertising at that time of the day. (...) When we arrive home, we never see advertising to healthy foods. Kids, on Saturday and Sunday mornings, while they watch cartoons on tv they are bombed with food-related marketing, only with foods that they should not eat on a daily basis.”	E (W,36)
	Social Influence	Media's	“(…) one of the things we are seeing today is the phenomenon of social networks and digital influences. (...) What happens today is what is on the other side of the screens. Following these people [influencers], and some are good, really good influencers, because they are well informed and others not so much (...). People guide themselves by them, and that impacts a lot, meaning it has an impact on sales. It's like advertising.”	CI (W,31)

Influential Factors of Food Literacy			
Category	Frameworks		Participant Area (Sex, Age)
	Code	A B	
Reaction to Consumer Demands		“The final consumer is the big driver (...). Within the value chain, the big driver of all this is the final consumer. It has no direct relation to the producer. (...) Current constraints on agri-food production are determined by consumers (...)”	FP (M,47)
Food Security: Challenge of Feeding the World		“(…) and right now maybe we are taking much more than we are giving back, therefore when we are taking much more than what we are giving back we are not yet at the breakeven point. But it's not easy to feed the millions of people that we are, and we [people in the world] keep increasing.”	CI (W,41)
Animal Welfare		“(…) if the cattle were freely in the pasture to be eaten, and there was no pressure for them to grow quickly to be slaughtered, there would be no such impacts.”	E (W,41)
Consequences of Animal-origin Foods		“If we reduced the consumption of animals, we would have more plant-based foods: cereals, vegetables, fruits. And there wouldn't be such a high impact on agriculture. And then there are other impacts of meat production: the amount of methane a cattle produces over its lifetime is too much for what the planet can handle. The amount of cattle we raise is the problem. The problem is not cattle, the problem is the amount of cattle that is quickly required for human consumption. Because cattle has been around for tens of thousands of years, and cattle wasn't the problem.”	E (W,41)
Impact of the Consumers' Demands	4.1	“There are consumption habits that are influencing agriculture and agri-food production a lot. So they are also beginning to interfere with the value and sustainability of the chain as a whole.”	FP (M,47)
Fair Trade	4.1	“(…) also, but not only, for example, to know if the place where we go to buy fruit supports its farmers.”	FP (W,31)
Local/National Trade	4.1	“(…) essentially local products, (...) this also had economic advantages for our national farmers, right? (...) and they are economically good for our economy.”	H (M,39)
Impact of Food Importation	4.1	“(…) instead of buying a mango that came from Brazil - if I consider the travelled distance in order to get to my plate, that it came by plane so it has consumed fuel and so it had its impact on environmental pollution - and choosing instead to consume something that is nationally produced and seasonal, I make a choice with a much smaller environmental impact.”	FP (W,28)
Seasonal: a Strategy for Sustainability	4.1	“If we have a sustainable food regime, then we have an adequate food regime. (...) because it's regional, it's local, because it's seasonal. I think, currently, maybe people don't have this notion or sensitivity. (...) Take the healthy and start implementing the sustainable.”	H (W,36)

Influential Factors of Food Literacy				Participant
Category	Code	Frameworks		Area (Sex, Age)
		A	B	
	Deforestation	4.1		E (W,41)
	Single-use Food-related Items	4.1		AI (M,52)
	Circular Economy	4.1		FP (M,47)
	Having a "Healthy Diet" to be Trendy			H (W,28)
Social and Cultural	Eating Gateway Unhealthier Choices	4.3		E (W,28)
	Social Support	4.3		CI (W,31)
	Food: the Glue of Social Connectedness	4.3		H (W,34)
	Evolution of Food Availability and Access	4.1		E (W,41)

"Nowadays, the land that is used for agriculture is land that is stolen from the forests. And deforestation is a serious global problem as we know, isn't it? We talk a lot about climate change and deforestation is one of the causes of climate change."

"Start by reducing these kinds of things (...) the use of straws, [plastic] cups, plastics."

"(...) sustainable development goals, the circular economy. (...) we stop generating waste, because one thing is to waste and another thing is not waste by continue to give it a second life. Until that residue has no chance at all, we will always keep trying to give it life."

"I think that there is already a certain trend, at the societal level, of having a healthier diet. So, at the societal level... if our neighbour does one thing, we also start doing it. We are very much like that, we are very influential people (...)."

"I mean, when my friends get together at someone's house to eat, we'll have pizza delivered (...). They will not be reading the food label, what matters is being reunited with friends. Food is just one way... It's an aid mechanism... Food is always a second or third priority."

"But obviously, in terms of social support, I would say... Having a group of friends or family who support us greatly in this kind of [food-related] changes and who don't recognise it as a barrier to socialisation."

"(...) around the table and we know that people and families - when they come together is around the table. It's always..., there's always food, there's always food."

"(...) especially at the population level, years and years ago, citizens made healthy choices - but they weren't really choices, because people had no other option, right? Back then, little meat was eaten, meat was only eaten on Sundays or when someone was sick, and on day-to-day life the main resources were vegetables, cabbages, pulses, and bread."

In contrast with food literacy's domains, the majority of influential factors and their attributes are not yet explored by current research; this culminates in 23 (50%) out of the 46 attributes having no correspondence with the contrasting frameworks. Nonetheless, a total of 19 (41.3%) attributes manifest similar content with at least one of the conceptual frameworks; that is the case for attributes such as tracking food intake in (i) Nutrition, critical analysis of food information in (ii) Psychological, information seeking in (iv) Learning Contexts, food: the glue of social connectedness in (viii) Social and Cultural, among others. Specifically, within (ii) Psychological, the attribute of sense of empowerment is corroborated by the definition of the construct proposed by Vidgen and Gallegos (2014). Finally, only four (8.7%) of the attributes are supported by both existing frameworks: awareness of food nutrients, awareness of nutritional needs, and interpret nutritional labels from (i) Nutrition, as well as food impacts health from (iii) Health.

Determinants of Food Literacy

Concerning the exploration of food literacy's determinants, two main categories were identified — (i) External Determinants, comprising five attributes, and (ii) Internal Determinants, assembling seven attributes (Table 4).

Differently from both domains and influential factors of food literacy, the manifested determinants were also compared with the framework of food literacy proficiency by Truman and Elliott (Truman & Elliot, 2018) regarding factors that can limit behaviour change: knowledge, attitudes, skills/abilities, resources, and environmental conditions.

Of the identified 12 attributes belonging to both (i) External and (ii) Internal Determinants, only one (8.3%) was corroborated by all frameworks (Thomas et al., 2019; Truman & Elliot, 2018; Vidgen & Gallegos, 2014). A sum of three (25%) attributes were validated by at least two of conceptual frameworks, and five (41.7%) were supported by a single of the conceptualisation. Finally, three (25%) of these 12 attributes were not matched by any of the elements embraced by the three theoretical frameworks.

Table 4

Representation of the theme Determinants of Food Literacy (categories) and concerning attributes (codes), the coding against conceptual frameworks (of Thomas et al., 2019, Truman et al., 2017, and Vidgen and Gallegos, 2014), an exemplifying quote and its respective author's professional and demographic characteristics

Determinants of Food Literacy					
Category	Code	Frameworks			Participant Area (Sex, Age)
		A	B	C	
External	Access to Food-related Information			1; 5	"I think the barrier is, above all, the communication, the access to information, as I just said... that seems to me, it seems to me to be key and important elements." FP (M,38)
	Perishable and/or Unreliable Food-related Information			1; 5	"(...) people also get a little lost because there is a lot of information and a lot of misinformation." CI (W,38)
	Food Security: Lack of Food Access			5	"(...) when kids bring lunch boxes, there are some who don't even... We also have kids who eat poorly because there's lack of food at home (...)" E (W,57)
	Family Dynamic and/or Identity			5	"It's about the example, and the child understands perfectly, isn't it? I can't be saying you have to eat the broccoli on your plate if I don't have it on my plate, right? Automatically, she [the child] makes this comparison: if I don't have it, then why does she need to eat it?" FP (W,28)
	Professionals' Unpreparedness on Food-related Expertise			5	"(...) in medical school, not even having a discipline about human nutrition... I mean, it gives the idea that medicine has nothing to do with food." AI (M,53)
Internal	Prioritise Food	1.1		2	"(...) it's about managing priorities, and everything in life is about managing priorities. (...) the consumer, what he should realize - or what he should ideally realize - is that his diet, the diet that is appropriate to his needs, his diet and that of his family is the number one priority! It should be first priority, first priority on the list, it should be first."
	Convenience and Practicality	1.1		2; 4	"(...) is accommodation, isn't it? It is much more practical and convenient to take a box of pre-cooked food out of the freezer and put it in the microwave than to exercise your imagination and start cooking your own food (...)" E (W,57)
	Time Management	1.1		4	"I think that management is the most important thing, if we can manage our time to go to the supermarket... and if not, to shop online (...). Our lives today don't allow us as much [time] as we would like, so we go back to the issue of time management, right?" CI (W,41)

Determinants of Food Literacy					Participant	
Category	Code	Frameworks			Example	Area (Sex, Age)
		A	B	C		
Financial Management	1.1; 1.3	4.2	4	“(…) in the families we work with, the perception that they want to do better and different but they cannot, due to financial issues - this is the first! Comparing with their financial and economic situation, the family tries to make the best possible management of it. (….) For families with no income, it is easier to go to the supermarket to buy pre-cooked foods - water, electricity, or gas are not spent in the same proportion when comparing to cooking a meal from scratch.”	E (W,37)	
Previous Habits	Food-related			“(…) population niches where eating habits and eating behaviours are established practices, right? It's about not knowing how to do it differently, because they never saw that a different reality could exist.”	E (W,37)	
Innate Flavour Preferences				“I think it's born with us, right? Feeling good and feeling that a specific food gives us pleasure or not. Therefore, we are born perhaps with a particular palate. It's already there, isn't it? Already there, our taste buds and what we like... So, it is born with us.”	CI (W,41)	
Learned Preferences	Flavour			“(…) in terms of flavour, it will taste much better [to eat] something with sugar than something with no sugar at all, right? Now the palate, the taste, is an educated thing. We can go training, experimenting and checking. (….) [taste] has to be educated, doesn't it?”	CI (W,41)	

Discussion

This study aimed to identify qualitative content on three different outlooks concerning food literacy – domains within the construct’s definition, influential factors, and determinants – according to Portuguese experts from diverse food-related fields, and to compare these findings to the most recently developed empirical conceptualisations of food literacy. The match of 50 out of the total 80 manifested attributes (62.5%) with the compared frameworks (A, B and C) demonstrates theoretical congruency among the obtained results with the current literature on food literacy, notwithstanding disparities across demographic, social and cultural characteristics. However, the remaining 30 manifested attributes that have not found validation across the displayed frameworks demand further reflection.

Domains of Food Literacy

Greatly supported by the presented frameworks (18 out of 22 attributes; 81.8%), the manifested categories that designated domains of food literacy in this study — (i) Origin, (ii) Safety, (iii) Choice and Decision, (iv) Select and Acquire, (v) Plan, (vi) Preserve, (vii) Prepare, (viii) Cook, and (ix) Knowledge — are, mostly, already well-known in current research (Thomas et al., 2019; Vidgen & Gallegos, 2014). Despite the similarity of this arrangement of food literacy domains with the categories of framework A, essential differences require to be mentioned. First, the inclusion of domains that singularly concern food safety (Safety), food decision-making (Choice and Decision), food preservation (Preserve), and cooking skills (Cook), highlight the importance of these elements concerning one’s food knowledge, skills and behaviours. Second, the addition of a domain strictly mentioning food-related theoretical and practical knowledge (Knowledge), which paves the way for future diversity on outlooks for the quality on food literacy-related proficiency. Third, the dissolution of preparation (Prepare) and cooking (Cook) skills, headlining that these two categories have distinct significance for one’s food literacy. Finally, it is essential to underline that, despite the similarity of these domains with current frameworks, the attributes that are incorporated within these domains outline aspects that were not yet stated with such detail (e.g., though being matched with framework B concerning the growing of food products within the attribute food systems, the manifested attribute of bio/organic: definition and impact specifically addresses the need to better define and know the consequences for biological/organic food products).

However, the attributes of seasonality in (i) Origin, matching cooking techniques to ingredients' nutritional value in (viii) Cook, and declarative and procedural (ix) Knowledge were not matched with the designated frameworks. In spite of this, FAO from the UN points out seasonality as essential to be considered to assess biodiverse food in dietary intake (FAO & Bioversity International, 2017). Moreover, seasonality has been mentioned as one of the aspects that defines balance among environmental-friendly and nutritionally beneficial eating patterns, being part of both the Mediterranean food wheel and food pyramid (Barbosa et al., 2017; Medina, 2011; van Dooren et al., 2014). Regarding the alteration of foods' nutritional value due to its cooking techniques, several recent studies have demonstrated not only that cooking methods can enhance the nutritional potential of diverse foods but also that nutritional losses may take place when preparing and cooking foods (Fabbri & Crosby, 2016). Having knowledge about how and why these changes occur demonstrates to be essential to the consumer because it will enable nutritional loss limit and improvement of foods' nutritional value. Though considered in previous food literacy-related research (Block et al., 2011; Cullen et al., 2015; Grier & Kumanyika, 2008; Truman & Elliot, 2017), declarative and procedural knowledge were not stated in either frameworks A or B. As psychological constructs applied to food-related topics, declarative knowledge states the awareness of facts and processes regarding food sources, nutrition aspects, and other theoretical apprehensions; procedural knowledge refers to the set of practical competencies such as food-related decision making or food preparation skills — driven from the application of declarative knowledge previously stated (Block et al., 2011; Grier & Kumanyika, 2008). The manifestation of (ix) Knowledge in this study re-states the pertinence of structuring conceptual and practical food-related expertise within food literacy domains, because both can qualify different aspects of other identified domains; for example, one can know which foods are in season (declarative knowledge) but not shop for seasonal foods (procedural knowledge).

The obtained results and their confrontation with current literature intend not only to characterise food literacy's definition and related domains within the Portuguese social and cultural contexts, but also to clarify and add up to the existent state of the art, expecting to contribute to further understand the meaning of being food literate.

Influential Factors of Food Literacy

In total, half of the attributes (23 out of 46 attributes; 50%) integrated within food literacy's influential factors were corroborated by the highlighted frameworks. Though

incorporating content similar to what is defined as food literacy in frameworks A and B, this study opted to display the influential factors separately from the domains of food literacy's definition. Instead, the influential factors depict areas that actively interact with food literacy, which is a unique approach in current research. As so, this dissolution of the influential factors from food literacy domains express that these attributes — such as the awareness of food nutrients and one's nutritional needs (Nutrition), the recognition of health-related consequences (Health), and the ability to seek food-related information in external environments (e.g., schools; Learning Contexts) — need to be understood not as being part of what food literacy means, but as aspects that interplay with what food literacy is, affecting and being affected by food-related skills, knowledge, and behaviours.

The attributes from the factors (i) Nutrition, (iii) Health and (iv) Learning Contexts were fully matched with content from frameworks A and/or B. This is validated by the exhaustive research concerning food literacy-related aspects (knowledge, competencies, behaviours) within the fields of nutrition, global health, and learning environments (e.g., Langford et al., 2015; Surgeon et al., 2016). As so, the corroborated attributes integrating these influential factors mirror (i) nutrition-related skills (e.g., tracking food intake, interpret labels, understand specific language), (iii) health-related consequences (e.g., overweight and obesity) and (iv) learning mechanisms (e.g., information seeking, professional support). However, differently from the highlighted frameworks, this study comprehends these attributes not as part of the food literacy definition but as elements that influence and can be influenced by food literacy.

Though integrating mostly matched attributes, the factors (vii) Sustainability and (viii) Social and Cultural present aspects that require further reflection due to the lack of correspondence with both frameworks.

Belonging to (vii) Sustainability, the unmatched attributes were food security: challenge of feeding the world, animal welfare and consequences of animal-origin foods. Illustrating insufficient physical, social and/or economical access to safe and nutritious food that allows for a healthy life, food insecurity is currently experienced by two billion people around the world (FAO et al., 2019). Interconnecting poverty, economic growth, and nutrition, the 2030 Agenda for Sustainable Development highlights food security also as a priority in this call for action. Linked to food security, land use (which relates to the attribute deforestation), water pollution and greenhouse gas emission (related to other sustainability-

related attributes, such as impact of food importation and impact of the consumers' demands) and global human health, animal welfare and health are seen as part of a responsible and sustainable food system (Makkar & Ankers, 2014). Taking into account the animal-source foods that are currently consumed across the planet, a safe supply of animal-origin food for people relies on animals' health and their nutrition — demonstrating that the welfare of humans is closely connected with animal welfare (FAO, 2017a).

Within the frame of sustainability, a mainly plant-based diet has been designated as the food regime that grants both health benefits and less environmental impact, considering the use of fewer natural resources in its production processes (Sabaté & Soret, 2014; Willett et al., 2019). As consequences of animal-origin foods, a large environmental footprint has been pointed out: cropland use, greenhouse-gas emissions, and water use are aspects that make animal-source foods responsible for three-quarters of climate change effects (Clark & Tilman, 2017; Willett et al., 2019). Not only having significant environmental impacts, the entire food supply chain (from production to processing and retail) is acknowledged as affecting animal welfare and human health, general society, economy, and culture (Willett et al., 2019). For diet-related sustainability purposes at a societal level, and considering that some populations are entirely dependent on livestock, it is essential that diets are contemplated according to regional contexts (Willett et al., 2019). Given the evidence that supports the connection between diet with both human health and environmental sustainability, and considering that further research on agrifood systems is recommended for food sustainability improvement, framing (viii) Sustainability as a factor of influence in a food literacy extensive conceptual structure appears to be relevant and well suited (FAO, 2017b; Willett et al., 2019).

Referent to the (viii) Social and Cultural factor, the attribute having a “healthy diet” to be trendy was the only one unmatched by both frameworks. With its potential role on social connectedness already recognised (related to the attribute food: the glue of social connectedness) (Desjardins et al., 2013), eating behaviours are closely connected with social attitudes and practices. Vast research identifies social factors — such as social and mass media, market globalisation, and economic growth — as drivers for individual and social behaviours, greatly influencing health and dietary-related practices (Carrillo-Álvarez et al., 2019; Vaterlaus et al., 2015). This influence of the social context on diverse food-related aspects (such as food choices) can either be supportive of a healthful eating approach (linked to the attribute social support) or depict a barrier to the endorsement of a balanced food intake

(related to the attribute eating socially: gateway for unhealthier choices). Consequently, social contexts and agents (such as schools, family and peers) are characterised as enablers of change in light of broader health tendencies (Uhlmann et al., 2018). As so, food-related trends (such as having healthful eating practices) may be learned and anchored within diverse social contexts; this would portray social aspects as main drivers to take these food behaviours into action, resulting in the acquisition of a “healthy diet” to be socially trendy. Thus, the influential factor (viii) Social and Cultural highlights these social and cultural surroundings that involve food literacy-related behaviours and competencies on a daily basis.

Out of the eight categories identified as influential factors, three incorporated content mostly unmatched with the identified frameworks: (ii) Psychological, (v) Policy, and (vi) Industry. Identified as a psychological attribute, creativity has been indicated as an internal feature that enables an adequate food intake, especially when applied within the cooking domain (Swan et al., 2018). Though unmatched with the designated frameworks, creativity was also stated by Desjardins and colleagues (Desjardins et al., 2013) in the first food literacy model developed by the Canadian team (later revised by Thomas and co-authors, 2019), as part of psycho-social factors that integrate personal dimensions of food literacy. Also, part of the (ii) Psychological factor of influence, the attribute critical analysis of food information was supported by Thomas and colleagues’ framework (Thomas et al., 2019) regarding the feature of nutrition literacy – defined as the ability to discriminate credible and inaccurate nutrition-related information, find this reliable information and use it for one’s benefit. Though not exactly with the same meaning, a critical analysis of food-related information incorporates the skill of identifying information’s reliability and validity, thus supporting this association. Furthermore, the attribute sense of empowerment was corroborated by Vidgen and Gallegos’ framework (Vidgen & Gallegos, 2014) concerning the definition of food literacy – described not only as a set of food-related knowledge, competencies and behaviours essential for one’s feeding but also as the structure that allows for individual and societal empowerment aimed to conserve diet quality and supply for dietary resilience. Nonetheless, either understood as a goal or as a process, empowerment is a psychological construct often related with other psychological aspects, such as control, self-efficacy, or autonomy (Tengland, 2008). Hence, the attribute sense of empowerment was integrated within the influential factor that represents (ii) Psychological aspects that may impact or be impacted by food literacy.

Food literacy has also been stated as effective in impacting one's behaviour by producing health behaviour change (Palumbo, 2016). As an intricate process, health behaviour change involves multiple causal factors operating with diverse mechanisms where individuals navigate through distinct mindsets of behaviour change (Schwarzer & Luszczynska, 2015). Though knowledge constitutes a precondition for this change, it is often not enough to transform individual behaviour (including food-related behaviour; Vaitkeviciute et al., 2015) as so, the integration of this attribute as part of a factor of influence intends to acknowledge other psychological mechanisms needed to achieve health behaviour change related with food literacy. Considering that food is a primary indicator of both individual and group identity, a behaviour change technique with a potential to act as mediator for health behaviour change would focus on one's food-related identity (Uhlmann et al., 2018). The attribute identity associated with changed behaviour is a recognised technique that translates how one's self-identification can be connected with the food-related behaviour that is aimed to change (Michie et al., 2013; Roberts et al., 2017); the affiliation of this attribute to a food literacy factor of influence aims to recognise the effect that self-identity can have on dietary behaviours. Still on the topic of behaviour change, the manifested attribute habit formation states how food-related behavioural patterns enact automatically, increasing the likelihood of the behaviours' maintenance across time and unexpected circumstances (Lally et al., 2011; Michie et al., 2013). Since food literacy concerns not only knowledge but also food-related behaviours, integrating attributes that focus on the acquisition and maintenance of these behaviours within the (ii) Psychological factor appears to be relevant.

The attributes emotional eating and manage emotions to manage food intake both refer to the influence of emotions on the context of food literacy. Expressing the tendency to overeat as a reaction to negative emotions, emotional eating focusses on how one's emotional state impacts food literacy-related behaviours (Frayn & Knäuper, 2018). Illustrating how decisions about food can be driven by emotions, manage emotions to manage food intake translates the need to have emotional management skills in order to manage one's food intake (Bublitz et al., 2010; Kemp et al., 2013).

Contrasting with emotions acting as driving forces for food-related behaviours, the attribute positive sensorial and psychological consequences underlines how food knowledge, competencies and behaviours can induce sensorial and psychological outcomes. Already acknowledged by research in the field of food literacy, food (iii) Choice and Decision and

eating behaviours are stated to interact with other domains of life and showed to be influenced by one's preferences, such as taste or sensory perceptions (Swan et al., 2018; Uhlmann et al., 2018). Multiple studies have also recognised food literacy's influence over not only physical but also psychological health and wellbeing (Poelman et al., 2018; Vidgen & Gallegos, 2014). These two attributes intend to represent that other outcomes not strictly related to nutrition — such as the sensorial pleasure of eating or the psychological contentment — can arise from dietary behaviours. Finally, the attribute indulgence as part of the balance and emotionally nurture through food emphasise other emotions that may also be related to food literacy. Since dietary behaviours frequently focus on strategies such as tracking food intake or interpret nutritional labels (attributes belonging to the factor Nutrition), an obsessive focus on food is often developed leading to deprivation and subsequent periods of overindulgence (Heatherton et al., 1991). Since overindulgence may cause feelings of guilt, developing a relationship with food that incorporates both healthy habits and the satisfied balance of food-related desires demonstrates a scenario in which the management of emotions benefits food behaviours (Bublitz et al., 2013). Integrating indulgence as part of the balance of a healthy food intake within the (ii) Psychological factor portraits this need to balance both sides of food intake to be food literate.

Within indulgence, cooking is frequently associated with demonstrating affection to others or to take care of someone (Szabo, 2014). This act of demonstrating fondness to someone through food is represented in the attribute emotionally nurture through food.

Concerning its impact on the food and agricultural process — from food production to process, distribution, acquisition, consumption, protection and disposal — the influential factor concerning (v) Policy aims to shed a light on the role of food-related public policy within the context of food literacy (International Food Policy Research Institute [IFPRI], 2017). With the goal to frame consumer's choices towards healthier directions, food-related policy approaches can be described as 'soft' policies, including providing information, education and product labelling, whereas 'hard' policies encompass bans, fiscal measures, and mandatory regulations (Lang et al., 2009). Therefore, the attributes obligation to educate consumers and display products information are examples of soft policies that influence food literacy. While the first attribute designates food policy's role to educate the final consumer with information campaigns and educational actions, the second identifies food-related public policies' function of guaranteeing transparency through the food chain aiming to promote a

sustainable food consumption by informing the final client. Soft approaches as these are the most common actions within the domain of food and global health, having demonstrated positive impact and effectiveness (Capacci et al., 2012; Grunert et al., 2014); however, these mostly preventive downstream actions demand personalised targeting (e.g., individual health education) ending up being successful mainly with smaller and target-specific populations. On the contrary, the attribute regulation prior to consumption is identified as a hard policy, because it targets food-market directly with mandatory regulations applied before the food decision from the final consumer; these approaches are characterised as more powerful, expeditious and cost-saving considering they are structural and upstream policies (Lang et al., 2009). Regardless of having soft and/or hard approaches and to guarantee the greatest possible effectiveness, food-related policy making must be developed and applied considering the target audience and its wider context (European Commission et al., 2018); the attribute tailored interventions mirrors this need to tailor the design and implementation of food-related interventions and policies. To proceed towards this, evidence also highlights the need to provide comprehensive strategies that include multi-sectoral policies (education, health, agriculture, etc.), allowing to tackle food-related issues with multi-stakeholder and multi-level approaches conceding systematic, interdisciplinary and holistic food policies (Bhunoo, 2019; FAO, 2019) – this approach for food policy is emphasised by the attribute food in all policies: inter-sectoral policies.

In the matter of mutual support and partnerships between (non-)governmental agencies and major stakeholders, food industry has a unique role within food-related policies considering its close relationship with the final consumer. The integration of food (vi) Industry as an influential factor within this framework aims to translate the active role of the industry as a potential advocate for healthful eating patterns and an active agent in the implementation food-related recommendations, cooperating in the achievement of favourable food-related outcomes. However, food marketing materialises a significant branch of this industry, linking a company with its consumer and aiming to influence food choices through food advertising (Waxman, 2004). Concerning sensory perceptions, evidence shows that intentional alterations of foods' composition can modify the behavioural response to their consumption as a result of discrepancies in taste (Onaolapo & Onaolapo, 2018). Regarding psychological variables, emotions are demonstrated to be increasingly used within advertisement due to their role in attitude formation (e.g., Grimm, 2005; Laros, 2005; Yoo &

MacInnis, 2005). Thus, the attributes flavour' intensifiers for consumers' loyalty and appeal to consumers' emotions express two different food industry strategies that are being used to impact one's food choice.

Within mainstream strategies to impact consumers' food-related habits, the attributes marketing's influence and social media's influence express two of the most frequently used avenues for food marketing disclosure: television and internet. Advertising on a large scale and with even short-term exposure being considered efficient, food marketing is highly controlled by sponsors and industry stakeholders, meaning that the provided information is not always for the benefit of public health (Boyland & Whalen, 2015; Peterson, 2012). Particularly with younger audience such as children and adolescents, cumulative exposure to food advertising through television and other social sources (e.g., social media platforms and sites such as Facebook, Instagram and Pinterest, food-related apps) is greatly associated with diverse food behaviours (Scully et al., 2012). Due to this growing trend, policy makers are being increasingly solicited to take action in order to promote meaningful transformations in the food environment that may allow for more healthful marketing strategies. A law concerning the restriction of food advertising that appeals to the consumption of food and drinks high in calories, salt, sugars and saturated fats, to minors below the age of 16 years is a recently implemented example of a hard policy within the Portuguese context (Decreto-Lei n.º 330/90, 2019). Nevertheless, solid knowledge and competencies concerning food selection and acquisition, planning and management, preparing and cooking food appear to be vital for one's consumption of healthy foods (Wickham & Carbone, 2018).

Closing the influential factor of food (vi) Industry, the attribute reaction to consumers' demands intends to emphasise that — despite the control that may be administered by public food-related policies or by industry stakeholders — consumers retain a powerful role within the food system, its marketing and its final outcomes. With consumers' interest expanding in the last two decades mainly due to the health and food security-related crisis, demand for transparency within food-related information (concerning its origin, process, production) as also increased. This demand for more information within the food chain leads to the judgement of food products concerning their quality, food safety, social consequences, and environmental impacts (Lappo et al., 2015). As so, industry's transformation is perpetually possible since consumers' demands act as a recognised driver of its performance — empowering consumers' role in producing change within the food system.

Acknowledging the influential factors (ii) Psychological, (v) Policy, and (vi) Industry as the most unmatched with the recent frameworks of food literacy emphasises not only the lack of participation from agents within these fields of action on food literacy-related studies but also the scarce research that recognises these areas as being influential for individuals' food literacy.

Determinants of Food Literacy

Most of the manifested attributes (9 out of 12 attributes; 75%) identified as determinants of food literacy were corroborated by at least one of the three highlighted frameworks (A, B, and C). Divided among (i) External and (ii) Internal, these determinants aim to indicate specific factors that may affect if and how individuals can develop and/or improve their food-related knowledge, competencies and behaviours. Thus, within the (ii) Internal determinants, the unmatched attributes of previous food-related habits, innate and learned flavour preferences call for a more detailed analysis.

Though concerning individual features, food choices and behaviours occur within a larger food environment that regards other characteristics. On this note, research is clear on how factors such as education, income, political and sociocultural surroundings influence dietary habits and general health (Boucher et al., 2017; Rao et al., 2013). The attribute previous food-related habits emphasises how one's familial and social contexts influence one's food literacy, highlighting that habits formed earlier in life or within a specific family background may influence one's lifelong habits (Vidgen & Gallegos, 2014). As so, one's previous food-related habits can impact if and how one's behaviour is being changed. Particularly regarding food literacy frameworks, the initial frame developed by the Canadian team recognised the impact of familial, social and cultural norms, values and behaviours as social-cultural influences and eating practices (Perry et al., 2017).

Concerning one's palate and sensory perceptions, the manifestation of the attributes innate and learned flavour preferences appears to be contradictory given the inherited and acquired enunciated nature of flavour. However, three fundamental senses of taste have been reported as related to flavour preferences: the taste for lipids (fats), the taste for sweets (sugars), and umami, referring to the taste of glutamate (savory/salty flavours; Onaolapo & Onaolapo, 2018). Though it is possible to exist an innate preference for either of these three senses of taste, studies indicate that most flavour preferences are learned (Sclafani & Ackroff, 2012; Yamamoto & Ueji, 2011). More importantly, these attributes emphasise how flavour

preferences can constitute personalised guidelines for one's search of food knowledge, development and implementation of food competencies, and both intended and unaware food-related behaviours.

Conclusions

Food literacy research is still growing. Nevertheless, despite the increased investigation on this construct, congruency on its definition and measurement is yet lacking.

Within the major FOODLIT-PRO project, the present findings provide additional qualitative insights within the ambit of food literacy. Namely, this study presents in-depth information for the comprehension of the meaning of this construct, presenting a new arrangement of what comprises food literacy by identifying its domains. This research also supplies distinct understanding of the influential factors that play singular roles in the functioning and development of food literacy within a larger scope, by including hierarchical relations among diverse aspects integrating the food system. Finally, this study informs on which features can act to affect the development, growth, and enhancement of individuals' food literacy, by identifying its determinants.

Integrating a sample with both men and women from food-related action fields as diverse as food policy, health, industry, and others, constitutes a strength, given that it provided for a wider comprehension of food literacy. Nonetheless, the absence of a Delphi structure to conduct this study could be regarded as a limitation. Although personal and contextual variables cannot be entirely controlled, conducting most of the interviews personally is a valued strength considering the analysis of nonverbal responses and the deepening of the responders' answers, enabled by the interviewers' presence. The inter-rater agreements as an indicator of reliability between researchers ($k = 0.82$) are also an important asset.

This study provides useful information on food literacy and contributes to a new understanding of the construct and its surrounding, hoping to assist in the advance of further measurement options and interventions' protocol elaboration.

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Chapter 3

Developing a conceptual and empirical framework of food literacy: The Food Literacy Wheel

This chapter is based on the paper

Rosas, R., Pimenta, F., Leal, I., & Schwarzer, R. (2021). FOODLIT-PRO: Conceptual and empirical development of the food literacy wheel. *International Journal of Food Sciences & Nutrition*, 72(1), 99-111. <https://doi.org/10.1080/09637486.2020.1762547>

Abstract

Pursuing food systems' sustainability is crucial. Given the risk constituted by unhealthy diets, scarce research on food-related adjacent fields, and inconsistency across food literacy conceptualisations, this study aims to explore the constructs' definition and develop a conceptual and empirical framework of food literacy. A quantitative approach was taken on previously obtained qualitative outcomes from 30 interviews with experts from food-related fields. Food literacy was defined by a four-dimension model: Cooking Skills, Preserve and Analyse, Choice and Acquisition, Search and Plan. The framework Food Literacy Wheel integrates the construct definition, food literacy determinants (Internal, External) and influential factors (Nutritional, Psychological, Health, Learning Contexts, Policy, Industry, Sustainability, Social and Cultural). Allowing a broader perspective of food literacy within major food systems, this study contributes with new insights for future instruments and interventions, paving the way to develop/implement food literacy-related multi-sectorial and multilevel actions.

Keywords: Food literacy; Definition; Mixed-methods; Framework; Conceptual; Empirical

Introduction

Safeguarding nutritional nourishment and food security worldwide have been permanent cross-cutting concerns for major food-related agencies, being integrated as objectives in most action programmes (FAO et al., 2019). The population growth across the globe, the volatile development of world economy, and the unstable climate circumstances faced nowadays have led to major shifts within the ambit of food and nutrition (FAO et al., 2019; The World Bank, 2019). Particularly, impacting not only food infrastructures and processes (meaning anything from production to processing, packaging, distribution, consumption, and disposal) but also causing significant effects on challenges such as food (in)security, general nutrition, and global health (FAO, 2017; FAO, 2019).

Acknowledging that poor diets constitute a greater risk to morbidity and mortality than the risks of unprotected sex, alcohol, tobacco and drug use combined (GPAFSN, 2016; Willett et al., 2019), it is also crucial to improve individuals' food-related knowledge and skills allowing for healthier food choices on the long term (Vidgen & Gallegos 2014; Willett et al., 2019). Paired with the need for sustainable food systems, the demand to enhance individuals' and communities' nutrition nourishment and consequent quality of life by improving their food-related competencies highlights the relevance of research and action within the field of food literacy (Vettori et al., 2019; Vidgen & Gallegos, 2014; Willett et al., 2019). As an increasingly used construct, the meaning of food literacy is not yet consensual among researchers. Mainly characterised as a set of food-related awareness, knowledge, skills and practices, food literacy has been set to protect diet quality across one's lifespan, operating to improve nutritional health; this is ideally achieved focussing on one's relationship with food, and recognising social and cultural influences within this relation (Block et al., 2011; Desjardins et al., 2013; Cullen et al., 2015; Perry et al., 2017; Slater et al., 2018; Thomas et al., 2019; Vettori et al., 2019; Vidgen & Gallegos 2014).

Regarding empirical conceptualisations of food literacy, Vidgen and Gallegos (2014) included four domains – Plan and Manage, Select, Prepare, and Eat – within the comprehension of this construct, specifically concerning food-related knowledge, practical skills and specific behaviours at an individual level. In another perspective, Thomas and colleagues (2019) identified five categories as the conceptualisation of food literacy: Food and Nutrition Knowledge, Food Skills, Self-efficacy and Confidence, Ecologic, and Food Decisions. Within the detailed attributes belonging to these categories, the authors go beyond

the stated individual level (Vidgen & Gallegos, 2014) by incorporating specific social determinants of global health and including the influence of food systems on individual, societal and environmental aspects (Thomas et al., 2019). Despite being exclusively based on a scoping review, Cullen and co-authors (Cullen et al., 2015) stated not only individual skills and social determinants of health but also community aspects (particularly related to food security). These were integrated within global food systems, and their relation to general health and wellbeing enhancement were also noted (Cullen et al., 2015). Despite targeting food literacy competencies exclusively for youth transitioning to an independent living through adulthood, Slater and colleagues (Slater et al., 2018) included three domains of competencies: Functional (Confidence and Empowerment with Food), Relational (Joy and Meaning through Food), and Systems (Equity and Sustainability for Food Systems). Within these domains, the authors highlighted the individual knowledge and skills needed to have nutrition health, the emotional and cultural aspects essentials for a positive relationship with food, as well as the social, environmental and corporate features that influence food systems (Slater et al., 2018).

Significant resemblance is noted among these conceptualisations of food literacy domains and definitions, emphasising how food-related individual skills, behaviours, emotions, cultural and social aspects, and environmental features are integrated within this concept (Truman et al., 2017; Slater et al., 2018; Thomas et al., 2019). Nevertheless, (i) the absence of cultural and environmental-related aspects in the majority of these conceptualisations, (ii) the scarce exploration of psychological and emotional features, (iii) the main focus on an individual perspective, and (iv) the poor manifestation of food systems-related surrounding contexts (e.g., political and educational) reflect the inconsistency that characterises food literacy research. Thus, though already identified as crucial in order to be food literate, food-related adjacent fields (such as policy and education) are yet alienated from most theoretical frameworks (Cullen et al., 2015; Ronto et al., 2016).

Being a privilege of food literacy, the achievement of sustainability within food systems is crucial for purposes of both general health and environmental protection (Vettori et al., 2019; Willett et al., 2019). As so, and considering that food systems include much more than health and environmental consequences for the final consumer, a multi-sectorial approach is demanded to achieve transformation (Bhunoo, 2019; FAO, 2019; IFPRI, 2017; Vettori et al., 2019). Comprehensive strategies including multi-stakeholders and multilevel

perspectives are necessary to concede systematic and holistic change across the diverse factors encompassed by food systems (Bhunoo, 2019; FAO, 2019; Willett et al., 2019). This means that only by taking action involving agriculture, water (and other resources) usage, environmental concerns (like climate change and biodiversity loss), health issues, educational matters, economic factors, policy development, and cultural and social aspects, will it be possible to tackle challenges concerning sustainable food systems (FAO, 2019; Willett et al., 2019).

Aiming to provide evidence-based research on food literacy while incorporating surrounding fields of action that may act as drivers for sustainable food systems, this team has conducted an in-depth qualitative study that explores food literacy's domains, determinants and influential factors (Rosas et al., 2019). As part of a major ongoing project designated as FOODLIT-PRO: Food Literacy Project, this study also presents a comparison of its obtained outcomes with other conceptualisations of food literacy, facilitating a clear perspective on the construct's comprehension and integration within the current literature. With outcomes partially corroborated by current research, this first study of FOODLIT-PRO identified nine domains of food literacy: Origin (e.g., knowing food origin), Safety (e.g., hygiene and safety practices), Choice and Decision (i.e., choice and decision skills), Select and Acquire (e.g., finding nutritionally equivalent foods), Plan (e.g., planning food intake ahead), Preserve (i.e. preservation skills), Prepare (i.e., preparation skills), Cook (e.g., matching ingredients), and Knowledge (i.e., declarative and procedural knowledge). As influential factors, eight categories were manifested: Nutritional (e.g., awareness of nutritional needs), Psychological (e.g., manage emotions to manage food intake), Health (i.e., food impact on health), Learning Contexts (e.g., professional support), Policy (e.g., regulation prior to consumption), Industry (e.g., marketing's influence), Sustainability (e.g., impact of food importation), Social and Cultural (e.g., evolution of food availability and access). Finally, Internal (e.g., prioritising food) and External (e.g., perishable and/or unreliable food-related information) determinants were also identified (Rosas et al., 2019). In addition to the innovative arrangement of food literacy's definition, this work provided for a distinct comprehension of influential factors that have particular roles within a broader food system. However, the exploration of original associations and internal structural cohesion among the new content of food literacy's domains, as well as the integration of the recently emerged food literacy's influential factors and determinants within a unique framework, are lacking.

Hence, this second study of FOODLIT-PRO intends (i) to further explore the previously identified food literacy domains (Study 1; Rosas et al., 2019) by using a quantitative methodology, aiming to determine the most suited internal structure for the construct definition, and (ii) to develop a new food literacy framework that integrates the formerly manifested influential factors and determinants (Study 1; Rosas et al., 2019), providing the contextual-related heterogeneity that is lacking within current literature.

Method

Study Approach and Design

Aiming to develop a conceptual model integrating the domains concerning the definition of food literacy and its interrelation with food literacy's influence factors – which were originally driven from an in-depth qualitative exploration of this construct – mixed methodologies were applied in this research (Costa et al., 2013; Elo & Kyngäs, 2008). As so, this cross-sectional and exploratory study derives from an initial qualitative deductive-dominant content analysis (Hsieh and Shannon, 2005; Rosas et al., 2019) which intended to explore food literacy's domains, influential factors and determinants, from the outlook of Portuguese professionals from diverse food-related fields. Posteriorly to the in-depth qualitative approach previously published (Rosas et al., 2019), a multiple correspondence analysis (MCA) was performed on the qualitatively analysed data. This quantitative approach was applied in order to (i) map and explain original associations among the manifested qualitative codes previously obtained and (ii) generate an explanatory model with these inherent associations, to develop a conceptual model that mirrors a further understanding of food literacy's definition, and including its factors of influence and determinants. Although this paper concerns particularly the findings from the quantitative approach, sufficient detail from the qualitative analysis is provided for context.

Recruitment and Sampling

Potential participants were reached directly by the leading researcher and by participants' referencing (snow-ball sampling, non-probabilistic convenience sampling) between February and June 2018. Institutions were intentionally selected in order to reach a variety of organisations from across the (a) food-system and (b) other related fields – including not only (a) food production, processing, distribution, marketing, consumption, and disposing, but also (b) education, policy-making, association with human and environmental

health, and sustainability. Inclusion criteria were (i) being 18 years or older, (ii) having minimum literacy and being capable of undertaking an extensive audio recorded interview, (iii) working in areas (in)directly related with food, and (iv) being responsible for one's own feeding. The criteria (iv) being responsible for one's own feeding was assessed through the presence of at least one out of the four possible items: holding responsibility over their food (a) choice and decision, (b) selection and acquisition, (c) preparation, and/or (d) cooking (based on the model of Vidgen & Gallegos, 2014).

The sample comprehended 30 Portuguese experts (20 women and 10 men; as showed in Table 1 - Chapter 2) with ages between 23 and 57 years ($M = 38.4$; $SD = 8.60$) from multiple food-related areas across 26 different organisations – including profit and non-profit, governmental and non-governmental entities. The fields in which the professionals work were grouped into five specific areas: Education (e.g., high school and environmental education), Health (e.g., nutrition, psychology, medicine), Food Policy (e.g., development and implementation of national/international priority programmes), Agricultural Industry (e.g., production and consulting), and Commercial Industry (e.g., marketing and product innovation). Sample characteristics are described in greater detail in our previously published paper (Rosas et al., 2019).

Ethical Considerations

This study was approved by the Ethics Committee of ISPA-Instituto Universitário (ref. D/002/03/2018). Information concerning the aim and methods of this research was provided to all participants; the voluntary and confidential nature of their participation and information given was guaranteed. The leading researcher also assured to all participants that their identities would not be disclosed. Additional clarification regarding the study's purpose was provided, when requested. All participants provided oral and written consent for the interview, along with a written authorisation specific for the audio recording (Appendices 3 and 4).

Data Collection

Data gathering started with the filling of a sociodemographic (e.g., education level and household income) and health-related behaviours (e.g., alcohol and tobacco consumption) questionnaire (Appendix 7). Interviews were carried out in either the participants' employer institution or the facilities of the WJCR – William James Centre for Research; all contexts allowed for a private setting with an individual room behind closed doors. From March to

June 2018, a total of 30 semistructured interviews were carried out by the leading research in person ($n = 21$) and by telephone ($n = 9$). Interviews' duration ranged from 25 to 120 minutes ($M = 53.7$; $SD = 19.9$) and continued until data saturation was achieved, meaning that no new contents were being included or explored. Randomised revisions were carried out to verify the transcriptions' accuracy to the recorded audio.

Interview Protocol

Given its complexity and description length, the protocol for the semi-structured interview was presented with full detail in this team's previously published paper (Rosas et al., 2019). Informed by published research concerning food literacy and comprehending mostly open-ended questions, the developed protocol intended to explore the domains of food literacy, as well as its influential factors and potential determinants (Thomas et al., 2019; Vidgen & Gallegos, 2014). The complete protocol is currently attached in the appendices (Appendix 1).

Data Analysis

Interviews were analysed with the MAXQDA Software (version 18), and the complete process of data analysis – which included initial and secondary qualitative data analyses, and data analyses verification – took place between April 2018 and January 2019. The developed categorisation matrix and its content were comprehended by (i) major categories – that is, categories that manifested the leading explored themes (for example, the domains of food literacy such as Origin, Safety, Choice and Decision, Select and Acquire, Plan); and (ii) their respective attributes – that is, the qualitative codes manifested as attributes of those categories (for example, the code planning skills and planning food intake ahead, which belong to the category Plan). Most categories and their respective attributes were theoretically informed; however, when particular text segments did not show a proper match with the published and available food literacy related literature, new codes and categories inductively surface (Elo & Kyngäs, 2008). Not being the primary focus of this study, the process for the qualitative analysis and the obtained results are fully described in our previously published paper (Rosas et al., 2019).

Posteriorly to the qualitative analysis, the descriptive method of MCA was performed using IBM SPSS Statistics (version 25). With an exploratory character, this multivariate statistical technique allows the mapping of existing active relations within a set of categorical

variables – in this study’s case, the presence/absence of the manifested qualitative attributes. Aiming to provide a summarised representation of the greatest amount of information initially contained within the variables, this technique extracts factorial dimensions that describe the juxtaposition among patterns of co-occurring responses across participants (Costa et al., 2013; Di Franco, 2016). Thus, the use of a MCA is particularly relevant and powerful when a large amount of qualitative data is collected, because this technique maximises all the qualitative content in the identification of the extracted factors and assures that the qualitative information is not sub-optimised within the data analysis (Costa et al. 2013). Criteria concerning the exploratory statistic included (a) a minimum eigenvalue of 1 for each dimension, and (b) a minimum of 5% of the total variance explained by each dimension.

Strategies for Trustworthiness

Considering the significance of consistency within a qualitative coding process, the analysis of agreement among inter-raters reflects the reliability among a given description of a particular subject identified between researchers (Warrens, 2014). Hence, in order to assess reliability for the qualitative analysis, two researchers independently coded three transcribed interviews using the final coding matrix. Cohen’s kappa coefficient was used, considering it is adequate for nominal categories and two coders (Cohen, 1960; McHugh, 2012). In light of both researchers’ analysis, the Cohen’s kappa indicator expressed a nearly perfect agreement ($k = 0.8$).

Results

Data Collection and Emerged Content

Considering the diverse interview’s duration range and to explore potential differences in the manifested content given by the participants, a Wilcoxon-Mann-Whitney nonparametric test was performed in order to compare the number of different qualitative codes emerged between interviews below the mean duration (equal or inferior to 53.7 minutes; group 1) and above the mean time (superior to 53.7 minutes; group 2). Within all the conducted interviews, there was no significant difference among emerged content of the two groups ($U = 143.5$; $W = 198.5$; $p = .06$).

Multiple Correspondence Analysis

In order to ascertain the most suited structure for the construct’s definition, a MCA was performed using the qualitative attributes that were incorporated by the domains of food

literacy previously published (Rosas et al., 2019). Concerning the presence/absence of the attributes across the respondents' manifested content, these qualitative codes were treated as nominal variables. Though driven from FOODLIT-PRO's first study, rearrangements to some domains' attributes were made in order to integrate them within the present quantitative methodology.

Firstly, belonging to the domain Origin, the attributes food additives and how origin relates to food quality were merged into a singular variable. Since food additives have the function of, among others, preventing product quality impairment and maintaining its safety and nutritional value, the qualitative closeness of these codes led to a unique variable designated as additives and food quality (WHO, 2018). Secondly, incorporated in the domain Safety, the attributes hygiene and safety practices and pesticides and herbicides were also combined. Considering that both substances for pest control and hygiene practices have crucial roles on food safety, this shared qualitative content was acknowledged by the merger of these attributes into the variable food safety practices (FAO & WHO, 2019; WHO, 2019). Finally, belonging to the domain Cook, the attributes using different cooking techniques and matching cooking techniques to ingredients' nutritional value were also combined into a single variable; concerning that the latter explicitly includes the former, this overlap of content is presently embraced in the variable cooking techniques and nutritional value. Although included as a domain, both attributes of declarative and procedural Knowledge were not included as variables for the MCA given its invariability across all the respondents.

Highlighting the individuals' active role in the development of their food literacy-related knowledge, skills and behaviours, attributes that expressed intentional behavioural strategies were also added as variables to integrate the MCA (Schwarzer & Luszczynska, 2015; Vaitkeviciute et al., 2015). As so, despite being acknowledged as attributes belonging to food literacy influential factors, five variables mirroring behavioural strategies that an individual could intentionally carry out in order to develop food literacy were considered (Table 5). Two of these variables constitute attributes from the influential factor Nutrition (tracking food intake and interpret nutritional labels), two were from Sustainability (buying from local/national trade, and consuming single-use food-related items), and one was from Learning Contexts (information seeking).

Table 5

Variables (attributes) included in the multiple correspondence analysis, and corresponding qualitative category concerning its relation to food literacy (domain or influential factor)

Domains	Attributes
Origin	Knowing Origin
	Seasonality
	Bio/Organic: Definition and Impact
	Additives and Food Quality
Safety	Food Safety Practices
Choice and Decision	Choice and Decision Skills
Select and Acquire	Selection and Acquisition Skills
	Nutritionally Equivalent Foods
Plan	Planning Skills
	Plan Food Intake Ahead
Preserve	Preservation Skills
Prepare	Preparation Skills
Cook	Cooking Skills
	Matching Ingredients
	Using Recipes
	Cooking Motivation/Attitude
	Cooking Techniques and Nutritional Value
Influential Factors	Attributes
Nutrition	Tracking Food Intake
	Interpret Nutritional Labels
Sustainability	Local/National Trade
	Single-use Food-related Items
Learning Contexts	Information Seeking

From the MCA analysis, a four-dimension solution (with the designations Cooking Skills, Preserve and Analyse, Choice and Acquisition, and Search and Plan) was considered

the most adequate output (Table 6). The dimensions presented the most significant factor loadings ranging from 0.094 to 0.474, eigenvalues from 2.073 to 3.318, and inertia from 0.094 to 0.151.

Table 6

Four-dimensional representation of the definition of food literacy: Factor loadings (bold values indicate the most significant factorial weights), eigenvalues, inertia, percentage of variance and Cronbach's alphas

Attributes	Dimensions				Mean
	Cooking Skills	Preserve and Analyze	Choice and Acquisition	Search and Plan	
Knowing Origin	.155	.009	.164	.002	.083
Seasonality	.048	.052	.058	.284	.111
Bio/Organic: Definition and Impact	.111	.338	.125	.003	.144
Additives and Food Quality	.094	.065	.043	.007	.052
Food Safety Practices	.065	.197	.063	.075	.100
Choice and Decision Skills	.000	.021	.317	.014	.088
Selection and Acquisition Skills	.027	.046	.462	.072	.152
Nutritionally Equivalents Foods	.040	.017	.065	.292	.103
Planning Skills	.088	.120	.036	.313	.139
Plan Food Intake Ahead	.188	.203	.027	.227	.161
Preservation Skills	.010	.374	.243	.000	.157
Preparation Skills	.317	.004	.010	.085	.104
Cooking Skills	.269	.014	.199	.042	.131
Matching Ingredients	.381	.001	.009	.000	.098
Using Recipes	.290	.115	.016	.008	.107
Cooking Motivation/Attitude	.403	.085	.005	.036	.132
Cooking Techniques and Nutritional Value	.474	.143	.002	.006	.156
Tracking Food Intake	.001	.330	.200	.003	.133
Interpret Nutritional Labels	.032	.075	.191	.090	.097
Local/National Trade	.139	.261	.039	.168	.152

Single-use Food-related Items	.016	.014	.158	.131	.080
Information Seeking	.170	.083	.046	.214	.128
Eigenvalue	3.318	2.569	2.478	2.073	2.610
Inertia	.151	.117	.113	.094	.119
% Variance	15.083	11.678	11.265	9.421	11.862
Cronbach's Alpha	.732	.640	.625	.542	-

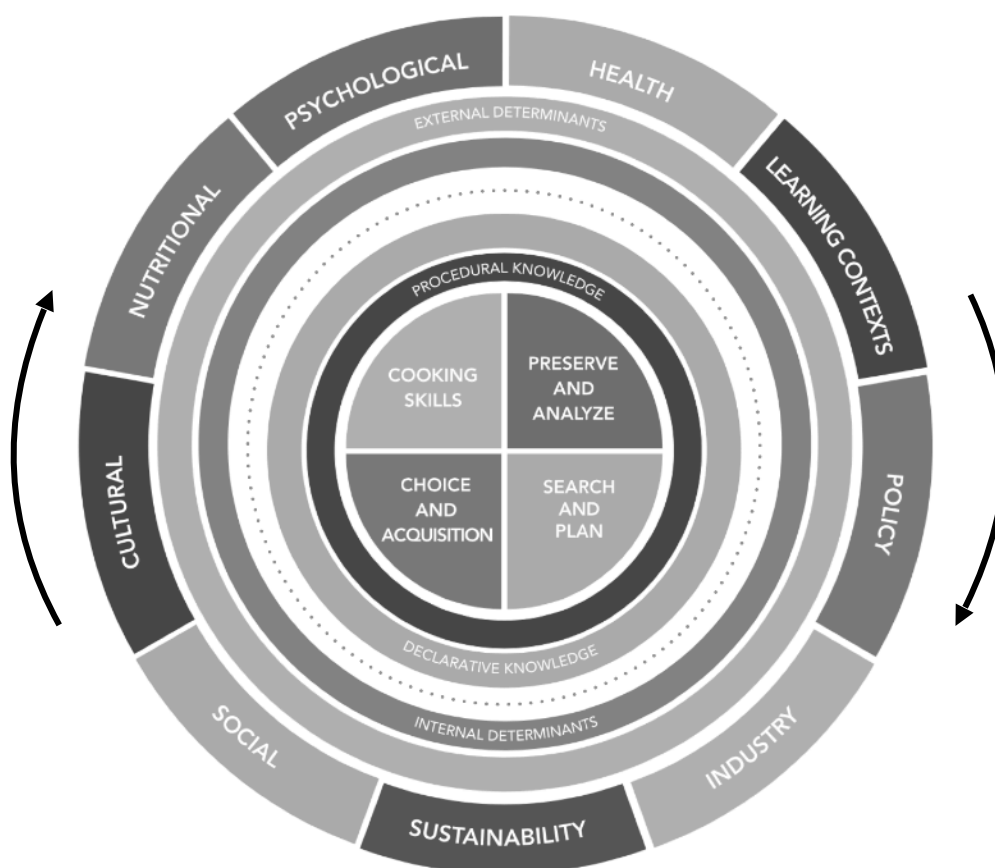
Accounting for 47.44% of the total variance, dimensions' variances ranged from 9.421% to 15.083% and Cronbach's alpha varied from 0.54 to 0.73. Although the commonly accepted lower limit for Cronbach's alpha is 0.70, smaller values are acceptable for exploratory research, with literature emphasising an alpha greater than 0.50 as satisfactory for studies with 25–50 respondents (Davis, 1964; Johnson & Wichern, 2007).

FOODLIT-PRO's Food Literacy Wheel

Posteriorly to the performance of the MCA, a graphic visual representation of both qualitative and quantitative outcomes was developed (Figure 2). Presenting the definition of food literacy at its core, this framework mirrors the four-dimensional quantitative structure (obtained through the MCA) which was applied to the manifested content from the first qualitative in-depth study (Rosas et al., 2019). Furthermore, the Food Literacy Wheel also integrates the domain Knowledge, with two individual rings representing both declarative and procedural knowledge, applicable to any dimension of food literacy.

Figure 2

Food Literacy Wheel (from the inside core to the outer rings): definition of food literacy (Cooking Skills, Preserve and Analyze, Search and Plan, and Choice and Acquisition), associated knowledge (procedural and declarative), its determinants (internal and external), and influential factors



Subsequently to the presentation of food literacy's domains, an intentional barrier illustrated with linear points sets the beginning of categories that, despite being external to food literacy's definition, impact and are impacted by this construct. Formerly manifested and identified in the first study of FOODLIT-PRO (Rosas et al., 2019), food literacy's determinants (Internal and External) and influential factors (Nutrition, Psychological, Health, Learning Contexts, Policy, Industry, Sustainability, and Social and Cultural) are represented within separate rings and segments, respectively. Given their possible inner or outer nature, determinants are illustrated as two independent rings, representing internal and external determinants respectively. Demonstrating broader contexts comprehended by major food systems, the influential factors are illustrated as areas that actively interact with food literacy; as so, they are portrayed in the most external ring as areas of interplay with food literacy. As so, the external section of the wheel emphasises the segregation from the construct definition,

highlighting the arising of contextual-related aspects by expressing features that can affect the development and enhancement of individuals' food literacy.

Discussion

Multiple Correspondence Analysis

This study aimed to further investigate the meaning of the construct food literacy, by exploring its domains through the employment of a quantitative methodology (multiple correspondence analysis) on previously gathered and analysed qualitative data (Rosas et al., 2019). Furthermore, given the current state of the art in the field of food literacy and its mirrored need to consolidate this concept within the function of major food systems, the development of a conceptual model integrating food literacy's definition, determinants and fields of influence was also an established goal of this paper.

With a mixed methodology, the firstly developed qualitative study gathered a total of 80 qualitative codes (mentioned by, at least, 10% of the sample) nested among 19 categories; food literacy domains comprised nine categories, determinants incorporated two categories, and influential factors integrated eight categories (Rosas et al., 2019). In the present study, a MCA was applied to food literacy domains, its respective codes and codes portraying intentional behavioural strategies; the domain Knowledge was exceptionally not comprised by the MCA since it was invariable across participants' manifested content. For this, some qualitative codes were transformed in order to be a part of this quantitative methodology. Subsequently, all codes were understood as nominal variables and a MCA was performed, where a four-dimensional solution demonstrated to be the most suited outcome for the definition of food literacy.

The first dimension – designated Cooking Skills (15.08% of total variance; $\alpha = 0.73$) – reflected the association among a total of seven codes regarding the preparation of food items (“Preparation Skills”), practical cooking competences (“Matching Ingredients”, “Using Recipes”, “Cooking Skills”), origin- and cooking-related impacts on food quality (“Additives and Food Quality”, “Cooking Techniques and Nutritional Value”), and cooking-related psychological variables (“Cooking Motivation/Attitude”). Preparation and cooking competences have been linked with one another across not only nutrition and food literacy-related literature but also studies referring to interventions aiming to improve one's interaction with food (Block et al., 2011; Murimi, 2013; Palumbo, 2016; Palumbo et al., 2019; Perry et

al., 2017; Santarossa et al., 2015; Slater & Mudryj, 2016; Slater et al., 2018; Thomas et al., 2019; Velardo, 2015; Vettori et al., 2019; Vidgen & Gallegos, 2014). In the same perspective, the feature of quality within foods was also alluded to the absence of additives in a recent study (Wijayarathne et al., 2018); however, functions of preventing product's quality deterioration and maintaining its nutritional value of origin are associated to food additives (WHO, 2018). Also related to food quality, it has been studied that the cooking technique applied to a particular food item affects its nutritional value (Martínez-Hernández et al., 2013; Roncero-Ramos et al., 2017); this supports the association represented in this dimension among these two attributes. Considering the relevance of one's relation with food in order to develop food literacy, food's preparation and cooking are set to be less about the produced meal and more about the significance of the process (Vidgen & Gallegos, 2014). As so, highlighting the importance of associating psychological variables (such as motivation, confidence, and empowerment) to food-related practical skills (Cullen et al., 2015; Krause et al., 2016; Thomas & Irwin, 2011), this corroborates the integration of the attribute of cooking motivation within this dimension.

The second dimension, nominated Preserve and Analyse (11.68% of total variance; $\alpha = 0.64$), aggregated five codes related to both food safety and preservation ("Preservation Skills", "Food Safety Practices", "Bio/Organic: Definition and Impact", "Local/National Trade"), and food intake ("Tracking Food Intake"). Across these variables, the analysis of food-related information demonstrates to be crucial so that associated specific behaviours – aiming for enhanced food literacy – may be developed.

Given that (i) basic preservation methods (e.g., freezing, dehydrating) and safety principles (e.g., appropriate cleaning, cooking temperature) are applied according to the food item characteristics, (ii) perceiving a food as bio/organic and as a local/national product requires the access and interpretation of origin-related information, and (iii) monitoring one's intake demands an intentional examination of regular food-related routines, it was imperative to incorporate the feature of food-related analysis on the designation of this dimension (Preserve and Analyse; Mukhopadhyay et al., 2017; WHO, 2019). Though food items' storage (belonging to "Preservation Skills") and hygienic handling (included in "Food Safety Practices") have been associated with each other in the current literature, the incoherence is significant given their understanding as part of either safety, selection competencies, knowledge, preparation skills, or general food techniques (Cullen et al., 2015; Perry et al.,

2017; Thomas et al., 2019; Vettori et al., 2019; Vidgen & Gallegos, 2014). Additionally to assembling these codes, the need to clarify consequences of biological/organic foods (“Bio/Organic: Definition and Impact”) and the consumption of local or national foods (“Local/National Trade”) have also been stated in previous research (Butcher et al., 2019; Durmus et al., 2018; Merriam, 2005; Sumner, 2013). Besides the uncertainty between organic or local foods as what is more beneficial, studies also demonstrate that people associate organic products with more healthful foods and that consumers who are aware of what organic foods are, also have more knowledge about food safety practices (Durmus et al., 2018; Sumner, 2013; Uhlmann et al., 2018). Regardless of this outlook, choosing local or national products is stated as a form of contributing to food-related sustainability, supporting local farming systems, community and economy, and reducing food-related anthropic actions over global environment (Canfora, 2016; Perry et al., 2017; Powell & Wittman, 2018; Willett et al., 2019). Similarly characterised as the self-awareness of what to include and restrict in one’s regime, ensuring a regular food intake has been included in food literacy literature (Vettori et al., 2019; Vidgen & Gallegos, 2014). As an intentional behavioural strategy, “Tracking Food Intake” was originally manifested as the monitoring of the foods and/or calories consumed (Rosas et al., 2019). However, the integration of this code within this dimension uncovers the possibility of broadening this variable for diverse content where the tracking mechanism may be applicable; as so, in spite of the initial content to be monitored referred to food or caloric intake, this assemble may be widened to focus on the quality – tracking the intake of, for example, organic and/or local products – instead of merely the quantity of the foods consumed.

The third dimension – named Choice and Acquisition (11.27% of total variance; $\alpha = 0.63$) – comprehended five codes concerning features that may be considered when selecting and/or making decisions about food (“Knowing Origin”, “Interpret Nutritional Labels”, “Single-use Food-related Items”, “Choice and Decision Skills”, and “Selection and Acquisition Skills”). Accessing origin-related information and transforming it into knowledge in order to choose, decide, and acquire food items are recognised competencies across the food literacy literature (Block et al., 2011; Vidgen & Gallegos, 2014; Powell & Wittman, 2018; Thomas et al., 2019; Vettori et al., 2019). Similarly to choosing and acquiring foods according to its origin (for example, local versus imported foods), the use of disposable food-related items appears to be a criteria progressively taken into account for the consumer, with a

particular negative emphasis on plastic-based packaging and takeout containers due to its adverse environmental and sustainability effects (Barnes et al., 2011; Lindh et al., 2016). However, though food literacy has been characterised as the understanding of the impact of food choices on – among others – environmental issues (Thomas et al., 2019), food-related plastic-based and single-use materials are yet to be linked to the construct's conceptual scope. On the contrary, reading and interpreting nutritional labels, as well as understanding basic nutritional information and guidelines, are skills linked to both nutritional and food literacy (e.g., Perry et al., 2017; Sumner, 2013; Thomas et al., 2019; Vettori et al., 2019; Vidgen & Gallegos, 2014). The association of the code “Interpret Nutritional Labels” to a dimension that highlights skills of choice and decision-making as well as of food selection and acquisition reflects the already demonstrated need to interrelate this variable with other practical competencies to assess one's food literacy level/quality (Poelman et al., 2018). Likewise, both “Choice and Decision Skills” and “Selection and Acquisition Skills” are competencies constantly featured within the food literacy literature (e.g., Block et al., 2011; Cullen et al., 2015; Perry et al., 2017; Thomas et al., 2019; Vettori et al., 2019; Vidgen & Gallegos, 2014; Wijayaratne et al., 2018). Recognising the complexity of these competencies and how they may not always be executed rationally, the development and/or enhancement of these skills transversally across behaviour-related interventions demonstrates to be crucial (National Academies of Sciences, Engineering, and Medicine, 2016).

Finally, the fourth dimension, designated Search and Plan (9.42% of total variance; $\alpha = 0.54$), incorporated five codes that mirror a set of behaviours and competencies (related to “Seasonality” and “Nutritionally Equivalent Foods”) linked by both the need to seek information (i.e., “Information Seeking”) and the need to plan in advance (i.e., “Planning Skills” and “Plan Food Intake Ahead”). Having knowledge concerning the identification of seasonal foods (i.e., declarative knowledge, belonging to the qualitative domain Knowledge) and applying such knowledge by consuming seasonal products (i.e., procedural knowledge, also integrated in the domain Knowledge) are both contemplated in the code “Seasonality”. Though scarcely represented in current food literacy frameworks (Rosas et al., 2019), seasonality has been increasingly pointed out as crucial not only for the balance of one's nutritional intake quality but also for environmentally friendly eating habits (Barbosa et al., 2017; Medina, 2011; van Dooren et al., 2014; Willett et al., 2019). However, in order to have a predominantly seasonal-based food intake, knowledge about which foods are nutritionally

equivalent (“Nutritionally Equivalent Foods”) is necessary given the need to substitute an unavailable food item for a nutritionally similar option. Within the current literature, the content that most closely resembles to this nutritional-related matters concerns knowledge about nutrition and its application to food choices (e.g., Block et al., 2011; Cullen et al., 2015; Perry et al., 2017; Thomas et al., 2019; Vettori et al., 2019; Vidgen & Gallegos, 2014). The association of the code “Information Seeking” emphasises how consumers’ active search for information, particularly nutritional and seasonal-related, is crucial to have awareness and understanding of seasonal foods so that one could not only acquire declarative knowledge on the matter but also to develop procedural knowledge and further food-related behaviours (Macdiarmid, 2014; Wilkins, 2002). Concerning procedural knowledge and practical competencies, planning aptitudes have significantly been stated in the food literacy literature and in some of the instruments developed to date (e.g., Amouzandeh et al., 2019; Begley et al., 2018; Cullen et al., 2015; Krause et al., 2016; Poelman et al., 2018; Velardo, 2015; Vidgen & Gallegos, 2014; Wickham & Carbone, 2018). Both codes integrated within this dimension that relate to planning competencies (i.e., “Planning Skills” and “Plan Food Intake Ahead”) emphasise the need to prepare in advance one’s seasonal-based and nutritionally balanced food regime; planning not only what to buy according to the season and how to nutritionally replace unavailable foods, but also what to ingest so that nutritional needs are met and fulfilled, are examples of how planning competencies may be linked to the other variables aggregated in this fourth dimension.

FOODLIT-PRO’s Food Literacy Wheel

With its core representing the definition of food literacy obtained through mixed-methodologies (four-dimension model developed with qualitative deductive-dominant content analysis and multiple correspondence analysis), the design of FOODLIT-PRO’s Food Literacy Wheel (Figure 2) is meant to be interpreted from the inside out. As so, the invariable domain Knowledge is graphically illustrated by the rings (expressing both procedural and declarative knowledge, respectively) following the model at the centre; this particular visual representation of the domain Knowledge intends to express the invariability of this code as part of the food literacy definition by continuously embracing all four core dimensions. In a broader understanding, this aims to disclose that the food literacy definition includes both procedural and declarative knowledge across all its dimensions and features.

Succeeding to its core, the Food Literacy Wheel presents a clear ring deliberately placed between the definition of the construct and the manifested determinants (internal and external, respectively) of food literacy, previously identified in FOODLIT-PRO's first study (Rosas et al., 2019). Stating (i) food as a priority, (ii) convenience and practicality, (iii) time and (iv) financial management, (v) previous food-related habits, and (vi) innate and (vii) learned flavour preferences as "Internal Determinants", and (a) information access, (b) perishable/unreliable information, (c) lack of food access (food security), (d) family dynamic/identity, and (e) professionals' unpreparedness on food-related expertise as "External Determinants", this external graphic section of the wheel portrays what may limit or enhance one's food literacy (Rosas et al., 2019; Vettori et al., 2019).

Though scarcely explored and absent from most frameworks, food literacy's intersection with other food systems-related surrounding contexts (such as economic, political, cultural, and environmental features) has been recognised as being essential for the understanding of food literacy beyond the individual level (Bellotti, 2010; Pendergast et al., 2011). The most external ring of the Food Literacy Wheel intends not only to express this extension of food literacy's wider contextual surroundings but also to portray fields of influence that may impact individuals' and communities' food literacy. Thus, the previously analysed and identified Influential Factors (Rosas et al., 2019) are represented in segmented parts of a unique more distal ring: (1) Nutritional, (2) Psychological, (3) Health, (4) Learning Contexts, (5) Policy, (6) Industry, (7) Sustainability, (8) Social and (9) Cultural. As fields of interplay with food literacy, the intent of contemplating the nine factors separately emphasises the dynamic rotation allowed by the wheel; this rotation was thought and created to represent how each Factor of Influence may impact and/or be impacted by any of the four dimensions of food literacy. For example, "Display of Products Information" belonging to the Policy Factor (graphically placed on the right side of the wheel) may impact individuals' and wider populations' selection and acquisition skills (competencies that integrate the dimension Choice and Acquisition, located on the left side of the model); in the same way, by having a more elaborated understanding about food additives (feature that integrates the dimension Cooking Skills, based on the top of the model) the consumer may demonstrate a greater awareness for industry's strategy to use "Flavour Intensifiers for Consumers' Loyalty" (belonging to the Factor Industry, placed at the bottom of the model).

Aiming to integrate wider and heterogeneous food systems-related surrounding contexts within the food literacy conceptualisation, the presence of Influential Factors within FOODLIT- PRO's Food Literacy Wheel intends to broaden the prospect of developing further food literacy-related actions integrating multi-stakeholders and multilevel approaches. That is, involving features from these factors – such as nutritional language (Nutritional), health behaviour change (Psychological), health-related consequences (Health), professional support (Learning Contexts), inter-sectorial policies (Policy), marketing's and social media's influence (Industry), circular economy (Sustainability), food-related trends and cultural representations (Social and Cultural) – embedded in food literacy-related actions, aiming to tackle broader challenges regarding global sustainability across food systems.

Conclusions

With a mixed analysis, this study determined the structure for the definition of food literacy using a quantitative approach posteriorly on results previously obtained through an in-depth qualitative methodology. Additionally, this paper introduces a newly and groundbreaking food literacy framework that innovates by unifying definition, determinants and factors of influence – which advocates for multilevel and multi-stakeholder inclusion to provide for food systems integration and global sustainability. Providing for food-related expert's perspectives, having a sample of both men and women from diverse action fields supplying for valuable manifested content is a strength of this study. As most of the interviews were personally conducted, nonverbal responses and its additional exploration was allowed by the interviewer's presence and interaction. Regarding the structure that a Delphi study can provide, the absence of this methodology is viewed as a limitation of this research. However, the use of a quantitative approach to explore the previously analysed qualitative content identified as food literacy definition highlights the innovative character of this study.

Within the field of food literacy, this study contributes not only to a significant shift on the understanding of this concept but also provides for essential insight to assist the development of food literacy instruments and interventions that aim for the change of attitudes, knowledge, and behaviours. This research also emphasises the importance of considering further psychological aspects on food literacy-related interventions. Finally, at a broader spectrum of action regarding food systems, this FOODLIT-PRO's study hopes to inform the development of multi-sectorial and top-down governmental, commercial, and

health-related regulations aiming for the improvement of food relations, behaviours and lifetime habits at the level of communities and nations.

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Chapter 4

Developing and validating a quantitative instrument to assess food literacy: The FOODLIT-Tool

This chapter is based on the paper

Rosas, R., Pimenta, F., Leal, I., & Schwarzer, R. (2022a). FOODLIT-Tool: Development and validation of the adaptable food literacy tool towards global sustainability within food systems. *Appetite*, 168, 105658. <https://doi.org/10.1016/j.appet.2021.105658>

Abstract

Facing multiple anthropogenic challenges and considering the current global pandemic, food sustainability is stated as threatened by major intergovernmental agencies. Given the heterogeneity of food systems, the need to enhance food-related behaviours by promoting the acquisition of knowledge and competencies, and the demand to involve stakeholder's diversity, this study aims to develop and validate an instrument that measures food literacy, its determinants and its influential factors in an adult sample. Based on the Food Literacy Wheel framework and integrated within the FOODLIT-PRO - Food Literacy Project, this study has three phases and a total of 2406 participants: (1) item development and content validity, (2) instrument development entailing item reduction strategies, factor extraction methodologies (exploratory and confirmatory analyses) and sensitivity testing, with two samples of a total of 1447 adults, and (3) instrument validation encompassing tests of dimensionality (confirmatory factor analysis), reliability (composite reliability) and validity (convergent and discriminant validity), and measure invariance testing, with 959 adults. Concerning statistical and psychometric properties, (1) a pool of 40 items (26 for food literacy; single items: five for determinants and nine for influential factors) was developed with inductive and deductive methodologies and reflected the Food Literacy Wheel, (2) a 5-factor structure was explored, demonstrated acceptable model fit, and good sensitivity indices, and (3) a 5-dimensional reliable structure with 24 items was validated, configural invariance was achieved, and convergent and discriminant validity were significant in most dimensions. The FOODLIT-Tool contributes with an innovative measure of food literacy in adults that allows for a tailored assessment when approaching food-related issues within global food systems, providing a multidisciplinary tool that can be cross-widely applied to promote food-related behaviour change.

Keywords: Food literacy; Sustainability; Food systems; Instrument; Adults

Introduction

Food systems face major alterations generated from multiple anthropogenic sources, such as the growing global population, an unsettled development of world economy, and insecure climate changes; most recently, the global COVID-19 pandemic has already affected consumers' food consumption behaviours, with more severe impacts threatening food security (FAO, 2019; Laborde et al., 2020; O'Hara & Toussaint, 2021; The World Bank, 2021). Concerning eating behaviours, recent data are beginning to show an increase of unhealthier diets and eating patterns during home confinements across different countries (Ammar et al., 2020). On the topic of food security, COVID-19 has already impacted both people's food access and the stability of food supply chains, with the FAO of the UN expecting a continuous increase in food insecurity due to the pandemic (UN, 2020).

On a universal call to action, the UN committed to deal with, among many others, significant food- and sustainability-related issues within the Sustainable Development Goals as part of the 2030 Agenda (UN, 2015). Particularly concerning food systems, the urgency to act has demanded for bold strategies and solutions in order to deliver healthier, more equitable, and more sustainable food systems; as a response, the UN will convene a Food Systems Summit mobilising diverse stakeholders from multiple fields, including science, policy, human and environmental health, food industry, among others (UN, 2021).

Intending to integrate these broader and heterogeneous food systems' contexts within the conceptualisation of food literacy, the FOODLIT-PRO - Food Literacy Project (Rosas et al., 2019) has developed a conceptual and empirical framework designated as Food Literacy Wheel (Rosas et al., 2021). As so, the Food Literacy Wheel (Figure 2, in Chapter 3) describes: the essential set of food-related knowledge, competencies and behaviours (that is, food literacy's definition); its enablers and inhibitors (food literacy's determinants); and fields of interplay aiming to tackle wider challenges concerning global sustainability within food systems (food literacy's influential factors). In accordance with the UN's outlook on food systems, the Food Literacy Wheel involves (i) nutritional, (ii) psychological, (iii) health, (iv) learning contexts, (v) policy, (vi) industry, (vii) sustainability, (viii) social, and (ix) cultural contexts as influential factors. This unique evidence-based strategy urges to broaden the prospect of developing further food systems-related actions integrating multi-stakeholders and multilevel approaches. Following the FOODLIT-PRO's contribution and considering the lack of evidence encompassing this diversity of stakeholders on the field of food literacy, the need

to evaluate these heterogeneous attributes along with the assessment of consumers' food literacy arises (Amouzandeh et al., 2019; Vidgen, 2016).

A recent scoping review was conducted aiming to identify developed instruments that specifically measure food literacy in adults, while compiling their psychometric properties; a total of 12 different tools was reported and these were confronted with the food literacy conceptualisation by Vidgen and Gallegos (Amouzandeh et al., 2019; Fingland et al., 2021; Vidgen & Gallegos, 2014). Including instruments to assess not only food literacy or its indicators but also to evaluate food literacy interventions, this review assembled studies from eight different countries and summarised the psychometric properties of each one. However, as analysed and stated previously (Rosas et al., 2019), the lack of mention regarding environmental, social, political, and cultural features in this and other frameworks (e.g., Cullen et al., 2015; Desjardins et al., 2013) have led to the development of FOODLIT-PRO's Food Literacy Wheel (Rosas et al., 2021). Furthermore, the crucial need of sustainable food systems – linking all economical, social, and environmental aspects – emphasises the demand to consider these influential factors within the assessment and posterior intervention not only on consumers' food literacy but also on food-related supply chains and associated contexts. More recently, and highlighting the topic of sustainability and food systems, a Korean team developed a questionnaire integrating multiple elements (such as production, processing, and distribution) as part of a food system domain, driven from a literature review (Park et al., 2020). Nonetheless, given (i) the limited literature scope regarding the absence of significant attributes despite evidence to impact food literacy (e.g., industry, policy or psychological features), and (ii) the limited studied sample and related psychometric analyses, further research is needed in order to integrate food systems' sustainability within food literacy's assessment (Park et al., 2020).

Hence, this study aimed to develop, test, and validate a quantitative assessment tool to measure (i) food literacy, (ii) its determinants, and (iii) influential factors, according to the conceptual and empirical framework Food Literacy Wheel (Rosas et al., 2021), in Portuguese adults.

Method

Subsequent to a qualitative exploration of food literacy's definition, determinants and influential factors (Rosas et al., 2019) and the development of a conceptual and empirical framework with a mixed methodology (Rosas et al., 2021), the present study was designed

with three different Phases (incorporating a total of six Steps; according to Boateng et al., 2018) aimed to develop and validate an instrument that assesses the diverse food-related knowledge, competencies and behaviours included in the FOODLIT-PRO's Food Literacy Wheel (Rosas et al., 2021).

Phase 1: Item Development and Content Validity

With the purpose of specifying the construct's (i) dimensions, (ii) its determinants, including its enablers and constrainers, and (iii) influential factors, the Food Literacy Wheel indicated that food literacy incorporates four dimensions: Cooking Skills, Preserve and Analyse, Choice and Acquisition and Search and Plan (Rosas et al., 2021). Driven by a mixed methodology, these dimensions provided the conceptual and empirical definition needed for the domain's identification (Boateng et al., 2018).

A pool of items was posteriorly generated by using both deductive and inductive methods. The first refers to the literature review previously performed (Rosas et al., 2019), which guided the development of the deductive-derived items. The second regards the qualitative data driven from semi-structured interviews (Appendix 1) with 30 food experts, which had been the stepping stone for designing the Food Literacy Wheel (Rosas et al., 2021) and for the generation of the inductive-driven items.

According to Boateng et al. (2018), content validity entails the need for content pertinence, representativeness, and technical quality. The process of item generation and assembling considered both theory and data-driven content, given its basis on a previously acknowledged conceptual and empirical framework of *food literacy* (Rosas et al., 2021). As the development of the constructs' dimensions within the Food Literacy Wheel entailed (i) the literature review of the most recent state of the art (Rosas et al., 2019) and (ii) the contribution of 30 experts working on food-related contexts (including food production, processing, distribution, marketing, consumption and disposing, along with additional fields – such as education, human and environmental health, policy-making, and sustainability; Rosas et al., 2021), the matching of theoretical and data-derived content on this process not only comprised specialised expertise but also ensured for content relevance and representativeness.

Phase 2: Instrument Development

Step 1 – pre-testing questions

In order to (i) minimise the misunderstanding of the items and consequent measurement error (Boateng et al., 2018), (ii) test for readability, (iii) account for usability of the online platform, and (iv) identify and rectify minor language amendments, pilot surveys were conducted with other psychology researchers from the William James Center for Research at ISPA - Instituto Universitário.

Step 2 – survey administration and sample size

All data were collected using software programs (namely, Typeform and SurveyHero) that allowed participants to fulfil the required survey on either laptops, tablets, or smartphones. The use of technology was preferred in all moments of data collection given its ability to (i) reduce the errors related with data logging, (ii) increase response rates, (iii) allow for data collection from larger samples with minimal costs, and (iv) constant monitoring of data collection (Fanning & McAuley, 2014; Greenlaw & Brown-Welty, 2009). Furthermore, given the onset of the COVID-19 pandemic during data collection, online participants' recruitment and data collection were chosen for all samples. The ideal ratio of 10:1 (the minimum of 10 participants for each item) was followed (Nunnally, 1978).

To ensure data availability for both the development and validation of the FOODLIT-Tool, three samples were collected at two points in time. The first two samples (for the instrument development) were concomitantly collected from May to July 2019, and the third sample (for the instrument validation) was collected in August 2020. These community samples were recruited through social media (Instagram and Facebook), by reaching out to diverse health-related platforms and accounts. The first author reached out to multiple health- and nutrition-related professionals through their social media account, where the information concerning the study's recruitment process would be shared with the accounts' followers. Inclusion criteria were: being at least 18 years old, and having minimum literacy and internet access in order to understand and reply to a digital and online questionnaire. Additionally to the items belonging to the FOODLIT-Tool, a sociodemographic questionnaire (Appendix 7) was applied to all samples, aiming to collect self-reported data concerning sociodemographic characteristics (e.g., sex, age, educational level) and health-related behaviours (e.g., tasks for

which one is responsible for in the food routine, encompassing choice and decision, selection and acquisition, preparation, and cooking; Vidgen & Gallegos, 2014).

This study was approved by the Ethics Committee of ISPA – Instituto Universitário (ref. D/002/03/2018), performed in accordance with the Declaration of Helsinki, followed the ethical principles and deontological norms of the Order of Portuguese Psychologists, and adhered to General Data Protection Regulation (Appendix 5).

Step 3 – item reduction, factor extraction, and sensitivity

In order to understand the internal structure on the assembled set of items, an exploratory factor analysis (EFA; Sample 1) was performed. To determine the potential number of underlying factors, the following criteria were applied: eigenvalues >1 , scree plot analysis, factor loadings above 0.30, a minimum of 50% of explained variance, plausibility of the factors in terms of their substantive meaning, and link to their conceptual and empirical basis considering the Food Literacy Wheel (Rosas et al., 2021). The Bartlett's test of sphericity (with a significance level of 0.05) and Kaiser-Meyer-Olkin (KMO; with a cut-off for suitability set at > 0.60) were used to assess the adequacy of the data for EFA (Kaiser, 1974).

To allow for the systematic comparison of the a priori factor structure obtained with the EFA, a confirmatory factor analysis (CFA; Sample 2) was conducted to estimate the relationship between latent variables and assess further model fit indices. The model fit indices considered were chi-square statistics (χ^2/df), standardised root mean square residual (SRMR), root mean square error of approximation (RMSEA), comparative fit index (CFI), goodness of fit index (GFI); reference values indicative of adequate model fit were considered according to Hu and Bentler (1999), Byrne (2016), and Boateng and colleagues (2018).

In both factor analysis, item reduction was performed (i) whenever criteria were not met, and (ii) as long as the removal of an item did not deprive the instrument of theoretical significance, according to the Food Literacy Wheel (Rosas et al., 2021).

Sensitivity was analysed according to both minimum and maximum scores of the Likert-type scale, skewness and kurtosis; the latter should have absolute values below 3 and 7, respectively (Marôco, 2014).

Phase 3: Instrument Validation

Step 4 – tests of dimensionality and measurement invariance

To confirm and validate the factor structure and dimensionality of the developed measure, a CFA was performed with a new sample (Sample 3); model fit was verified using the same indices as indicated in Step 3.

Considered of essential significance for the test of dimensionality, configural invariance was tested as part of measurement invariance. Regarding the assessment of the hypothesised factor structure, configural invariance is achieved if the model of interest fits across different samples (Boateng et al., 2018; Yu & Shek, 2014). Configural invariance was tested with Sample 2 and Sample 3, and the above mentioned criteria for model fit were applied (Step 3).

Step 5 – tests of reliability

Internal consistency was assessed by composite reliability, and a threshold of 0.70 was applied (DeVellis, 2003; Nunnally, 1978).

Step 6 – tests of validity

Concerning the extent to which the FOODLIT-Tool is capable of measuring the concept of *food literacy* and its entailed domains (Rosas et al., 2021), construct validity was assessed. Occurring when the behaviour of a factor is strongly explained by its items, convergent validity was explored through the average variance extracted (AVE); an AVE equal or above 0.50 was considered appropriate (Fornell & Larcker, 1981). Regarding the ability to discern dissimilar constructs, discriminant validity was analysed by comparing the inter-factors' squared correlation (r^2) with each factor's AVE; when r^2 demonstrated to be smaller than each factor's AVE, discriminant validity was shown (Anderson & Gerbing, 1988; Fornell & Larcker, 1981).

Results

Phase 1: Item Development and Content Validity

According to the Food Literacy Wheel (Rosas et al., 2021), food literacy's conceptualisation includes its four-dimensional definition (Cooking Skills, Preserve and Analyse, Choice and Acquisition, and Search and Plan), determinants (e.g., convenience and practicality, time and financial management), and influential factors (e.g., psychological,

sustainability, policy, and industry). A pool of 40 items was developed considering the diverse attributes of food literacy's definition, determinants and influential factors (Table 7). Intending to assess individuals' food-related knowledge, competencies, and behaviours (that is, *food literacy*; Block et al., 2011; Cullen et al., 2015; Desjardins et al., 2013; Perry et al., 2017; Slater et al., 2018; Thomas et al., 2019; Vidgen & Gallegos, 2014), the FOODLIT-Tool integrates the items referring to the FLW's core, which entails the definition of food literacy. Items concerning both food literacy's determinants and influential factors were designed as single items meant to be used when needed.

Table 7

Pool of items develop in Phase 1 (instrument development and content validity), according to each of the Food Literacy Wheel components (definition, determinants, and influential factors; Rosas et al., 2021)

Food Literacy Definition	Corresponding Items
Cooking Skills	1 I easily prepare everything that is necessary to make a meal.
	2 I combine different ingredients to create a suitable meal.
	3 I adapt recipes to be more to my taste.
	4 I use kitchen equipment and utensils (e.g., oven, blender) efficiently.
	5 I cook adequate meals with what I usually have at home.
	6 The quality of the food depends on its origin (e.g., domestic or industrial agricultural production, local or imported products).
	7 It is important for me to avoid consuming foods that contain additives.
	8 I cook in different ways (e.g., stewing, baking).
	9 I enjoy cooking.
Preserve and Analyse	10 I have knowledge of different types of preservation (e.g., freezing, salting*) suitable for different foods.
	11 I apply food hygiene and safety practices (e.g., storing food at appropriate temperatures, cleaning utensils).
	12 I recognise the impacts of pesticides and/or herbicides on food.
	13 I know what <i>organic products</i> are (e.g., food grown without pesticides).
	14 I know the impact that <i>organic products</i> have on food-related sustainability (e.g., less soil contamination).
	15 I buy local/national trade products to support local/national business.

	16	I control the calories and/or other nutritional characteristics of the food I eat daily.
	17	I can identify the origin of a food (that is, where a food comes from).
	18	I can identify how a food is produced and processed (that is, how it is manufactured, how it is packaged).
Choice and Acquisition	19	I read and interpret food labels to select the most appropriate foods.
	20	I make informed food choices.
	21	I dedicate time and invest in food selection (e.g., when I go shopping).
	22	I eat food according to its seasonality.
	23	I am aware of the time of year of each food.
Search and Plan	24	I can easily substitute one food for another nutritionally equivalent one.
	25	I plan various aspects of my diet.
	26	I plan my meals in advance.
<hr/>		
Food Literacy Determinants	Corresponding Items	
	27	My financial resources influence my eating habits.
	28	It is hard to find time to invest in my diet.
Internal and External	29	It is important that my diet is practical and convenient.
	30	Having an adequate diet is a priority for me.
	31	The available information on food is excessive and/or contradictory.
<hr/>		
Food Literacy Influential Factors	Corresponding Items	
Nutritional	32	In my diet, I take into account my nutritional needs.
Social	33	It is important for me to have the support of those around me (family, friends) regarding my diet.
Health	34	My health is influenced by what I eat.
Sustainability	35	My food decisions have an impact on the climate's sustainability.
Learning Contexts	36	When I have questions about food, I know where to find reliable information.
Cultural	37	Moments with my family or with my friends are always accompanied by
Industry	38	As a consumer, my food decisions influence the food industry (e.g., availability of food outside its season, importation of food).
Food Policy	39	Food policies (e.g., tax on sugary drinks) influence my eating decisions.
Psychological	40	My emotions influence my eating habits.

Note. *Salting is a common preservation method for Portuguese food, specifically used for codfish, as well as for some types of meat and cheeses.

As so, a total of (i) 26 items were developed reflecting the four-dimensional definition of food literacy, (ii) five items were created portraying its determinants, and (iii) nine items were intended to represent its influential factors. All items were developed with a four-point Likert-type response scale referring to either frequency (0 - *never*; 1 - *sometimes*; 2 - *frequently*; 3 - *always*) or agreement (0 - *completely disagree*; 1 - *disagree*; 2 - *agree*; 3 - *completely agree*).

Phase 2: Instrument Development

Step 1 – pre-testing questions

The study participants ($n = 5$) regarding the pilot surveys reported that the measure was well understood, clear in meaning and length, and not being time consuming.

Step 2 – survey administration and sample size

The collected samples (Sample 1, 2, and 3) represented a total of 2406 adults, aged between 18 and 69 years ($M_{\text{Sample 1}} = 28.2$; $SD_{\text{Sample 1}} = 7.9$; $M_{\text{Sample 2}} = 27.9$; $SD_{\text{Sample 2}} = 7.8$; $M_{\text{Sample 3}} = 30.1$; $SD_{\text{Sample 3}} = 7.8$). Participants' characteristics are shown in Table 8.

Table 8

Participants' socio-demographic characteristics (Sample 1, 2, and 3)

Socio-demographic characteristics	Sample 1		Sample 2		Sample 3	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Sex						
Female	632	90.5	668	89.2	906	94.5
Male	66	9.5	81	10.8	53	5.5
Affective-sexual relationship						
Yes	524	75.1	557	74.4	691	72.1
No	174	24.9	192	25.6	268	27.9
Children						
Yes	118	16.9	115	15.4	179	19
No	580	83.1	634	84.6	777	81
Educational level						
Middle school	10	1.4	8	1.1	12	1.2

High school	161	23.1	178	23.8	167	17.4
Bachelor	328	46.9	355	47.4	374	39
Master	188	26.9	203	27.1	394	41.1
Doctorate	11	11.6	5	0.7	12	1.3
Professional status						
Active	548	83.7	626	83.6	834	87
Unemployed	113	16.2	119	15.9	123	12.8
Retired	1	0.1	4	0.5	2	.2
Annual household income						
10.000 EUR or less	191	27.4	202	27	167	17.4
10.001 EUR - 20.000 EUR	253	36.2	268	35.8	333	34.7
20.001 EUR - 37.500 EUR	173	24.8	182	24.3	273	28.5
37.501 EUR - 70.000 EUR	61	8.7	75	10	115	12
Above 70.000 EUR	20	2.9	22	2.9	43	4.5
Body Mass Index						
Below normal	35	5	46	6.1	50	5.2
Normal weight	481	68.9	519	69.3	683	71.2
Overweight	142	20.3	137	18.3	160	16.7
Obesity	37	5.3	44	5.9	52	5.4
Food-related Responsibility						
Choice and decision	629	90.1	668	89.2	900	93.8
Selection and acquisition	564	80.8	598	79.8	788	82.2
Preparation	556	79.7	594	79.3	821	85.6
Cooking	559	80.1	605	80.8	826	86.1
None	34	4.9	40	5.3	21	2.2

Note. Frequency (*n*) and percentage (%).

Collected simultaneously for the instrument development (Phase 2) and in the same online platform, Sample 1 (*n* = 698) and Sample 2 (*n* = 749) achieved a completion rate of 58.7% and an average completion time of 13 min. Collected posteriorly for the instrument validation (Phase 3), Sample 3 (*n* = 959) had a response rate of 73.1% and an average completion time of 9 min. The decrease in the average completion time can be understood given that the items concerning food literacy's determinants and influential factors were

applied in the samples for the instrument development (Phase 2; Samples 1 and 2), but not for the stage of the instrument validation (Phase 3; Sample 3).

Step 3 – item reduction, factor extraction, and sensitivity

Items concerning food literacy’s definition. In all samples, responses to the 26 items regarding food-related knowledge, competencies, and behaviours ranged from 0 to 3 in the Likert-type scale and presented good values of skewness ($-1.901 < Sk < 0.347$) and kurtosis ($-0.975 < Ku < 4.897$). With sampling adequacy (Sample 1) confirmed by Bartlett’s test ($\chi^2 = 5704.2$; $p < .001$) and KMO (0.90), a five-factor structure with varimax rotation, eigenvalue >1 and a total of explained variance of 52.2%, was obtained in an EFA (Table 9).

Table 9

Results from the EFA with Sample 1 (n = 698), including the factor loadings (bold values indicating the most significant factor weights; bold and underlined values indicated the final EFA, after changing the preservation item from the Origin to the Culinary Competencies factor), eigenvalues, inertia, percentage of variance and Cronbach’s alphas (including the modification on the Cooking Skills factor, regarding the addition of the item concerning preservation skills)

Items	Factor Loading				
	Culinary Competencies	Selection and Planning	Production and Quality	Environmentally Safe	Origin
Food literacy definition					
1 I easily prepare everything that is necessary to make a meal.	0.569	0.369	0.027	0.157	0.152
2 I combine different ingredients to create a suitable meal.	0.676	0.297	0.140	0.169	0.197
3 I adapt recipes to be more to my taste.	0.597	0.182	0.086	0.007	0.159
4 I use kitchen equipment and utensils (e.g., oven, blender)	0.685	0.105	0.086	0.135	0.006
5 I cook adequate meals with what I usually have at home.	0.626	0.306	0.045	0.167	-0.067

6	The quality of the food depends on its origin (e.g., domestic or industrial agricultural production, local or imported products).	0.125	-0.006	0.493	0.109	-0.274
7	It is important for me to avoid consuming foods that contain additives.	0.045	0.193	0.591	0.158	-0.045
8	I cook in different ways (e.g., stewing, baking).	0.750	0.063	0.077	0.134	0.126
9	I enjoy cooking.	0.683	0.103	0.123	-0.009	0.087
Preserve and Analyse						
10	I have knowledge of different types of preservation (e.g., freezing, salting) suitable for	0.345	0.039	0.030	0.297	0.380
11	I apply food hygiene and safety practices (e.g., storing food at appropriate temperatures, cleaning utensils).	0.248	0.099	-0.043	0.441	-0.038
12	I recognise the impacts of pesticides and/or herbicides on	0.070	0.127	0.665	0.164	0.083
13	I know what <i>organic products</i> are (e.g., food grown without pesticides).	0.136	0.024	0.694	-0.125	0.236
14	I know the impact that <i>organic products</i> have on food-related sustainability (e.g., less soil contamination).	0.070	-0.071	0.769	0.095	0.078
15	I buy local/national trade products to support local/national business.	0.025	0.136	0.210	0.596	0.125
16	I control the calories and/or other nutritional characteristics of the food I eat daily.	-0.004	0.766	-0.061	0.013	0.071
Choice and Acquisition						
17	I can identify the origin of a food (that is, where a food comes from).	0.169	0.163	0.057	0.065	0.771

18	I can identify how a food is produced and processed (that is, how it is manufactured, how it is packaged).	0.111	0.193	0.012	0.217	0.755
19	I read and interpret food labels to select the most appropriate foods.	0.126	0.705	0.193	0.078	0.219
20	I make informed food choices.	0.283	0.601	0.225	0.214	0.286
21	I dedicate time and invest in food selection (e.g., when I go	0.288	0.614	0.187	0.200	0.045
Search and Plan						
22	I eat food according to its seasonality.	0.096	0.088	0.082	0.759	0.096
23	I am aware of the time of year of each food.	0.114	0.060	0.158	0.705	0.167
24	I can easily substitute one food for another nutritionally equivalent	0.236	0.460	0.137	0.112	0.359
25	I plan various aspects of my diet.	0.325	0.685	-0.037	0.056	0.031
26	I plan my meals in advance.	0.202	0.651	-0.013	0.072	0.005
Eigenvalues		7.032	2.162	1.663	1.505	1.213
Percentage of Variance		27.048	8.316	6.394	5.787	4.666
Original Cronbach's alpha		0.835				0.637
Final Cronbach's alpha		0.831	0.828	0.690	0.608	0.707

The first factor – Culinary Competencies – entailed items concerning food-related preparation and cooking skills (e.g., adapting recipes, matching ingredients), as well as the importance of one's enjoyment in culinary activities. Considering (i) the association of the items with the Food Literacy Wheel (Rosas et al., 2021), (ii) the plausibility of the factors with the respective item loadings and (iii) the non-significant statistical differences, a theoretically supported decision was made concerning this factor; it was determined that the item concerning preservation skills (item 10: “*I have knowledge of different types of preservation (e.g., freezing, salting) suitable for different foods*”) would be added to the Culinary Competencies factor (with a factor weight of 0.345) instead of remaining in its original structure (factor Origin, with a factor weight of 0.380). This decision also improved the reliability of the Origin factor (from 0.637 to 0.707; Table 3). The second factor –

Selection and Planning – aggregated items concerning food acquisition practices (e.g., reading food labels, investing in food selection) and planning skills. The third factor – Production and Quality – regarded agricultural practices within food production (e.g., use of pesticides and herbicides) and its impact on food quality. The fourth factor – Environmentally Safe - combined items related to environmental-friendly actions (e.g., eating according to seasonality) and the use of food-related hygiene and safety practices. Finally, the fifth factor – Origin – entailed items related to how food is originated and processed in its source.

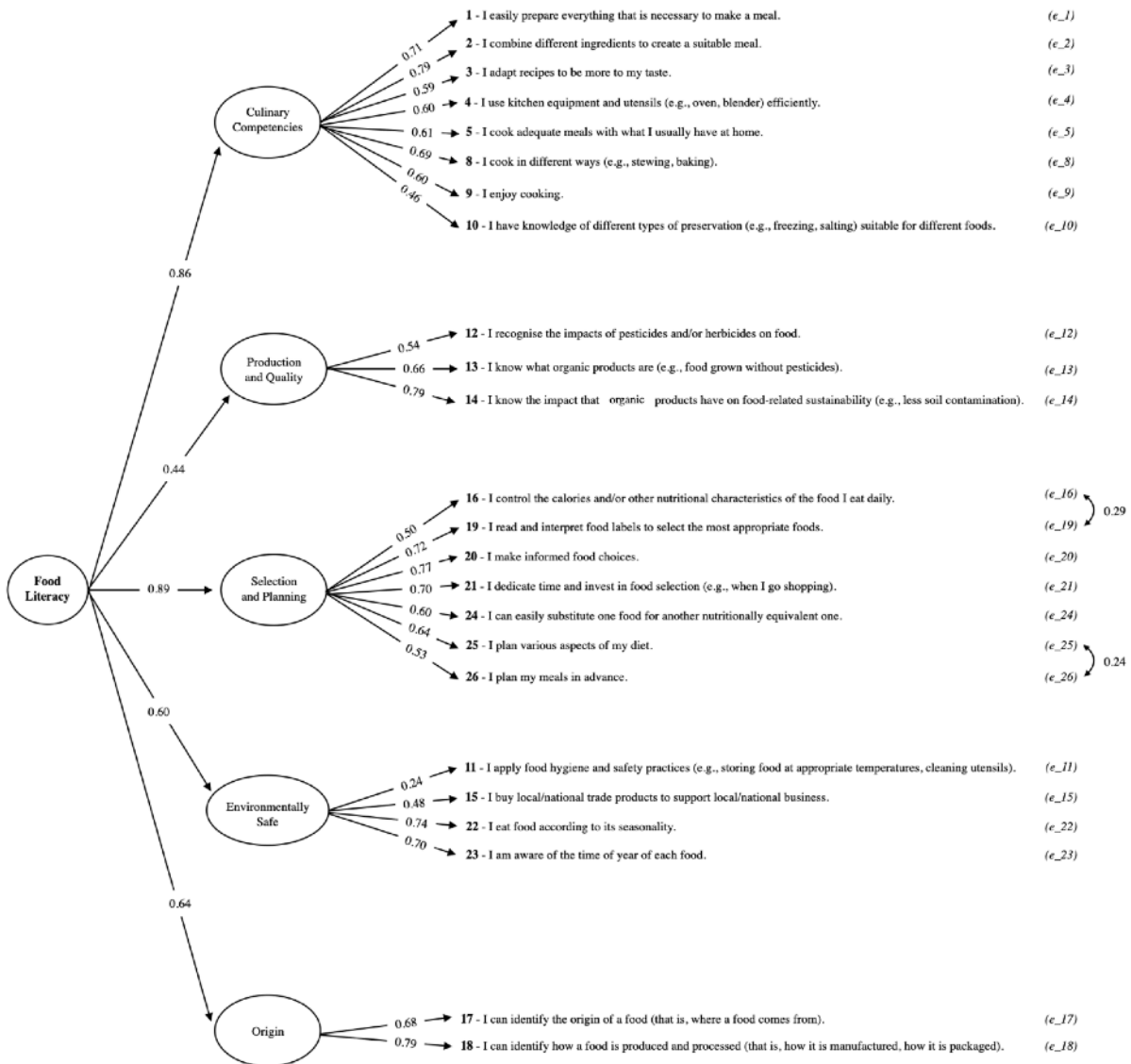
To draw further model fit comparisons with the previously obtained structure, a CFA was performed in a different sample (Sample 2). In this analysis, an a priori second-order model structure was elected given the seemingly distinctive but related dimensions ($0.496 < r^2 < 0.843$) which account for the common underlying construct of food literacy, validated in the Food Literacy Wheel (Chen et al., 2005; Rosas et al., 2021). The first model, which included all 26 items across the five-factor structure demonstrated in the EFA, presented an acceptable fit ($\chi^2/df = 2.941$; $SRMR = 0.057$; $RMSEA = 0.051$; $CFI = 0.905$; $GFI = 0.915$). The first-order standardised factor loadings for Culinary Competencies (0.855), Selection and Planning (0.858), Environmentally Safe (0.604) and Origin (0.635) demonstrated acceptable levels; despite Production and Quality (0.476) having a loading weaker than 0.50, all factor loadings were statistically significant. Ranges of factor loading values for the five first-order factors were as following: 0.459–0.788 (Culinary Competencies), 0.556–0.749 (Selection and Planning), 0.658–0.788 (Origin), 0.329–0.758 (Production and Quality), and 0.240–0.739 (Environmentally Safe). The items with weaker factor loadings concerned food-related (i) hygiene and safety practices ($\lambda = 0.240$; $r^2 = 0.058$; item 11 - “*I apply food hygiene and safety practices (e.g., storing food at appropriate temperatures, cleaning utensils)*”), (ii) quality ($\lambda = 0.329$; $r^2 = 0.108$; item 6 - “*The quality of the food depends on its origin (e.g., domestic or industrial production, local or imported products)*”), and (iii) additives ($\lambda = 0.426$; $r^2 = 0.181$; item 7 - “*It is important for me to avoid consuming foods that contain additives*”). Given the current context of the global pandemic and the emphasis of international guidelines to ensure food-related hygiene and safety practices as precaution measures against COVID-19 (European Commission, 2020a), the authors decided to retain item 11 within these analyses, despite its poorer indicators. Items 6 and 7 were removed given their lower factor loading and squared multiple correlation values; this decision was made considering that the removal of these items did not deprive the developed measure of capability to assess any of the food

literacy's domains and their respective features presented in the Food Literacy Wheel (Rosas et al., 2021). Additionally, error correlations among two items (items 16 and 19; items 25 and 26) were established following high modification indices.

As so, the second and final model included a total of 24 items. Model fit ($\chi^2/df = 2.702$; $SRMR = 0.053$; $RMSEA = 0.048$; $CFI = 0.927$; $GFI = 0.930$) demonstrated slight improvements when compared with the first model. Figure 3 shows the final model for the FOODLIT-Tool's development, including its standardised factorial loadings.

Figure 3

Final model regarding the CFA for the instrument's development (Step 3; Sample 2; n = 749)



Single items concerning food literacy's determinants and influential factors. In the samples where these items were developed (Samples 1 and 2), all items except one ranged from 0 to 3 in the response scales; the exception was item number 30, corresponding to a determinant ("Having an adequate diet is a priority for me"), whose responses ranged from 1 to 3. All items regarding both food literacy's determinants and influential factors demonstrated appropriate values of skewness ($-0.631 < Sk_{\text{Determinants}} < 0.175$; $-1.108 < Sk_{\text{Influential Factors}} < 0.298$) and kurtosis ($-0.716 < Ku_{\text{Determinants}} < 0.153$; $-0.823 < Ku_{\text{Influential Factors}} < 0.683$) in Sample 1 and Sample 2.

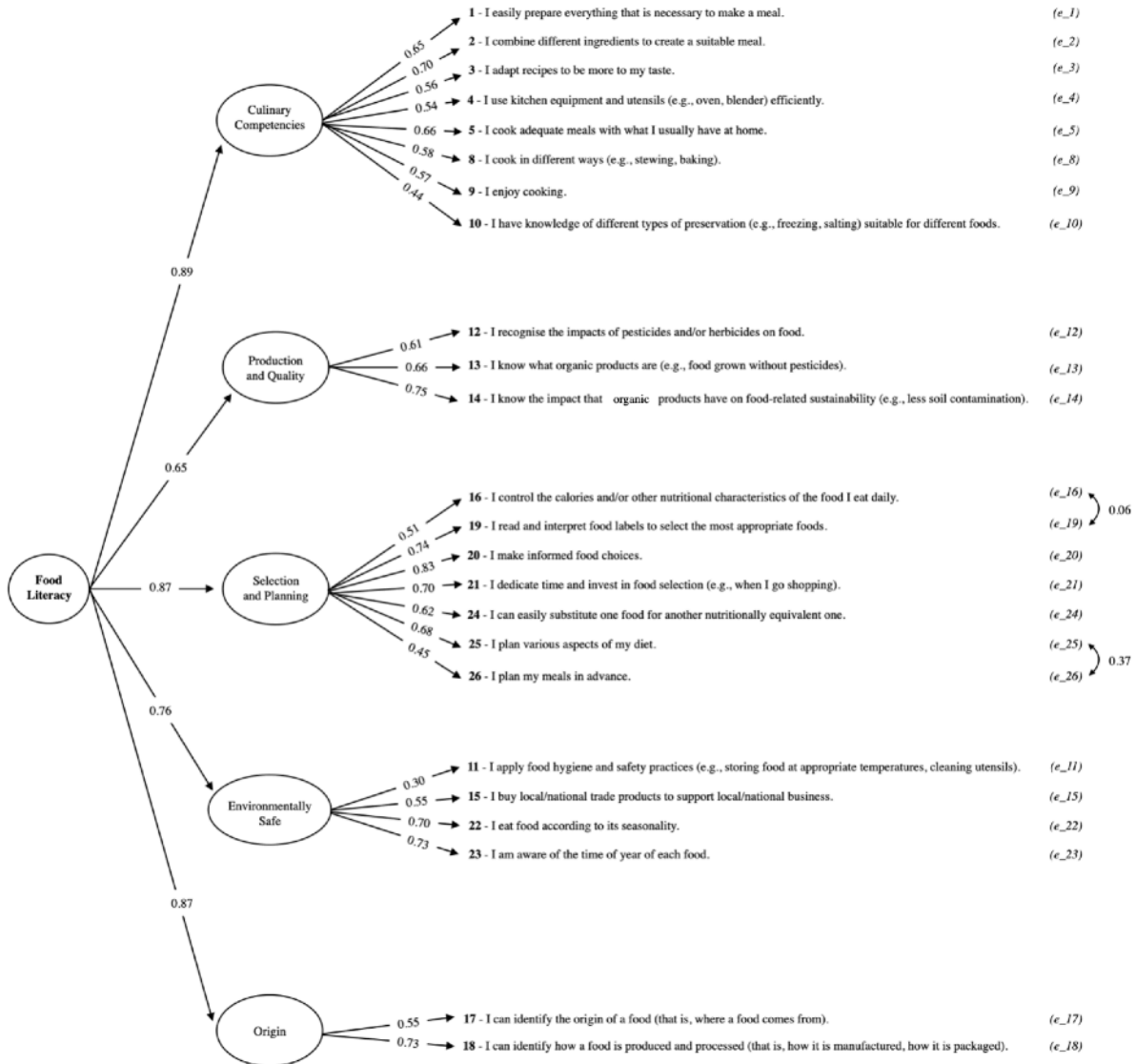
Phase 3: Instrument validation

Step 4 – tests of dimensionality and measurement invariance

For the FOODLIT-Tool validation, a CFA was performed with Sample 3 in order to validate the previously obtained factor structure (Step 3). Maintaining the 24 items and the items' errors correlations, model fit for dimensionality testing was acceptable ($\chi^2/df = 3.958$; $SRMR = 0.055$; $RMSEA = 0.055$; $CFI = 0.907$; $GFI = 0.917$). When compared to the values obtained for the instrument's development final model (Figure 3), the CFA regarding the instrument's validation (Figure 4) presented higher first-order standardised factor loadings for four out of the five dimensions: Culinary Competencies (0.894), Environmentally Safe (0.764), Production and Quality (0.651), and Origin (0.874). Only the dimension Selection and Planning (0.874) had a slight decrease (from 0.890 in the instrument's development model). Factor loadings for the five first-order factors ranged between 0.437 and 0.704 (Culinary Competencies), 0.450–0.833 (Selection and Planning), 0.301–0.729 (Environmentally Safe), 0.613–0.746 (Production and Quality), and 0.553–0.728 (Origin). Despite showing a slight improvement, item 11 remains being the item with weaker factor loadings ("I apply food hygiene and safety practices (e.g., storing food at appropriate temperatures, cleaning utensils)"; $\lambda = 0.301$; $r^2 = 0.091$).

Figure 4

Final model regarding the CFA for the instrument's validation (Step 4; Sample 3; n = 959)



As the first level in measurement invariance, configural invariance refers to testing if the construct maintains its pattern and factor loadings across different groups (Milfont & Fischer, 2010; Putnick & Bornstein, 2016). Given the adequacy of model fit for the developed factor structure in both Sample 2 and Sample 3, invariance of model form was achieved ($\chi^2/df = 3.330$; $SRMSR = 0.053$; $RMSEA = 0.037$; $CFI = 0.916$).

Step 5 – tests of reliability

Internal consistency of all dimensions was explored (Table 10); as shown, the five factors demonstrated acceptable to good reliability ($0.695 < CR < 0.892$).

Table 10

Reliability analysis (composite reliability) for all the dimensions of the FOODLIT-Tool with Sample 3 (n = 959; instrument's validation; Step 6)

FOODLIT-Tool dimensions	Number of items	Composite Reliability
Culinary Competencies	8	0.869
Production and Quality	3	0.807
Selection and Planning	7	0.892
Environmentally Safe	4	0.752
Origin	2	0.695

Step 6 – tests of validity

Convergent validity was assessed through the AVE, where three out of the five dimensions had values above 0.50 (AVE Selection and Planning = 0.551; AVE Production and Quality = 0.583; AVE Origin = 0.538); the factors Culinary Competencies and Environmentally Safe had AVE values slightly below the threshold (0.457 and 0.452, respectively). Explored through the comparison of the AVE values with the inter-dimensions' squared correlation, six out of the 10 paired-factors presented discriminant validity (Table 11).

Table 11

Discriminant validity of the FOODLIT-Tool's dimensions (Sample 3; n = 959; Step 6)

FOODLIT-Tool dimensions	Dimensions' AVE	Inter-dimensions' squared correlation	Discriminant validity
Culinary Competencies	0.457	0.415	Yes
Environmentally Safe	0.452		
Culinary Competencies	0.457	0.227	Yes

Production and Quality	0.583	0.287	Yes
Culinary Competencies	0.457	0.710	No
Selection and Planning	0.551		
Culinary Competencies	0.457	0.511	No
Origin	0.538		
Selection and Planning	0.551	0.246	Yes
Production and Quality	0.583		
Selection and Planning	0.551	0.368	Yes
Environmentally Safe	0.452		
Selection and Planning	0.551	0.555	No
Origin	0.538		
Production and Quality	0.583	0.438	Yes
Environmentally Safe	0.452		
Production and Quality	0.583	0.438	Yes
Origin	0.538		
Environmentally Safe	0.452	0.612	No
Origin	0.538		

Discussion

Within the FOODLIT-PRO – Food Literacy Project and building upon the previously developed conceptual and empirical framework of food literacy (Rosas et al., 2021), this study created a tool with the purpose to assess not only adults' food literacy but also to evaluate its determinants and influential factors. The 40-item instrument incorporated a 5-dimensional definition of food literacy, internal and external determinants (e.g., financial management, convenience and practicality), and multi-stakeholder-related influential factors (such as policy, sustainability, and industry), and was developed and validated in a Portuguese sample, mirroring the FLW model formerly designed with food experts using both qualitative and quantitative methods (the full instrument in both English and Portuguese is featured in Appendix 11 and 12, respectively). Thus, the FOODLIT-Tool portrayed (i) the four dimensions of the Food Literacy Wheel core as a total of 24 items in order to assess food-related knowledge, competencies and behaviours that institute food literacy's definition, (ii) the middle rings of the FLW as a 5-item independent arrangement representing its determinants, and (iii) the outer ring as a 9-item distinct configuration depicting the influential factors.

Despite reflecting the framework's content for item development (Phase 1), the factor extraction (Phase 2, step 3) obtained a 5-factor structure. When comparing this structure with the FLW's four-dimensional core, the FOODLIT-Tool (a) focused the association of acquisition skills and planning competencies (factor Selection and Planning), (b) emphasised the link among production aspects and its impact on food quality (factor Production and Quality), (c) highlighted the connection between food safety and sustainable food consumption (factor Environmentally Safe), and (d) particularised an origin-specific dimension (factor Origin). These dissimilarities accentuate the need to specify distinct sets of skills and practices previously understood as part of more general dimensions within the conceptual and empirical framework (from Food Literacy Wheel's core – Choice and Acquisition, Preserve and Analyse, and Search and Plan; Rosas et al., 2021); as a quantitative assessment tool, the particularisation of discrete food-related competencies and behaviours was crucial to ensure the instrument's validity. Maintaining the majority of content equivalence, the factor Culinary Competencies was the most similar to its pair (the dimension Cooking Skills) from the Food Literacy Wheel; the addition of the item regarding preservation skills reflected the application of these behaviours within the culinary context as a current practice to allow for food conservation. Posteriorly to the exploratory analysis, the confirmatory analysis conducted with a second sample for the tool's development presented a similar structure considering the items and their respective factors. In this procedure, the decision to integrate a second-order model structure emerged from the accountability of the diverse dimensions for the construct's definition, formerly demonstrated on the conceptual and empirical framework from which the item development proceeded (Chen et al., 2005; Rosas et al., 2021).

On the process of item reduction (Phase 2, step 3), items with reference to hygiene and safety practices (item 11), food quality (item 6) and food additives (item 7) were identified as having weaker psychometric properties when the CFA was performed. The decision to remove two of those items (items 6 and 7) while retaining item 11 relied on the significance of hygiene and safety aspects in the current public health situation due to the COVID-19 pandemic. Though presenting the weaker factor loadings, item 11 represents the only item reflecting the importance to ensure food-related hygiene and safety behaviours as safeguarding practices on the *from farm to fork* context (European Commission, 2020b). However, despite the need of featuring hygiene and safety as essential subjects within the

FOODLIT-Tool as a measure of food literacy, the poor psychometric properties of this item demonstrate the necessity to revise its form and content for future studies. As so, the authors strongly suggest that further developments of the instrument entail two separated items to encompass hygiene and safety competencies – two constructs that, though having common elements overlapping, present some crucial differences (Canadian Centre for Occupational Health and Safety, 2021; FAO & WHO, 1969) – along with featuring more specific examples on how to implement these practices. For instance, a possibility for a transformed food hygiene item could be *“I apply food hygiene practices (e.g., keep the kitchen and the food storage areas clean; wash my hands before and after handling food; use a clean spoon each time I taste food)”*, and a modified food safety item could state *“I apply food safety practices (e.g., make sure that food is safe to eat by looking to its expiration date and freshness characteristics; transporting and storing foods at appropriate temperatures; using adequate re-heating temperatures)”*.

The final model for the instrument’s development was then tested on a third sample for the instrument’s validation (Phase 3). Concerning the dimensionality testing (Phase 3, step 4), the developed factor structure was validated with acceptable model fit; furthermore, establishing configural invariance highlighted the fact that the FOODLIT-Tool consistently measured food literacy and its dimensions across different groups. Given that the comparison and interpretation among groups is only valid if the basis of factorial invariance is achieved, this tool is demonstrated to be successful on future assessments in different populations (Yu & Shek, 2014). Both testing of reliability (step 5) and validity (step 6) indicated favourable outcomes; particularly regarding the tests of validity, the absence of discriminant validity in almost half of the pairings mirrors the high correlations among dimensions as well as the need and justification for the second-order factor (Chen et al., 2005). Still regarding the tests of validity (step 6), the absence of the criterion validity analysis (particularly, predictive and concurrent validity) presents as a limitation of this study. Moreover, the strong predominance of female participants transversally to all samples is also a feature to be improved in future studies. However, as a psychometric study aiming for the development and validation of an assessment tool based on a recent and innovative framework which was built with a mixed methodology, the display of step-by-step statistical procedures as well as the availability of three different samples are main features of this work.

Future Studies and Implications for Practice and Research

Aiming to broaden the spectrum of food systems through the measurement of food literacy's enablers and inhibitors (that is, determinants) and by assessing the impact caused by fields of interplay (that is, influential factors), the development of the FOODLIT-Tool aimed to contribute with a more comprehensive approach towards food-related global sustainability. Intending to be used when needed, items concerning food literacy's determinants and influential factors were depicted in the steps concerning the tool's development (Phase 1, and steps 1, 2 and 3 from Phase 2) given that the instrument's validation (Phase 3) concerned food literacy skills exclusively. Allowing for an expanded measurement of food literacy's contextual and individualised features, these single items highlight the required tailoring when approaching food-related issues within global food systems. This innovative feature of the FOODLIT-Tool grants the possibility to adapt its content according to its aim, personalising which items to include depending on the target population or on a food-related intervention with a particular context. For instance, (i) applying item 30, which concerns the priority of a healthy diet, to patients on weight management programs, or (ii) using item 38, regarding the consumer's influence on food industry, to understand to what extent a retail's final consumer perceives the responsibility of their food choices on more sustainable food consumption. As so, this singular feature of the FOODLIT-Tool provides for opportunities to widen the action on food-related interventions from diverse fields, from nutrition to psychology, policy, industry, and sustainability. Future studies should investigate the potential cut-off points to differentiate levels of food literacy on each dimensions and on a global score. Assessing the instrument's psychometric qualities in different populations and specific target groups from multiple contexts (e.g., health professionals, food industry workers, policy-makers, teachers, students) is also advised.

Conclusions

The urgency to tackle issues that threaten sustainability within food systems demands for stakeholders diversity along with multilevel approaches (UN, 2015). Recognising the impact of these areas of interplay and promoting its action is crucial to enhance consumers' food-related knowledge, competencies and behaviours effectively. As so, it is essential to considerate the plurality of fields – from food policy to human and environmental health, along with industry and learning environments – in order to assess and further intervene to promote food-related behaviour change, nourishment, and quality of life. This study

contributes with an innovative instrument that provides for tailoring within the assessment and allows for its use on diverse contexts. Based on the conceptual and empirical framework Food Literacy Wheel previously built with mixed methodologies, the FOODLIT-Tool is both valid and reliable and it is intended to assess not only food literacy but also to identify which determinants and influential factors have repercussions on one's food literacy. Lastly, the development of the FOODLIT-Tool aims to provide for a resourceful, adaptable and efficient assessment tool to be used in adult populations working towards healthier, more equitable and sustainable food systems by promoting behaviour change.

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Chapter 5

Development of a Randomised Controlled Trial to Promote Food Literacy: Protocol for the FOODLIT-Trial

This chapter is based on the paper

Rosas, R., Pimenta, F., Leal, I., & Schwarzer, R. (2022b). FOODLIT-Trial: Protocol of a randomised controlled digital intervention to promote food literacy and sustainability behaviours in adults using the Health Action Process Approach and the Behaviour Change Techniques Taxonomy during the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, 19, 3529. <https://doi.org/10.3390/ijerph19063529>

Abstract

Dietary quality and sustainability are central matters to the international community, emphasised by the burden of the COVID-19 pandemic. To promote healthier and more sustainable food-related practices, the protocol of a web-based intervention to enhance adults' food literacy is presented. The FOODLIT-Trial is a two-arm, parallel, experimental, and single-blinded randomised controlled trial delivered over 11 weeks. Based on the Food Literacy Wheel framework and supported by the Health Action Process Approach (HAPA) and the Behaviour Change Techniques (BCTs) Taxonomy, weekly content with customised behaviour change techniques (experimental group) is hypothesised to be more effective to promote food behaviour change when compared to a single-time and non-customised delivery of food-related international guidelines, with no theoretically informed approaches (comparison group). Primary outcome is food literacy, including food-related knowledge, skills, and behaviours, assessed with the FOODLIT-Tool; a secondary outcome includes psychological mechanisms that efficaciously predict change in participants' food literacy, measured with HAPA-driven items. Enlisted through online sources, participants will be assessed across five time points (baseline, post-intervention, and 3, 6, and 9-month follow-ups, i.e., T0–T4). A randomisation check will be conducted, analyses will follow an intention-to-treat approach, and linear two-level models within- (T0–T4) and between-level (nested in participants) will be computed, together with a longitudinal mediation analysis. If effective, the FOODLIT-Trial will provide for a multidimensional and cost-effective intervention to enable healthier and more sustainable food practices over the long term.

Keywords: Food literacy; Behaviour change; Health Action Process Approach; Randomised controlled trial; COVID-19

Introduction

Both adequate nutrition and worldwide environmental sustainability are strongly sustained by global food systems. In the last decades, imposed by diverse anthropogenic sources, such as growing population and uncertainty of global economy, food systems have been facing major alterations that have deeply impacted food consumption behaviours (FAO et al., 2019; O'Hara & Toussaint, 2021; Willett et al., 2019). Intricately linking human health and sustainability, food consumption patterns represent one of the greatest challenges of this century. Trending unhealthy meal patterns, often driven by needs of convenience and inadequate accessibility to nutritious foods, are characterised as high in caloric value, excessively processed, and rich in animal source foods (Rosas et al., 2019; Willett et al., 2019). Leading to over 2 billion adults with overweight or obesity and a global prevalence of non-communicable diseases such as diabetes, unhealthy diets pose a greater risk to morbidity and mortality than those of unprotected sex, alcohol, tobacco, and drug use combined (GPAFSN, 2016; Willett et al., 2019). Moreover, with the global public health pandemic of COVID-19, food consumption behaviours are demonstrating an increased pattern of unhealthier diets during home confinements and other related restrictions across diverse countries (Ammar et al., 2020).

Additional to increasing the burden of food-related diseases, these unhealthy dietary trends also play a crucial role in environmental degradation (Springmann et al., 2016; Tilman & Clark, 2014). Food regimes identified as lose–lose diets – characterised by being both unhealthy and environmentally unsustainable – are not only described as high in saturated fats, added sugars, and red meats, but also represent a higher environmental burden, being associated with the transformation of natural ecosystems into croplands and threatening biodiversity with species' extinction (Tilman et al., 2017). With 40% of global land occupied by agriculture, and food production being accountable for up to 70% of freshwater use and 30% of worldwide greenhouse-gas emissions, a change in the global food system is needed to minimise its impact on both human health and environmental sustainability (Foley et al., 2005; Steffen et al., 2015; Vermeulen et al., 2012; Willett et al., 2019).

A shift towards improved nutrition and more sustainable food systems has been a concern to the international community, represented by global agendas such as the Sustainable Development Goals integrated within the 2030 Agenda (UN, 2015), its Food Systems Summit (UN, 2021), and the Decade of Action on Nutrition (UN, 2022). However, this shift will not

thrive without a simultaneous bottom-up transformation; it is crucial that people change how they view, understand, and engage with food systems, ultimately changing their food-related knowledge, competencies, and behaviours – that is, their food literacy (Rosas et al., 2019; Rosas et al., 2021; Rosas et al., 2022; Willett et al., 2019).

Food Literacy

Designated as crucial to protect the quality of diets across the lifespan, food literacy has been gaining prominence across research, practice, and policy during the last decade (Cullen et al., 2015; Perry et al., 2017; Slater et al., 2018; Thomas et al., 2019; Vettori et al., 2019; Vidgen & Gallegos, 2014). Generally seeking to improve nutrition knowledge and food-related skills, most programmes and interventions developed within the scope of food literacy either (i) exclusively feature nutrition information (Rawl et al., 2008; Rothman et al., 2006; West et al., 2020), (ii) are targeted towards younger populations and often developed in an educational context (Kelly & Nash, 2021; Powell & Wittman, 2018; Thomas & Irwin, 2011; Truman et al., 2017; Wickham & Carbone, 2018), and/or (iii) narrowly focus on preparation or cooking skills, not emphasising other food-related competencies (e.g., planning, acquisition; Brooks & Begley, 2014; Rawl et al., 2008; Slater et al., 2018; Thomas & Irwin, 2011). More importantly, current interventions do not provide for knowledge to face the complexity of today's food environment, nor the competencies to deal with it and navigate within aiming for healthier food patterns; consequently, food-related behaviour change is limited (Brooks & Begley, 2014).

Acknowledging the intertwined relation among food system stakeholders and individuals' food literacy, and its relevance in order to tackle major challenges concerning global sustainability, this team developed the Food Literacy Wheel (Rosas et al., 2021) and the FOODLIT-Tool (Rosas et al., 2022). The first is a conceptual and empirical framework of food literacy, comprehending not only the set of food-related knowledge, competencies, and behaviours but also its determinants (such as convenience and practicality, time and financial management, access to food information, and professionals' unpreparedness on food-related expertise) and influential factors (psychological and learning surroundings, policy and industry settings, sustainability and social contexts, among others). The second concerns a validated and reliable instrument to assess the food literacy of adults based on the Food Literacy Wheel; this quantitative measure allows for its own tailoring to diverse contexts and

intends to evaluate one's food literacy, its determinants, and influential factors, as a resource to promote behaviour change towards more healthier and sustainable food habits.

Aiming to make a contribution for the development of food-related competencies, attainment of healthier eating habits and achievement of more sustainable practices within one's diet, the FOODLIT-Trial will integrate both the Food Literacy Wheel and the FOODLIT-Tool on a digital intervention to promote food literacy and sustainability behaviours in adults.

Digital Interventions to Promote Behaviour Change

The use of technology within the daily life of developed countries' population has gained particular relevance in recent years, being even more emphasised by the current COVID-19 global pandemic. With almost 90% of European households having online access and more than 70% adults affirming the use of online resources on an everyday basis, studies conducting digital interventions aiming for behaviour change have become widespread (European Commission, 2021; Eurostat, 2022; Hedin et al., 2019). Particularly in the scope of health promotion, food consumption has been one of the most mainstream topics for the use of digital technologies; accounting for daily activities, the potential for food-related behaviours (such as purchasing, cooking, or eating) to be changed through digital solutions, such as web-based self-guided programmes and smartphone applications, is significantly appealing (Hedin et al., 2019; Yardley et al., 2016). However, with the increase in digital interventions for the promotion of food-related healthier and sustainable behaviours, various trends have emerged. Within the theme of food sustainability, targeted behaviours have mainly focused on the reduction of food waste (Comber & Thieme, 2013; Pohl et al., 2017; Woolley et al., 2016; Young et al., 2017); food-related competencies, purchasing, and cooking have been the most recurrent aimed behaviours (Begley et al., 2017; Harrington et al., 2019; Reicks et al., 2018). The predominance of programmes targeted at younger populations (dos Santos Chagas, et al., 2020; Serebrennikov et al., 2020) or specific to clinical conditions (Hutchesson et al., 2015; Young et al., 2021) is also notorious. Particularly concerning food literacy, the use of digital tools to promote food-related knowledge, competencies, and behaviours is still taking its first steps; either featuring technology or not, the prevalence of a younger target across food literacy interventions and programmes is evident (Brooks & Begley, 2014; Thomas et al., 2019; Wickham & Carbone, 2018a; Wickham & Carbone, 2018b). More recently, however, the adult population has been targeted in research-based

interventions (Begley et al., 2019a; Begley et al., 2019b; Begley et al., 2020; Dumont et al., 2021) , and digital resources remain scarce in the field.

Another noticeable characteristic of digital interventions to promote for healthy, sustainable, and knowledgeable food-related behaviours is the lack of clear theoretical backdrop to sustain behavioural change. The majority of these studies are scarcely grounded on a behavioural change theory (Comber & Thieme, 2013; Woolley et al., 2016); most report an increase in participants' awareness but do not explore longitudinal and evidence-based behaviour change (Hedin et al., 2019). Limitations of previous studies include lack of baseline data, lack of control or comparisons group, and lack of longitudinal follow-up data (Hedin et al., 2019; Reicks et al., 2018; Begley et al., 2019).

Addressing the promotion of food-related knowledge, competencies, and behaviours through a digital and online intervention, the FOODLIT-Trial is grounded in the HAPA (Schwarzer, 2008; Schwarzer & Luszczynska, 2015) and applies behaviour change techniques from a consensual taxonomy (BCTs Taxonomy; Michie et al., 2013), aiming to lead to effective and sustained food behaviour change.

Study Objectives and Hypothesis

This study presents the detailed research protocol of a randomised controlled trial (RCT) to assess the efficacy of a web-based intervention in enhancing adults' food literacy, using (i) digital evidence-based resources, (ii) BCTs (Michie et al., 2013), and (iii) the HAPA framework (Schwarzer, 2008; Schwarzer & Luszczynska, 2015) as a theoretical backdrop.

The study's primary objective is to evaluate whether the developed digital intervention is effective in improving food-related knowledge, competencies, and behaviours, based on the Food Literacy Wheel (Rosas et al., 2021) and evaluated with the FOODLIT-Tool (Rosas et al., 2022). Potential differences in participant's food literacy over time will also be assessed with a longitudinal design. We hypothesise that the use of a web-based intervention combined with behavioural change strategies (customised to each food-related skill) will be more effective to enhance food literacy than the approach used with the comparison group (single-time delivery of non-customised food-related national and international guidelines, without any additional theoretically informed, evidence-based behaviour change approaches). The second objective is to understand the intervention performance, by evaluating which psychological mechanisms, such as self-efficacy, planning, and action control (Schwarzer, 2008; Schwarzer

& Luszczynska, 2015), efficaciously determine change in participants' food literacy. It is hypothesised that HAPA-derived mechanisms will significantly mediate the participants' outcomes concerning food literacy.

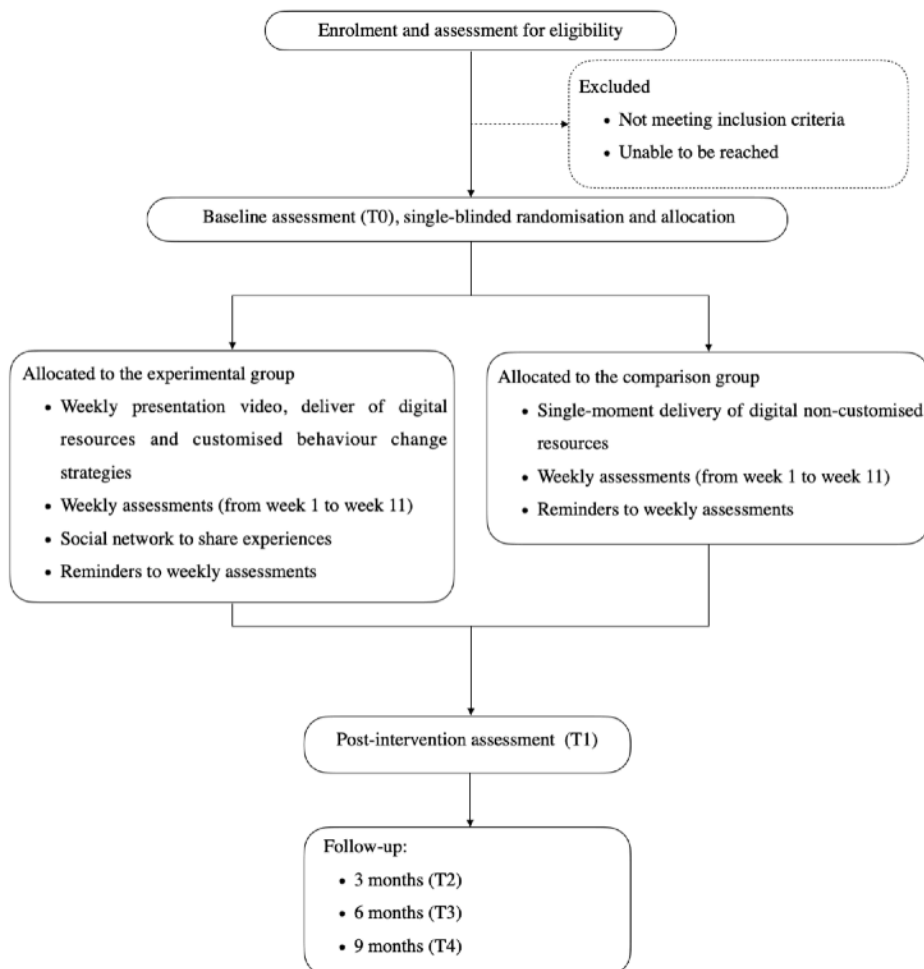
Method

Trial Design

The FOODLIT-Trial is a two-arm (allocation ratio 1:1), parallel, experimental, and single-blinded randomised controlled trial for Portuguese adults (Figure 5). The web-based intervention is delivered over 11 weeks, where each week is themed with content either according to the Food Literacy Wheel framework or to the HAPA model.

Figure 5

Flowchart of the FOODLIT-Trial intervention, including both experimental and comparison groups



In conformity to the week's thematic, each ability, skill, and behaviour is matched with a behavioural change strategy to facilitate its implementation (Michie et al., 2013). All measures will be assessed at five time points: baseline (T0), to measure baseline characteristics, pre-intervention, before randomised allocation, and prior to the trial's first week; post-intervention (T1); one week after the 11-week intervention delivery; and at follow-up times 3, 6, and 9 months after the intervention (T2, T3, and T4, respectively).

This protocol adheres to the Consolidated Standards of Reporting Trials (Moher et al., 2010) guidelines for randomised controlled trials.

Ethical approval

As part of a major project titled FOODLIT-PRO: Food Literacy Project, this study was approved by the Ethics Committee of Ispa – Instituto Universitário (ref. D/002/03/2018). The FOODLIT-Trial was developed according to the Declaration of Helsinki, followed the deontological norms and ethical principles of the Order of Portuguese Psychologists (2011), and adhered to General Data Protection Regulation (Lei da Proteção de Dados Pessoais n.º 58/2019, 2019). This protocol was approved and registered by ClinicalTrials.gov (NCT04806074).

Participants and recruitment

Considering its web-based format, FOODLIT-Trial's potential participants will represent a sample of convenience and snowballing, and will be reached and enlisted through online sources. Online reach out will be made by using both advertisements in social media websites according to the researcher's network (Instagram and Facebook) and a developed website for participants' enrolment. During the recruitment stage, potential participants will be informed that trial participation will entail compensation in order to acknowledge their time and effort dedicated to the study. An a priori power analysis was conducted with G*Power (version 3.1), and a minimum sample size of 28 was necessary in order to detect a medium effect size (Cohen's $d = 0.50$) at the 5% level of significance with 95% power, with the assumption of the non-violation of sphericity (non-sphericity correction $\epsilon = 1$) considering the trial's repeated-measures design. Given a potential attrition rate of 50% due to the digital nature of the trial, its duration, and required weekly assessments, a minimum of 56 participants will be recruited.

Participants for the FOODLIT-Trial must (i) be adults aged 18 years or older, (ii) be able to understand and read Portuguese, (iii) have availability to engage in the 11-week trial, and have internet access that allows for their engagement, (iv) be responsible for, at least, one out of four tasks in their food routine (encompassing choice and decision, selection and acquisition, preparation, and cooking, according to Vidgen & Gallegos, 2014). Potentially eligible participants will be invited to the trial through an online information sheet, and will be provided with the consent form (Appendix 6); if eligible, the baseline questionnaire (T0) will be made available and delivered online. Additionally, all participants will be asked to complete a sociodemographic questionnaire aiming to collect self-reported data concerning sociodemographic and health-related characteristics (e.g., sex, age, educational level, diagnosed diseases, height, weight; Appendix 7).

Randomisation and Blinding

Consenting participants meeting inclusion criteria will be randomised and allocated to either the experimental group (EG) or the comparison group (CG), following the baseline period. At baseline, each participant will create a unique code (based on the name's initials and year of birth) to allow for longitudinal correspondence along the different time points. Randomisation will then be performed using a computer-generated random 1:1 allocation list. Knowledgeable concerning the specifications of the trial arms in the consent form, all participants will also be informed that both groups will (i) be contacted weekly to take part in every assessment, (ii) receive the same online reminders through digital sources (email and WhatsApp), and (iii) be featured in the compensation mechanism. As such, randomisation results will be concealed from participants at all moments. It will not be possible to apply this to the primary researcher of the study (RR), given her responsibility to create and deliver the weekly customised resources to the EG. Thus, the FOODLIT-Trial's allocation will be single-blinded for its participants.

Intervention

The FOODLIT-Trial is an online-enabled intervention to promote food literacy and food sustainability practices delivered with digital evidence-based resources in multiple formats, based on theoretically informed behaviour change approaches, and made available through mobile phone, tablet, and computer. The intervention will include weekly reminders for participants to evaluate their food-related knowledge, competencies, and behaviours, and

assess related psychological mechanisms associated with behaviour change. Experimental and comparison group specifications are described below.

Experimental Group

Participants allocated to the EG will receive weekly information concerning a specific theme through digital sources such as videos, infographics, and web-directed links. The 11-week intervention is designed according to (a) the food-related knowledge, competencies, and behaviours belonging to the core of the Food Literacy Wheel conceptual and empirical model, and (b) the psychological mechanisms within the HAPA framework. As shown in Table 11, each week entails not only a set of skills, behaviours, and/or mechanisms that feature the above mentioned theoretical and empirical frames, but also a customised, well-defined, and identifiable BCT to prompt participants' food-related behaviour change.

Table 11

Description of the EG intervention, including (i) the weekly thematic, (ii) its correspondent frameworks, including both Food Literacy Wheel and HAPA, (iii) the instruments used for weekly assessment, entailing items either from the FOODLIT-Tool or the HAPA, and (iv) the identification of the each BCT used in across all weeks, customised to the thematic's content

Week	Framework	Instruments	Behaviour change techniques
Thematic	Variables or dimensions	Dimensions and/or items	BCTs title
Week 1	HAPA	HAPA	Total: 3 BCTs
	Action self-efficacy	Five items	(15.1) Verbal persuasion about capability
Pre-intenders	Risk perception	Three items	(5.1) Information about health consequences
	Outcome expectancies	Nine items	(9.3) Comparative imagining of future
Week 2	FLW	FOODLIT-Tool	Total: 2 BCTs
	Choice and acquisition	<i>Origin</i> Items 17 and 18	(4.1) Instruction on how to perform the behaviour

Week	Framework	Instruments	Behaviour change techniques
Thematic	Variables or dimensions	Dimensions and/or items	BCTs title
Origin and conservation	Preserve and analyse	<i>Culinary competencies</i> Item 10	(4.1) Instruction on how to perform the behaviour (6.1) Demonstration of the behaviour
Week 3	FLW	FOODLIT-Tool	Total: 4 BCTs
Prepare and adapt	Cooking Skills	<i>Culinary competencies</i> Item 1	(1.4) Action planning (4.1) Instruction on how to perform the behaviour (6.1) Demonstration of the behaviour
		Item 2	(4.1) Instruction on how to perform the behaviour
		Item 3	(15.1) Verbal persuasion about capability
Week 4	FLW	FOODLIT-Tool	Total: 3 BCTs
Cooking	Cooking Skills	<i>Culinary competencies</i> Item 4	(6.1) Demonstration of the behaviour (1.1) Goal setting (behaviour)
		Item 8	(4.1) Instruction on how to perform the behaviour (6.1) Demonstration of
Week 5	FLW	FOODLIT-Tool	Total: 1 BCT
Choice and selection	Choice and acquisition	<i>Selection and planning</i> Item 20 Item 21	(4.1) Instruction on how to perform the behaviour (in both items)
Week 6	HAPA	HAPA	Total: 3 BCTs
Intenders	Maintenance self-efficacy	Six items	(15.3) Focus on past
	Action planning	Five items	(1.4) Action planning
	Coping planning	Six items	(1.2) Problem solving
Week 7	FLW	FOODLIT-Tool	Total: 3 BCTs

Week	Framework	Instruments	Behaviour change techniques
Thematic	Variables or dimensions	Dimensions and/or items	BCTs title
Nutrition and intake	Cooking Skills	<i>Culinary competencies</i> Item 5	(6.1) Demonstration of the behaviour
	Preserve and analyse	<i>Selection and planning</i> Item 16	(2.4) Self-monitoring of outcome(s) of behaviour
	Choice and acquisition	Item 19	(6.1) Demonstration of the behaviour
	Search and plan	Item 24	(4.1) Instruction on how to perform the behaviour
Week 8	FLW	FOODLIT-Tool	Total: 4 BCTs
Planning and cooking pleasure	Cooking skills	<i>Culinary competencies</i> Item 9	(5.6) Information about emotional consequences (10.4) Social reward
	Search and plan	<i>Selection and planning</i> Item 25	(4.1) Instruction on how to perform the behaviour <i>(in both items)</i>
		Item 26	(6.1) Demonstration of the behaviour <i>(in both</i>
Week 9	FLW	FOODLIT-Tool	Total: 2 BCTs
Hygiene and safety (within production and kitchen)	Preserve and analyse	<i>Environmentally safe</i> Item 11	(4.1) Instruction on how to perform the behaviour (6.1) Demonstration of the behaviour
		<i>Production and quality</i> Item 12	(4.1) Instruction on how to perform the behaviour
		Item 13	<i>(in all items)</i>
		Item 14	(6.1) Demonstration of the behaviour <i>(in all</i>
Week 10	FLW	FOODLIT-Tool	Total: 2 BCTs
Local and seasonal	Preserve and analyse	<i>Environmentally safe</i> Item 15	(5.3) Information about social and environmental consequences
		Item 22	(4.1) Instruction on how

Week	Framework	Instruments	Behaviour change techniques
Thematic	Variables or dimensions	Dimensions and/or items	BCTs title
	Search and plan	Item 23	to perform the behaviour <i>(in both items)</i>
Week 11	HAPA	HAPA	Total: 3 BCTs
	Recovery self-efficacy	Three items	(8.7) Graded tasks (1.6) Discrepancy between current behaviour and goal (2.3) Self-monitoring of
Actors	Action control	Six items	

Participants in the EG will receive weekly (A) evidence-based and customised information related to a specific skill, behaviour, and/or mechanism, from sources such as national and international guidelines - namely, the Portuguese Directorate-General for Health ([DGS]; DGS, 2020; Gregório et al., 2012; DGS & PNPAS, 2020) and the EAT-Lancet Commission on Food, Planet, Health (EAT-Lancet Commission, 2020); (B) designated tasks based on each behaviour change technique and related to the week's thematic; (C) a short introductory video, featuring the research coordinator, briefly mentioning the week's thematic and alerting to the week's assessment; (D) notifications reminding the need to respond to the week's questionnaire (two days before the end of the week and the day of the due date for questionnaire response) and the corresponding link leading to the week's questionnaire. All materials, except for the weekly questionnaires, will be stored in a purposely created website, allowing for participants to revisit previous weeks' resources (if desired). Shown in Table 12 is two-week example of (A) a customised infographic, (B) its associated task based on a behaviour change strategy, and (C) its corresponding items. All visual resources are featured in Appendix 13.

Table 12

Example of the FOODLIT-Trial's EG Week 4 (themed Cooking) and Week 11 (themed Actors), entailing (A) customised infographics, (B) its associated tasks, presented within the infographics and reflecting the behaviour change strategies applied, and (D) corresponding items, to be responded in the end of the week

Week 4 - Cooking

Customised infographics (A) and its associated tasks (B), reflecting the behaviour change strategies applied.



Corresponding items (D), to be responded in the end of the week.

Item 4

I use kitchen equipment and utensils (e.g., oven, blender) efficiently.

Four-point Likert-type response scale (0 - never; 1 - sometimes; 2 - frequently; 3 - always).

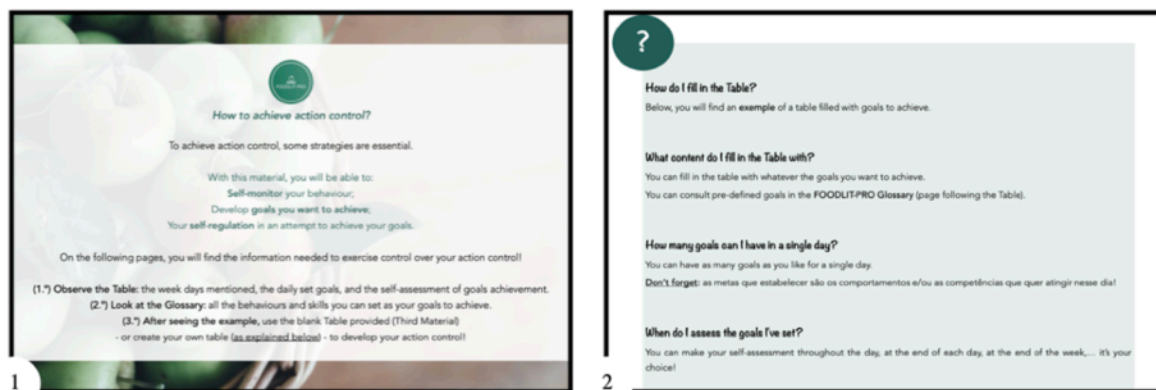
Item 8

I cook in different ways (e.g., stewing, baking).

Four-point Likert-type response scale (0 - never; 1 - sometimes; 2 - frequently; 3 - always).

Week 11 - Actors

Customised infographics (A) and its associated tasks (B), reflecting the behaviour change strategies applied.



How to fill in the table

fill in at the beginning of each day or at the beginning of the week

evaluate at the end of each day or at the end of the week

My weekly goals	What I want to do is...	My assessment of what I did
Monday	Plan my meals in advance (Week 8) Cooking in different ways (Week 4)	✓ ✗
Tuesday	Replace one food with another nutritionally equivalent (Week 7)	✓
Wednesday	Controlling the calories of what I ate (Week 7)	✗
Thursday	Apply hygiene and food safety practices (Week 9)	✓
Friday	Recognise the origin of a food (Week 2)	✓
Saturday	Combine different ingredients to create a suitable meal (Week 3)	✗
Sunday	Dedicate time and investing in food selection (Week 5)	✗

3

Here you can download the table

My weekly goals	What I want to do is...	My assessment of what I did
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		
Saturday		
Sunday		

4

GLOSSARY

What are the behaviours or skills I want to achieve ?

- Identify the **origin** of a food (Week 2)
- Identify how a food is **produced and processed** (Week 2)
- Using different types of **preservation** (e.g., freezing, salting) (Week 2)
- Prepare** everything that is necessary to make a meal (Week 3)
- Combine different ingredients to create a suitable meal (Week 3)
- Adapt** recipes to be more to my taste (Week 3)
- Use different kitchen equipment and utensils (Week 4)
- Cook** in different ways (e.g., stewing, baking) (Week 4)
- Dedicate time and investing in food **selection** (Week 5)
- Make informed food **choices** (Week 5)

5

GLOSSARY

What are the behaviours or skills I want to achieve ?

- Control** the calories and/or other nutritional characteristics of the food I eat (Week 7)
- Substitute a food for another that is **nutritionally equivalent** (Week 7)
- Cook adequate meals with what I usually have at home (Week 7)
- Read and interpret **food labels** to select the most appropriate foods (Week 7)
- Enjoy **cooking** as a pleasurable activity (Week 8)
- Planning** various aspects of my diet (Week 8)
- Planning my meals **in advance** (Week 8)
- Apply **hygiene and food safety** practices (Week 9)
- Recognising the **impact of organic products** (Week 9)
- Consume products from **local / national trade** (Week 10)
- Identify a food's **seasonality** (Week 10)
- Eat food **according to its seasonality** (Week 10)

6

GLOSSARY

What are the behaviours or skills I want to achieve ?

- Identify the **origin** of a food (Week 2)
- Identify how a food is **produced and processed** (Week 2)
- Using different types of **preservation** (e.g., freezing, salting) (Week 2)
- Prepare** everything that is necessary to make a meal (Week 3)
- Combine different ingredients to create a suitable meal (Week 3)
- Adapt** recipes to be more to my taste (Week 3)
- Use different kitchen equipment and utensils (Week 4)
- Cook** in different ways (e.g., stewing, baking) (Week 4)
- Dedicate time and investing in food **selection** (Week 5)
- Make informed food **choices** (Week 5)

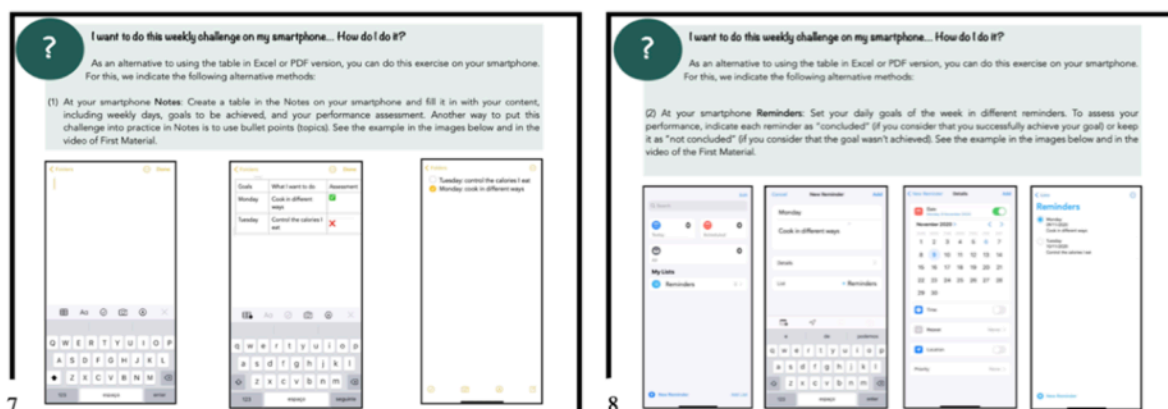
5

GLOSSARY

What are the behaviours or skills I want to achieve ?

- Control** the calories and/or other nutritional characteristics of the food I eat (Week 7)
- Substitute a food for another that is **nutritionally equivalent** (Week 7)
- Cook adequate meals with what I usually have at home (Week 7)
- Read and interpret **food labels** to select the most appropriate foods (Week 7)
- Enjoy **cooking** as a pleasurable activity (Week 8)
- Planning** various aspects of my diet (Week 8)
- Planning my meals **in advance** (Week 8)
- Apply **hygiene and food safety** practices (Week 9)
- Recognising the **impact of organic products** (Week 9)
- Consume products from **local / national trade** (Week 10)
- Identify a food's **seasonality** (Week 10)
- Eat food **according to its seasonality** (Week 10)

6



Corresponding items (D), to be responded in the end of the week.

Recovery self-efficacy (three items)

I believe that I could return to having a diet adequate to my needs, even if:

- (1) *I had spent a few days without doing so.*
- (2) *I had spent many days without doing so.*
- (3) *I had spent a few weeks without doing it.*

Action control (six items)

- (1) *I have evaluated regularly when, where and how I am making an adequate diet suited to my needs.*
- (2) *I have assessed my behaviour daily to check if I am having an adequate diet.*
- (3) *I am always aware of the diet that is adequate to my needs.*
- (4) *I have always in mind the intention to make a diet adequate to my needs.*
- (5) *I have worked hard to have a diet that meets my needs on a regular basis.*
- (6) *I have been making the effort to have an adequate diet as much as I intend to.*

Comparison Group

Participants allocated to the active CG will receive a single-time and non-customised delivery of the same food-related national and international guidelines. There will be no theoretically informed approach and no behaviour change techniques, and the delivered content will generically regard nutritious eating and food-related habits. No digital presence of the research coordinator will be featured to the CG (that is, no weekly introductory videos will be sent to this cohort). Additionally, to the (A) single-time (but non-customised) delivery of informative guidelines from the same entities, the CG will receive (D) the identical notifications serving as reminders for the weekly questionnaires (identical to the

questionnaires delivered to the EG). Similarly to the EG, the guidelines will be stored in a specifically designed website, providing for uninterrupted access.

Adherence and Strategies to Minimise Drop-Out

To encourage intervention adherence and engagement, weekly reminders will be sent to participants of both EG and CG via email and/or WhatsApp. At the beginning of each week, the reminder will be sent via WhatsApp, notifying participants that a new week of FOOLIT-Trial is starting and that the weekly welcoming email was sent; for the EG, a link enabling the access to the week's resources (A, B, and C) will be featured, while CG participants will be reminded of the access to where guidelines are stored (non-customised A). Two days before the end of each week, an email will be sent in the morning with the link leading to the week's questionnaire; a notification through WhatsApp will be delivered later that day reminding that the link for questionnaire response is already available. At the due date for the weekly response, a final reminder will be sent through WhatsApp, indicating that the questionnaire will be available until the end of that day.

Additionally, as a strategy to minimise drop-out and to prompt continuous engagement, compensation will be featured within the FOODLIT-Trial. Compensation will entail the following randomised allocations of gift cards to participants for grocery shopping: (i) one gift card at the end of the 11-week intervention (with a credit of 50 EUR), (ii) a gift card at the end of the first and second follow-up (T2 and T3; a total of two gift cards with a credit of 25 EUR each), and (iii) two gift cards at the end of the last follow-up (T4; each gift card with a credit of 50 EUR).

Outcomes

Primary Outcome Measure

Considering FOODLIT-Trial's first aim, the primary outcome to be assessed is food literacy. Food-related knowledge, competencies, and behaviours will be assessed with the FOODLIT-Tool (Rosas et al., 2022) at baseline (T0), during the 11-week intervention (with the items distributed across the theme for the week; Table 1), post-intervention (T1), and at all follow-ups (T2, T3, and T4). These longitudinal assessments will evaluate participants' food literacy according to the five dimensions portrayed in the instrument (Culinary Competencies, Production and Quality, Selection and Planning, Environmentally Safe, and Origin) and based on the FLW (Rosas et al., 2021). These include (i) theoretical knowledge, such as knowing

various types of food preservation suitable to different foods (item 10); (ii) practical competencies, as interpreting food labels to select adequate foods (item 19); and (iii) food habits and behaviours, such as eating foods according to their seasonality (item 22). All items are assessed with a four-point Likert-type response scale, concerning either frequency (0 - *never*; 1- *sometimes*; 2- *frequently*; 3- *always*) or agreement (0- *completely disagree*; 1 - *disagree*; 2 - *agree*; 3 - *completely agree*). The FOODLIT-Tool is available in both English and Portuguese in Appendices 11 and 12, respectively.

Secondary Outcome Measure

Aiming to explore intervention performance, FOODLIT-Trial's second aim is to evaluate which psychological mechanisms efficaciously predict change in participants' food literacy. To achieve this objective, psychological mechanisms derived from the HAPA – including risk perception, outcome expectancies, self-efficacy, planning, and action control – will also be assessed at similar time points (from T0 to T4). All measures to evaluate HAPA constructs are adapted from Sniehotta, Scholz, and Schwarzer (2005) and are specific to food literacy, depicting eating according to one's needs as the intended behaviour (Appendix 2). All items are also assessed with four-point Likert-type response scales, regarding agreement (0 - *totally disagree*; 1 - *disagree*; 2 - *agree*; 3 - *totally agree*) and possibility (0 - *very unlikely*; 1 - *unlikely*; 2 - *likely*; 3 - *very likely*).

Statistical Analyses

Randomisation Check, Drop-Out Analyses, and Intention to Treat

A randomisation check will address equal distributions of all baseline measures of all primary and secondary outcomes and covariates across conditions using multivariate analyses of variance interval–scale data, and chi-square tests for nominal and ordinal-scale data. Analyses will be carried out in an intention-to-treat manner, accounting for missing values using the full information maximum likelihood approach (Graham, 2009). Drop-out analyses will test baseline differences between continuers and non-continuers in all variables using t-tests, chi-square tests, or logistic regression.

Hypotheses Tests for Intervention Effects

Linear two-level models with five time points (T0, T1, T2, T3, T4; within-level) nested in participants (between-level) will be computed. For each outcome measure, time (linear day trend, centred at 0) x experimental condition (0 = comparison condition; 1 =

intervention condition) interactions will be estimated. Moreover, grand-mean centred covariates (e.g., sex, age) will be added as between-level predictors. The linear time trend and the linear time trend x experimental condition interaction will be modelled as fixed effects.

Examining Intervention Mechanisms

To explore the assumptions of the HAPA framework, a series of longitudinal mediation analyses will be conducted using manifest or latent path analyses. Experimental condition will be specified as a dummy-coded independent variable, proposed cognitive mechanisms as mediators, and food literacy factors as the outcomes (with or without control for respective baseline assessments). Because of the flexible conceptual framework of HAPA, reasonable time points (T1–T4) will be explored to identify the most useful mediators (e.g., self-efficacy, outcome expectancies, behavioural intention, planning) within the entire time span of the study. Bias-corrected bootstrap confidence intervals (95%) of direct and indirect effects will be generated by bootstrapping with 5000 re-samples.

Dissemination Plan

The study protocol is the first publication of this RCT. Findings of this RCT will be published in peer-reviewed international journals and at national and international conferences. Dissemination of results in journals will comply with the Consolidated Standards of Reporting Trials. Important protocol modifications will be reported.

Conclusions

By introducing the research protocol of a RCT that aims to evaluate the efficacy of a digital intervention to promote adults' food literacy, this study highlights not only the use of web-based resources to tackle food-related competencies and behaviours, but also addresses the need to design and apply a trial based on strong theoretical foundations linked to health behaviour change. We hypothesise that the support allowed by the delivery of digital materials entailing behavioural change strategies customised to food literacy-related information will improve food knowledge, competencies, and behaviours. A secondary hypothesis is that mechanisms acknowledged as part of a theoretical background to promote behaviour change will mediate these food literacy outcomes. To achieve the hypothesised outcomes, this team developed an 11-week plan that (A) gathers evidence-based resources based on national and international guidelines, (B) designates specific and diversified tasks based on behaviour change techniques, (C) provides for a multiple thematic, and (D) shares online notifications.

Presenting the first known randomised digital intervention to integrate behavioural strategies, based on a validated taxonomy and a theoretical framework of behaviour change in the field of food literacy, the FOODLIT-Trial intends to contribute to the promotion of healthier and more sustainable food habits during a global public health pandemic. With growing evidence on the impact of the COVID-19 pandemic on consumers' food patterns and worldwide food security (Laborde et al., 2020; O'Hara & Toussaint, 2021; The World Bank, 2021), it is urgent to provide for mechanisms that promote positive change on food-related competencies and behaviours, while providing for strategies that guide one's navigation within this transformative food system. Accounting for a specific web-based platform for the delivery of digital resources and integrating online communication throughout the intervention, the FOODLIT-Trial transforms extensive international recommendations into thematic weekly challenges with the expectation to advocate for more informed food knowledge and more adequate and sustainable eating habits in adult samples. If effective, this intervention – along with its assessments of the FOODLIT-Tool and its conceptual basis from the Food Literacy Wheel – has the potential to be adapted and applied across multiple professional contexts, allowing for a digital cost-effective resource that promotes healthier and more sustainable food habits according to international guidelines.

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Chapter 6

Intervention Effects and Psychological Mechanisms of the FOODLIT-Trial

This chapter is based on the paper

Rosas, R., Pimenta, F., Leal, I., & Schwarzer, R. (submitted). FOODLIT-Trial: Can food literacy be improved by a digital intervention during a pandemic? Null findings and psychological mechanisms of a randomised controlled trial.

Abstract

Striving for a change in consumers' food patterns, education towards more knowledgeable, healthier, and sustainable food habits is essential. This study presents the results of the FOODLIT-Trial, a web-based randomised controlled trial to promote food literacy in Portuguese adults, based on the Food Literacy Wheel, using Behaviour Change Techniques (BCTs), and theoretically anchored in the Health Action Process Approach (HAPA). Cognitive mechanisms theoretically driven were also explored as mediators. A total of 99 adults (experimental condition) received weekly digital content via email (evidence-based guidelines themed with food-related knowledge, competencies and behaviours or HAPA cognitive determinants, customised with BCTs), and 105 adults (comparison condition) received a single-time delivery of non-customised guidelines, with no theoretically informed approach used and no BCTs applied. Five longitudinal assessments of food literacy and cognitive determinants were obtained. Mixed effect models for intervention effects demonstrated no significant outcomes on time x condition interaction. Motivational and volitional factors, namely intention, action planning, and action control were found to predict skills of selection and planning, culinary competencies, environmental concerns and food safety practices. Three sequential mediation models were found to be significant, affirming the facilitating role of self-efficacy and both action and coping planning towards food literacy competencies. The FOODLIT-Trial represents the first digital strive to enhance food literacy by promoting behaviour change towards more adequate food-related habits. Paving the way in the field, this trial provides for valuable insights on the development of a web-based and theoretically supported intervention aiming to promote adults food literacy, and confirms the important role of cognitive mechanisms in the path of food-related behavioural change.

Keywords: food literacy; behaviour change; behaviour change techniques; Health Action Process Approach; randomised controlled trial; COVID-19

Introduction

With more than two billion adults suffering from overweight and obesity worldwide, unhealthy dietary patterns and associated diseases are increasing trends. Simultaneously, widespread undernutrition is still prevalent with over 800 million people remaining undernourished and more than two billion presenting micronutrient deficiency (Willett et al., 2019). The most recent data shows that around 68% of the adult Portuguese population are overweight (pre-obesity or obesity), with a growing tendency for both overweight and obesity between 2005 and 2019 (Instituto Nacional de Estatística, 2021; Instituto Nacional de Estatística & Instituto Nacional de Saúde Doutor Ricardo Jorge, 2009). As one of the main causes for non-communicable diseases, unhealthy dietary patterns are part of the top five risk factors for morbidity and mortality in Portugal (Institute for Health Metrics and Evaluation, n.d.). Additionally to the health burden, unhealthy diets also play a key role on environmental matters. Diets high in saturated fats, added sugars, and red meats are considered environmentally unsustainable for threatening biodiversity with the extinction of species and due to its impact on the transformation of natural ecosystems into croplands (Tilman et al., 2017). To tackle these food-related challenges, measures are being taken to improve food environments for more healthier choices. Within the last five years, Portugal has implemented an excise tax on sugary drinks, continuously monitored digital food marketing aimed particularly at children, and prompted commitments for the reformulation of food products, among other policy-oriented measures (PNPAS, 2019).

However, the worldwide COVID-19 pandemic has also been reported to make an impact not only on food systems and environments — with increased global food insecurity — but also on consumers' food habits (UN, 2020). A national survey with almost 5.000 Portuguese adults was conducted between 2020 and 2021, aiming to evaluate their eating habits during the first 12 months of the pandemic. In total, 36.8% of the participants reported a change in their eating habits (DGS et al., 2021). From these, almost 42% admitted to currently have poorer eating routines, with an increase on the amount of foods eaten (25%) and on the number of meals (18%), as well as an increase in the frequency of snacking between meals (23%). Main reasons for this transformation in eating habits included appetite alterations motivated by emotional aspects with an increased hedonic hunger, and a change in the frequency of grocery shopping trips. Consequently, almost 36% of the respondents also reported the perception of increased body weight during the first year of the pandemic.

Whether aiming at nutritional status improvement or environmentally sustainable food patterns, striving for a shift in consumers' food habits also requires a bottom-up approach. With food environments constantly saturated by highly processed, ready-to-eat, low-cost foods with poor nutritional value, educating and empowering consumers to navigate towards more adequate and sustainable food habits is essential (Swinburn et al., 2011; WHO Regional Office for Europe, 2014). Aiming to contribute to the improvement of adults' food-related knowledge, competencies, and behaviours within the scenario of a pandemic, this study presents the results of the FOODLIT-Trial — a web-based randomised controlled trial to enhance adults' food literacy, based on the Food Literacy Wheel (Figure 2, in Chapter 3) and using the FOODLIT-Tool as the main assessment instrument (Rosas et al., 2020; Rosas et al., 2022a). Promoting healthier and more sustainable food-related practices with an exclusively digital approach during the COVID-19 pandemic, the FOODLIT-Trial's published protocol provides an updated conceptual and empirical overview on both the construct of food literacy (according to the Food Literacy Wheel) and the state of art on digital interventions to promote behaviour change (Rosas et al., 2022b). Intending to achieve effective dietary behaviour change and its maintenance, this trial used BCTs from a consensual taxonomy (Michie et al., 2013) and the HAPA framework (Schwarzer, 2008; Schwarzer & Luszczynska, 2015) as theoretical underpinnings.

Behaviour Change Techniques

Described as the 'active ingredients' of interventions, BCTs are the most specific components of behaviour change interventions that carry the potential to transform behaviour. Aiming to synthesise these specific contents into a comprehensive and cross-context taxonomy that could strengthen the interventions' efficacy, the BCT Taxonomy v1 was developed with a series of consensus exercises entailing experts from diverse disciplines and countries (Michie et al., 2013). Organised hierarchically, this taxonomy groups BCTs according to an inductive 'bottom-up' methodology based on the comparability of these active ingredients. This resulted in 16 distinct and higher-order sets of BCTs (with the number of BCTs presented in brackets): Goals and planning (9), Feedback and monitoring (7), Social support (3), Shaping knowledge (4), Natural consequences (6) and Scheduled consequences (10), Comparison of behaviour (3) and of outcomes (3), Associations (8), Repetition and substitution (7), Reward and threat (11), Regulation (4), Antecedents (6), Identity (5), Self-belief (4), and Covert learning (3). Within each set of BCTs, a label for each technique is

presented (e.g., *Self-monitoring of behaviour*, belonging to Feedback and monitoring), a definition of the BCT is given (e.g., *Self-monitoring of behaviour*: ‘Establish a method for the person to monitor and record their behaviour as part of a behaviour change strategy’), and one or two examples of its application on a health-related context are provided (e.g., *Self-monitoring of behaviour*: Ask the person to record daily, in a diary, whether they have brushed their teeth for at least two minutes before going to bed). These comprehensive and reliable key ingredients help specifying, evaluating and implementing behaviour change interventions and allow for their precise report and replication. Furthermore, the taxonomy’s hierarchical structure enables the processing of significant amounts of information by organising it into smaller sets, which allows to easily recall the range of BCTs when developing and reporting interventions (Michie et al., 2013).

Although some indications of what potential combinations of BCTs could work best on changing eating habits — such as the combination of self-monitoring strategies with other techniques — experimental research on exploring the efficacy of single BCTs or combinations of BCTs is still scarce (Michie et al., 2009; Peters et al., 2015; Schroé et al., 2020). With the unclear efficacy of the use of BCTs in web-based interventions and the lack of its study within the field of food literacy, research integrating these active ingredients into experimental and digital studies is needed. To prompt food-related behaviour change, this trial featured diverse BCTs specifically appointed to each ability, competency and behaviour implemented along the intervention.

Health Action Process Approach

Requiring more than a single act of will, changing health-related behaviours entails motivational and volitional factors that can lead the course to self-regulatory mechanisms. Despite the need to form an explicit behavioural intention, such intentions often fall short to the translation into corresponding behaviours. The HAPA framework (Figure 1) provides a framework of the description, explanation and prediction of health-related behavioural change (Schwarzer, 2008; Schwarzer & Luszczynska, 2015). Differentiating pre-intentional motivation processes from post-intentional volition factors, the HAPA describes a set of cognitive mechanisms that allow to predict change while emphasising the contribution of volitional factors to the intention-behaviour gap (Sheeran, 2002). Within the motivational stage, (i) risk perception, (ii) outcome expectancies, and (iii) action self-efficacy describe the pre-intender stage. Transitioning from deliberation into action, the volitional stage portrays

both intenders and actors — that is, individuals who have not yet turned their intentions into practice and those who have. Thus, the volitional stage aggregates the mechanisms of (iv) maintenance and (v) recovery self-efficacy, (vi) action and (vii) coping planning, and (viii) action control.

Though not necessarily impacting intention for its limited influence as a predictor, (i) risk perception entails the perception of a health threat, with personal perceptions having a greater significance than general acknowledgments. Representing the association between one's actions and their consequent outcomes, (ii) outcomes expectancies are identified as influential beliefs in the motivation to achieve change and often underline that one knows what actions to take in order to produce the desired results. Referring to the personal belief on one's capabilities to master challenging demands, self-efficacy is significant at every stage of behavioural change. The HAPA framework distinguishes three types of self-efficacy: (iii) action, (iv) maintenance, and (v) recovery self-efficacy. Action self-efficacy pertains to the initial phase of the process, where the individual develops the motivation to act, prior to performing the action itself. Maintenance self-efficacy portrays the personal conviction to deal with potential obstacles that may emerge during the maintenance period. Finally, recovery self-efficacy is associated with the experience of failure and consequent readjustment, referring to one's confidence in resuming the course after setbacks. Since having strategies on how to perform a challenging task increases the chances of turning intention into action, planning is crucial to the volitional stage; while (vi) action planning refers to generating a detailed plan to perform a behaviour, (vii) coping planning entails the anticipation of potential obstacles and the development of alternative behaviours to overcome them. Along with planning, (viii) action control is also a self-regulatory strategy, with the difference between them being that the first is a prospective mechanism while the latter is a concurrent strategy. Action control refers to the constant evaluation of one's behaviour in regards to a behavioural standard, entailing self-monitoring, awareness of standards, and self-regulatory effort (Schwarzer, 2008; Schwarzer & Luszczynska, 2015).

As a framework widely used in behavioural health contexts (Zhang et al., 2019), HAPA has been applied in order to study not only predictors of intention and behaviour but also to explore potential mediators that may bridge the intention-behaviour gap (Schwarzer, 2008; Schwarzer & Luszczynska, 2015). However, theoretical support within experimental and longitudinal digital research is scarce, with most of the studies lacking a foundation on

behavioural change theory (Comber & Thieme, 2013; Woolley et al., 2016). Aiming to achieve effective food-related behaviour change, the FOODLIT-Trial was grounded in the HAPA framework.

Method

The rationale and features of the trial design were given in detail elsewhere (Rosas et al., 2022b) and, thus, will only be briefly summarised here.

Trial Design

The FOODLIT-Trial was a 11-week, web-based, parallel, controlled trial with a single-blinded randomisation (allocation ratio 1:1) to both arms (experimental and comparison condition), that aimed to promote adults' food literacy. This intervention was based on the Food Literacy Wheel framework (Rosas et al., 2021) and had the HAPA as theoretical backdrop (Schwarzer, 2018; Schwarzer & Luszczynska, 2015). Including BCTs (Michie et al., 2013) customised to food literacy topics considering its association with the underlying mechanism of action (Johnston et al., 2020), the trial had exclusively digital evidence-based resources (adapted to smartphone, tablet and computer). All participants were assessed at baseline (T0) before randomised allocation and prior to the first intervention week, again one week after the 11-week intervention (post-intervention, T1), and at follow-up times 3, 6, and 9 months post-intervention (T2, T3, and T4, respectively). It is hypothesised that this web-based intervention combined with behavioural change strategies customised to food-related content would be more effective in enhancing food literacy than the approach used for the CG (a single-time delivery of non-customised nutritional guidelines, without any theoretical support and evidence-based behaviour change approaches). A secondary hypothesis is that cognitive mechanisms derived from the HAPA framework will significantly mediate the participants' outcomes on perceived food literacy. The primary outcome was the perception of food literacy, including food-related knowledge, competencies and behaviours, assessed with the FOODLIT-Tool (Rosas et al., 2022a). The secondary outcomes were HAPA-derived mechanisms, such as self-efficacy, planning, and action control as predictors of food literacy, assessed with previously adapted items (Sniehotta, Scholz, & Schwarzer, 2005) (Sniehotta et al., 2005) that were adjusted to depict eating according to one's needs as the intended behaviour. All evaluation moments repeated the assessment of the perception of food literacy and of psychological mechanisms. This trial was conducted between September 2020 and September 2021.

Integrating the FOODLIT-PRO: Food Literacy Project, approval for this study was obtained from the Ethics Committee of Ispa - Instituto Universitário (ref. D/002/03/2018) and its protocol was approved and registered by ClinicalTrials.gov (NCT04806074; Rosas et al., 2022b). This trial was developed according to the Declaration of Helsinki, adhered to General Data Protection Regulation (Lei da Proteção de Dados Pessoais n.º 58/2019, 2019), and followed the ethical principles and deontological norms of the Order of Portuguese Psychologists (Order of Portuguese Psychologists, 2011).

Participants and Procedure

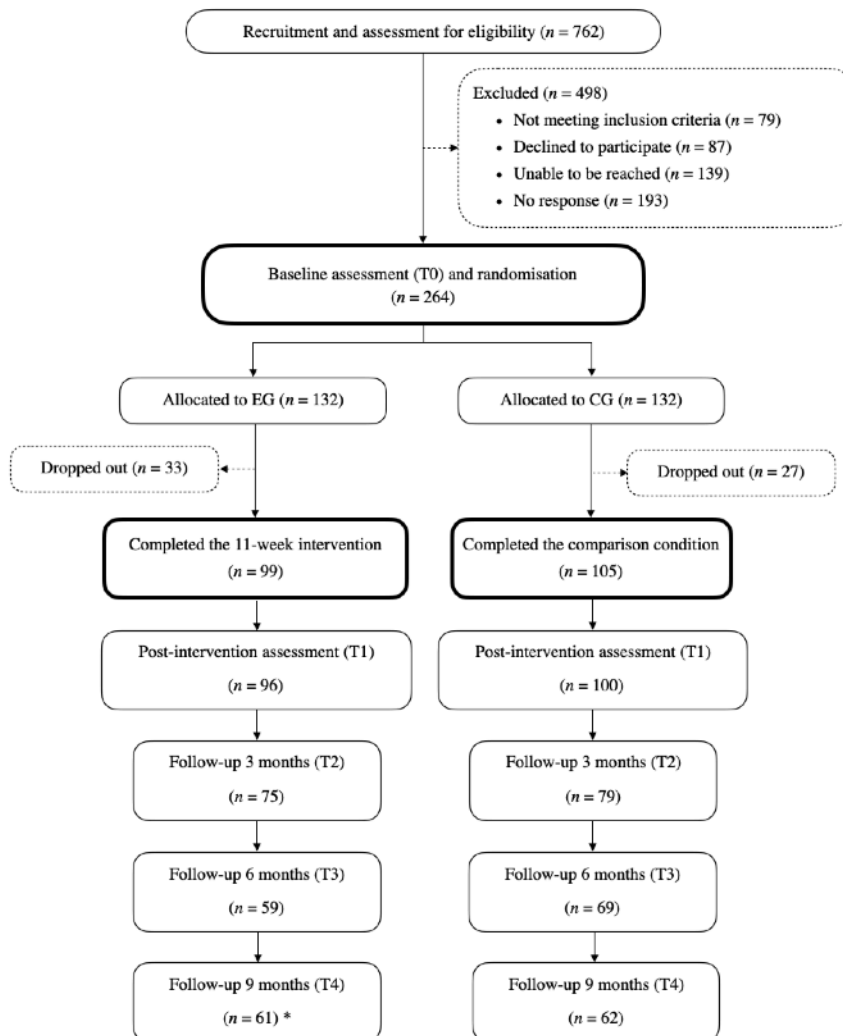
Participants constituted a convenience and community sample of Portuguese adults recruited between July and September 2020 through social platforms (Instagram and Facebook) and the project's website (<https://foodlitpro.wixsite.com/foodlitpro>). The first author reached out to multiple health- and nutrition-related professionals through their social media account, where the information concerning the study's recruitment process would be shared with the accounts' followers. In this digital reach out, potential participants were invited to participate in a food literacy intervention, filling an eligibility screener (concerning their responsibilities over choice and decision, selection and acquisition, preparation, and cooking, according to Vidgen & Gallegos, 2014) and stating their interest in taking part by leaving their contact details to be reached later for enrolment (options were email address and/or mobile number). In the recruitment stage, compensation in form of gift cards for groceries was stated to be featured at diverse moments of the trial (50 EUR at T1, 25 EUR at T2, 25 EUR at T3, and two gift cards with 50 EUR each at T4) for randomly selected participants, regardless of their experimental condition. Information about both conditions (experimental and comparison) was also provided during the recruitment (Appendix 6). Inclusion criteria were to (i) be 18 years or older, (ii) be able to understand and read Portuguese, (iii) have the availability to engage in the 11-week trial, needing internet access to allow for their participation, and (iv) be responsible for a minimum of one out of four tasks in their food routine — including choice and decision, selection and acquisition, preparation, and cooking (according to Vidgen & Gallegos, 2014).

From the digital reach out, 762 adults demonstrated interest to participate. From these, a total of 79 did not meet the inclusion criteria, 139 were unable to be contacted (e.g., misspelled email, incorrect contact number), 193 did not reply to the contact for baseline assessment, and 87 stated to have reconsidered when being contacted, and having no further

availability or interest to participate. In total, 264 adults provided their informed consent, sociodemographic (including health-related; Appendix 7) data, completed the baseline questionnaire and were assigned to one of the two conditions using simple random sampling on IBM SPSS Statistics (version 27). After randomisation, 60 individuals dropped out (dropout from EG: $n = 33$; dropout from CG: $n = 27$). The Consolidated Standards of Reporting Trials' flow diagram (Figure 6) displays exclusion, randomisation and dropout rates to both EG and CG.

Figure 6

Flowchart of the FOODLIT-Trial intervention, including both experimental and comparison groups



Note. As the trial considers missing data, missing values are not considered drop-outs if the participant fill assessments subsequent to missing data. In the 9 month follow-up, the assessments of two participants (EG) that previously had missing values on the 6 month follow-up are accounted.

Experimental Group

Participants allocated to the experimental condition received (1) weekly digital content via email and (2) notifications via WhatsApp. Each week had a specific theme based either (a) on the diverse food-related knowledge, competencies and behaviours that constitute food literacy (Rosas et al., 2021; Rosas et al., 2022a), or (b) on the psychological mechanisms encompassed by the HAPA framework (Schwarzer, 2008; Schwarzer & Luszczynska, 2015). Featured weekly themes (a) on food literacy comprehended *origin and preservation*, *cooking skills*, and *choice and decision*, among others, and included every domain belonging to the Food Literacy Wheel, and (b) on psychological mechanisms were *pre-intention*, *intention*, and *action*. On the beginning of each week, themed content was delivered including (1.1) a short video featuring the research coordinator introducing the weekly theme, (1.2) previously assorted evidence-based information from national and international nutrition guidelines (DGS, 2020; EAT-Lancet Commission, 2020; Gregório et al., 2012; DGS & PNPAS, 2020), arranged into the weekly thematics and displayed in form of videos, infographics, and/or web-directed links (Appendix 13), and (1.3) BCTs, customised to each theme and presented as small tasks to prompt food-related behaviour change (Johnston et al., 2021; Michie et al., 2013). In total, 16 BCTs belonging to nine different sets were used (with corresponding BCTs displayed in brackets): Goals and planning (behaviour goal setting, problem solving, action planning, and discrepancy between current behaviour and goal), Feedback and monitoring (self-monitoring of behaviour and self-monitoring of outcomes of behaviour), Shaping knowledge (instruction on how to perform the behaviour), Natural consequences (information about health consequences, information about social and environmental consequences, and information about emotional consequences), Comparison of behaviour (demonstration of the behaviour), Repetition and substitution (graded tasks), Comparison of outcomes (comparative imagining of future outcomes), Reward and threat (social reward), and Self-belief (verbal persuasion about capability and focus on past success). A full overview on the display and use of BCTs within the FOODLIT-Trial is provided in the trial's protocol (Rosas et al., 2022b).

All the themed weekly content was stored at the end of each week in a purposely developed website, allowing for uninterrupted access to all EG participants. Notifications via email and WhatsApp were used. Starting a new week, participants received digital resources by email and were notified with a WhatsApp alert informing that new materials were available. At the end of each week, a small survey with items corresponding to the weekly

content was also made available by email. WhatsApp alerts notified the survey reception and gave notice of the two-day deadline for completion. This weekly assessment was made to prompt participants' engagement and as a strategy to minimise dropouts. A two-week example of the experimental condition was presented in greater detail in the published protocol of the trial (Rosas et al., 2022b). On this experimental condition, participants were also randomly assigned to WhatsApp groups to allow for social sharing. No involvement or any form of participation from the research team was made to the WhatsApp groups.

Comparison Group

Participants allocated to the comparison condition received a single-time delivery of the same evidence-based information from both national and international nutrition guidelines. In this condition, the materials were delivered in their original format and without any arrangement per theme (e.g., delivered by the Portuguese Summary Report from the EAT-*Lancet* Commission, 2020), and concerned healthy eating and other food-related knowledge and competencies. No theoretically informed approach was used, no BCTs were applied, and no presence of the research coordinator featured this condition. Notifications at the beginning and at the end of each week were also delivered to the CG as a strategy to minimise dropout. At the start of each week, an email was sent as a reminder that a new week (out of the 11-week intervention) was beginning. Identically to the EG, the weekly surveys were sent by email, and alerts sent by WhatsApp notified the survey reception and reminded the deadline for completion. No WhatsApp groups were provided for this condition.

Measures

Demographic data were collected at baseline and included age, sex, educational level (from middle school to doctorate), relationship and household status (e.g., single, married, or divorced, with or without children), professional status (active, unemployed or retired), household income, body mass index (underweight, < 18.5 kg/m²; normal weight, 18.5–24.9 kg/m²; overweight, 25–29.9 kg/m²; obesity, ≥ 30 kg/m²) and food-related responsibility (previously mentioned as inclusion criteria). Table 13 shows sociodemographic characteristics for both groups.

Table 13*Participants' socio-demographic characteristics*

Socio-demographic characteristics	Experimental group (<i>n</i> = 99)		Comparison group (<i>n</i> = 105)		Total (<i>n</i> = 204)	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Sex						
Female	95	96	101	96.2	196	96.1
Male	4	4	4	3.8	8	3.9
Affective-sexual						
No	23	23.2	23	21.9	46	22.5
Yes, but not living	23	23.2	20	19	43	21.1
Yes, and living together	53	53.5	62	59	115	56.4
Children						
Yes	13	13.3	21	20	34	16.7
No	86	86.9	84	80	170	83.3
Educational level						
Middle school	1	1	-	-	1	0.5
High school	16	16.2	7	6.7	23	11.3
Bachelor	31	31.3	47	44.8	78	38.3
Master	51	51.5	49	46.7	100	49
Doctorate	-	-	2	1.9	2	1
Professional status						
Active	83	83.8	92	87.6	175	85.8
Unemployed	16	16.2	13	12.4	29	14.2
Annual household income						
10.000 EUR or less	19	19.2	17	16.2	36	17.6
10.001 EUR - 20.000	30	30.3	37	35.2	67	32.8
20.001 EUR - 37.500	31	31.3	30	28.6	61	29.9
37.501 EUR - 70.000	15	15.2	20	19	35	17.2
Above 70.000 EUR	4	4	1	1	5	2.5
Body Mass Index						
Below normal	8	8	6	5.9	14	7

Socio-demographic characteristics	Experimental group (n = 99)		Comparison group (n = 105)		Total (n = 204)	
	n	%	n	%	n	%
Normal weight	73	74	70	65.1	143	69.5
Overweight	13	13	24	24	37	18.5
Obesity	5	5	5	5	10	5
Food-related Responsibility						
Choice and decision	95	96	100	95.2	195	95.6
Selection and acquisition	86	86.9	90	85.7	176	86.3
Preparation	85	85.9	97	92.4	182	89.2
Cooking	85	85.9	93	88.6	178	87.3

Food Literacy

The perception of food-related knowledge, competencies, and behaviours that constitute food literacy were assessed with the FOODLIT-Tool (Rosas et al., 2022a). Developed and validated with adult Portuguese samples, this quantitative instrument measures food literacy using 26 items; this tool can yet be customised with 14 extra items if aiming to measure determinants and influential factors of food literacy. Based on the Food Literacy Wheel framework, this instrument evaluates perceived food-related knowledge (e.g., ‘I am aware of the time of year of each food’), competencies (e.g., ‘I read and interpret food labels to select the most appropriate foods’), and behaviours (e.g., ‘I plan my meals in advance’). The tool portrays five dimensions: (i) *culinary competencies*, with eight items such as ‘I adapt recipes to be more to my taste’, (ii) *production and quality*, having three items such as ‘I know the impact that organic products have on food-related sustainability (e.g., less soil contamination)’, (iii) *selection and planning*, with seven items as ‘I dedicate time and invest in food selection (e.g., when I go shopping)’, (iv) *environmentally safe*, having four items such as ‘I buy local/national products to support local/national business’, and (v) *origin*, with two items as ‘I can identify how a food is produced and processed (that is, how it is manufactured, how it is packaged)’. All items have a four-point Likert-type response scale that concerns either frequency (0 - *never*, 1 - *sometimes*, 2 - *frequently*, 3 - *always*) or agreement (0 - *completely disagree*, 1 - *disagree*, 2 - *agree*, 3 - *completely agree*). A mean score was created for each dimension, with higher mean scores indicating a perception of higher food literacy. At baseline, reliability values for four of the FOODLIT-Tool dimensions

ranged from $\alpha = .60$ (on environmentally safe) to $\alpha = .79$ (on selection and planning). The dimension origin presented a moderate correlation between its two items ($r^2 = .385$; $p < .001$). The FOODLIT-Tool in both English and Portuguese is featured in the Appendices 11 and 12, respectively.

Psychological Mechanisms

All the measures to assess potential cognitive determinants derived from the HAPA framework (namely, outcome expectancies, risk perception, self-efficacy, intention, action and coping planning, and action control) were adapted from Sniehotta, Scholz, and Schwarzer (2005) and modified to specifically portray eating according to one's needs as the aimed behaviour (Appendix 2). For outcome expectancies, the positive outcome expectancy measure started with the statement 'If I ate according to my needs,...' and was followed by 9 items, as 'I would improve my health'. Also for risk perception, the acknowledgement of a threat began with the statement 'If I don't eat according to my needs,...' and was followed by 3 items, such as 'then I risk getting cardiovascular diseases'. Perceived self-efficacy was portrayed and assessed in three different types: action self-efficacy, maintenance self-efficacy, and recovery self-efficacy. For action self-efficacy, the affirmation 'I believe I can regularly eat according to my needs,...' was followed by 5 items portraying diverse barriers, as 'even if others who surround me don't do it'. Maintenance self-efficacy was assessed with the statement 'I believe I can maintain a diet suited to my needs,...' followed by 6 items depicted as obstacles, such as 'even if I need a lot of time to develop the necessary routines'. In the same format, for recovery self-efficacy the affirmation 'I believe that I can go back to eating according to my needs,...' was followed by 3 items, as 'even if I had gone a few weeks without doing so'. Three items such as 'I intend to eat according to my needs on a daily basis' were used to assess the intention. Action planning was evaluated with the statement 'I already have concrete plans on...' followed by 5 items, such as 'what foods to eat in order to have a diet suited to my needs (e.g., avoid excessive salt consumption, avoid excessive alcohol consumption)'. Coping planning was assessed with the sentence 'To deal with situations that may hinder the maintenance of a diet adequate to my needs, I have concrete plans on...' followed by 6 items, as 'how to deal with a relapse, that is, how to act if I fail to have an adequate diet for some time'. Lastly, action control was assessed with 3 items, such as 'I evaluate my behaviour on a daily basis to see if I am having a diet suited to my needs'.

Data Analysis

Intervention Effects

Intervention effects were assessed following the intention-to-treat principle and using Linear Mixed Models (LMM) with the IBM SPSS Statistics MIXED (version 27) procedure. While its interpretation is similar to Repeated Measures ANOVAs, LMM are a recommended method to analyse longitudinal data with missing assessment points (Gueorguieva & Krystal, 2004; Littell et al., 2000). As so, the best fitting solution is based on all available data and estimated using residual maximum likelihood. Mean level changes on the five dimensions of food literacy over the five time points (from T0 to T4; within-level) nested in participants (between-level) were examined. Linear-two-level models were computed for each of the five food literacy dimensions, where time (centred at 0) \times condition (0 = comparison condition; 1 = experimental condition) were estimated. An unstructured covariance matrix (using the covariance and variance values from the sample) was chosen for random intercepts and a first-order autoregressive covariance matrix (indicating that covariance between repeated measures decrease with more time between assessments in a particular way) for random time effects was chosen. The time \times condition factor will be the main test of the primary experimental hypothesis concerning changes in participants' food literacy. In a LMM approach, the responses from participants (e.g., perceived culinary competencies, selection and planning skills) are understood as the sum of fixed and random effects. While random effects contribute to the covariance structure of the data, fixed effects are of primary interest with results having more accuracy due to the adjustment for the covariance structure (Heek et al., 2014). Mixed effects models included fixed effects for time, age, sex, condition, and time \times condition; in order to achieve interpretable intercepts, grand-mean centred variables of motivational and volitional factors (namely, behavioural intention, action planning, and action control) were also added as fixed effects.

Intervention Mechanisms

Longitudinal mediation analyses to explore the assumptions of the HAPA were conducted using the IBM SPSS Statistics Process Macro (Hayes, 2017). Experimental condition was specified as a dummy-coded independent variable, HAPA-derived cognitive mechanisms were explored as mediators, and food literacy dimensions as outcomes. The trial's time points (from T1 to T4) were explored to identify the most useful and meaningful mediators (e.g., behavioural intention, outcome expectancies, self-efficacy, planning) within

the full duration of the study. The sequential models included the control for baseline assessments of the respective food literacy dimensions, and the identification of covariates such as age and condition. All the mediation models were then replicated by structural equation modelling using AMOS 26 with full information maximum likelihood estimates. Since this study accounted for missing assessment points, bootstrapping was not possible to be performed. To evaluate the overall fit of the models, several goodness-of-fit indices were used, such as the chi-square test, the comparative fit index (CFI), and the root mean square error of approximation (RMSEA), representing absolute (that is, χ^2/df), comparative (that is, CFI) and residual aspects of fit (that is, RMSEA). A χ^2/df inferior to 2 indicates an overall goodness of fit, acceptable if inferior to 5, and unacceptable to values over 5 (Arbuckle, 2008). For CFI, values over .90 indicate acceptable model fit (Hu & Bentler, 1999). For RMSEA, values under .08 indicate an adequate model fit, having the .10 cut-off to indicate a poor fit (Hu & Bentler, 1999).

Results

Randomisation and Attrition Analyses

Randomisation to the two experimental arms was based on the total of 264 individuals (254 women, 10 men) who initially enrolled in the trial, aged from 18 to 64 years ($M = 30.27$; $Mdn = 29$; $SD = 7.63$). A randomisation check (χ^2 and t -tests, followed by logistic regressions) using the experimental condition variable as the outcome revealed no unique between-condition differences in baseline variables (demographics, primary food-related and secondary psychological outcome measures).

After baseline assessment and randomisation, 60 individuals dropped out ($n = 33$ in EG, and $n = 27$ in CG) leaving a subsample of $n = 204$ adults who took part in the trial. To examine attrition bias, t -tests and logistic regressions were performed across baseline variables, using a dummy-coded attrition variable (0 = dropped out; 1 = remained in the study) as the outcome. Only one of the tests yielded a significant difference between dropouts and participants who remained in the trial, namely the dimension environmentally safe ($p = .02$) where participants who remained in the study had slightly higher scores than the dropouts (2.46 vs. 2.15). This indicates that 204 participants in the longitudinal intervention sample had the vast majority of same characteristics compared to those 60 who previously dropped out. At the 9-month follow-up assessment point (T4), the sample of $n = 123$ (60% out of 204; $n =$

61 in EG, and $n = 62$ in CG) provided data on the dependent variables. To examine attrition bias, the same procedures as above were applied. None of the tests yielded a significant difference between dropouts and participants who remained in the trial. Attrition rates within the range of the current study are common for digital interventions due to the minimum virtual contact and personal interaction provided between participants and the research team, resulting in a higher likelihood for participants to drop out (Eysenbach, 2005).

Intervention Effects

Mixed effects models were generated for the five food literacy dimensions (*culinary competencies, production and quality, selection and planning, environmentally safe, and origin*) over the five assessment points (T0-T4, level-1) nested in participants (level-2). Table 14 presents the results of the analyses for the intervention effects on each food literacy dimensions.

Table 14

Intervention effects on the five dimensions of food literacy and HAPA-derived predictors

	Estimates (SE)	t (df)	p	95% Confidence	
				Lower bound	Upper bound
Culinary competencies					
Intercept	1.94 (.11)	17.59 (207.46)	<.01	1.72	2.16
Time	.00 (.01)	.41 (144.19)	.68	-.02	.02
Condition	.20 (.05)	3.97 (185.73)	<.01	.10	.30
Age	-.01 (.00)	-2.52 (196.71)	.01	-.01	-.00
Sex	.35 (.11)	3.26 (194.12)	<.01	.14	.57
Time × Condition	-.05 (.01)	-3.45 (143.76)	<.01	-.08	-.02
Intention	.03 (.05)	.68 (197.23)	.50	-.06	.13
Action Plan	.22 (.05)	4.37 (202.90)	<.01	.12	.32
Action Control	.12 (.04)	2.89 (201.94)	<.01	.04	.20
Production and quality					
Intercept	2.22 (.15)	15.30 (212.06)	<.01	1.94	2.51
Time	.00 (.01)	.34 (146.23)	.74	-.02	.03
Condition	-.03 (.01)	-.49 (186.48)	.63	-.17	.10

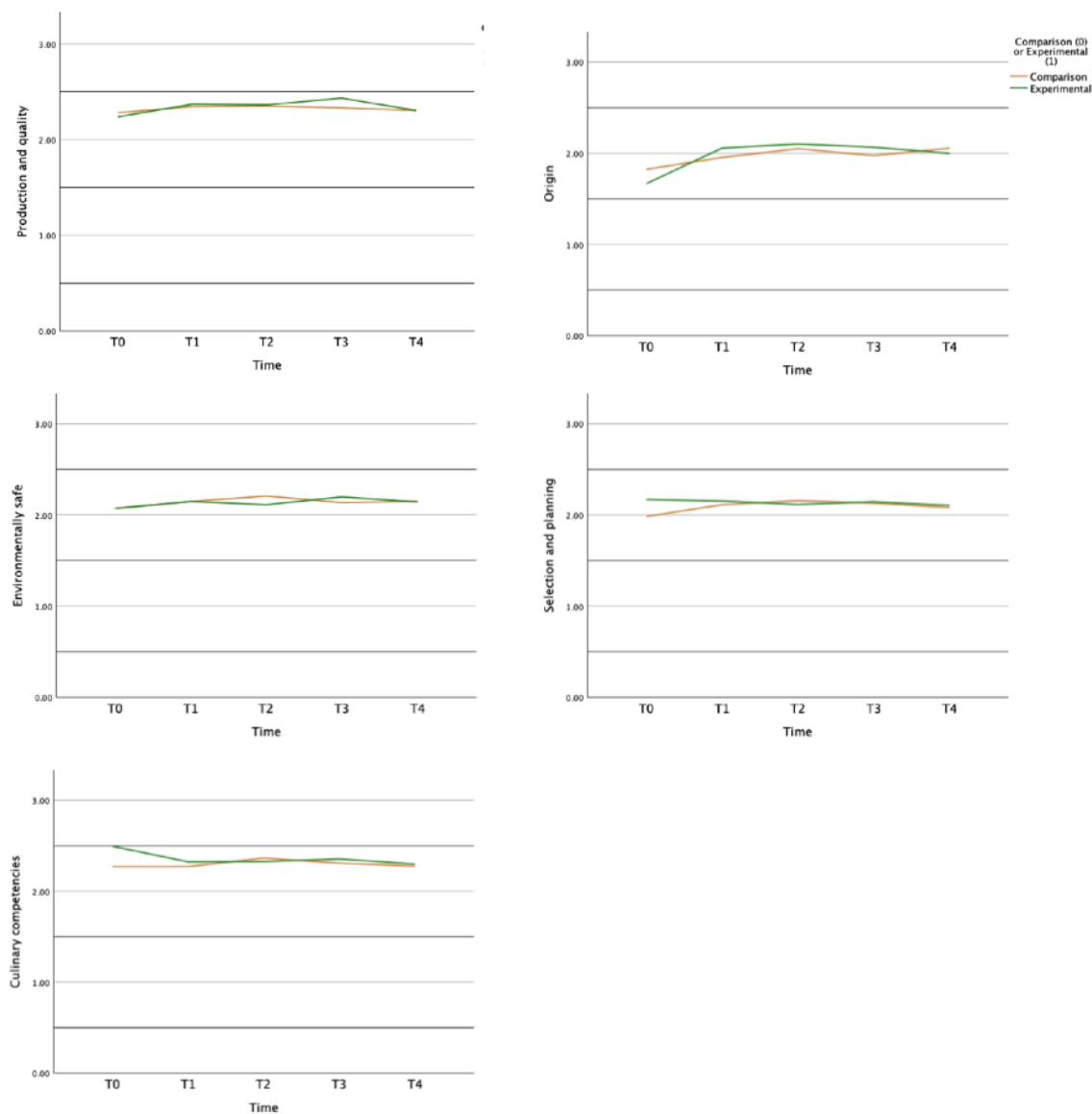
	Estimates (SE)	<i>t</i> (<i>df</i>)	<i>p</i>	95% Confidence	
				Lower bound	Upper bound
Age	.01 (.00)	2.04 (197.78)	.04	.00	.01
Sex	.09 (.14)	.61 (193.55)	.54	-.19	.37
Time × Condition	.02 (.02)	1.08 (146.20)	.28	-.02	.06
Intention	.04 (.06)	.61 (197.44)	.54	-.08	.16
Action Plan	.10 (.07)	1.46 (205.92)	.15	-.03	.23
Action Control	-.01 (.05)	-.19 (204.38)	.85	-.12	.10
Selection and planning					
Intercept	1.89 (0.12)	15.81 (214.73)	<.01	1.65	2.13
Time	.01 (.01)	1.33 (151.18)	.19	-.01	.04
Condition	.17 (.06)	2.85 (178.67)	<.01	.05	.29
Age	.00 (.00)	.31 (198.07)	.76	-.00	.00
Sex	.14 (.12)	1.21 (192.78)	.23	-.09	.37
Time × Condition	-.04 (.02)	-2.02 (150.93)	.05	-.07	-.00
Intention	.13 (.05)	2.51 (198.74)	.01	.03	.23
Action Plan	.32 (.05)	5.98 (207.25)	<.01	.22	.43
Action Control	.16 (.04)	3.71 (205.14)	<.01	.08	.25
Environmentally safe					
Intercept	1.67 (.10)	16.49 (213.80)	<.01	1.47	1.87
Time	.01 (.01)	1.38 (157.70)	.17	-.01	.04
Condition	.00 (.05)	.03 (193.00)	.98	-.10	.11
Age	.00 (.00)	1.54 (194.25)	.13	-.00	.01
Sex	.44 (.10)	4.45 (184.58)	<.01	.24	.63
Time × Condition	-.00 (.01)	-.13 (157.37)	.90	-.03	.03
Intention	-.02 (.04)	-.43 (195.08)	.67	-.10	.07
Action Plan	.05 (.05)	.98 (207.74)	.33	-.05	.14
Action Control	.08 (.04)	2.20 (203.92)	.03	.01	.16
Origin					
Intercept	1.73 (.15)	10.71 (217.66)	<.01	1.41	2.05
Time	.04 (.01)	2.60 (156.38)	.01	.01	.07
Condition	-.08 (.09)	-.91 (184.38)	.37	-.25	.09

	Estimates (SE)	<i>t</i> (<i>df</i>)	<i>p</i>	95% Confidence	
				Lower bound	Upper bound
Age	.00 (.00)	.79 (195.30)	.43	-.00	.01
Sex	.10 (.16)	.65 (185.30)	.52	-.21	.41
Time × Condition	.04 (.02)	1.67 (154.91)	.10	-.01	.08
Intention	-.00 (.07)	-.05 (195.24)	.96	-.14	.13
Action Plan	.15 (.07)	2.01 (211.60)	.05	.00	.29
Action Control	.12 (.06)	1.93 (206.59)	.06	-.00	.23

While significant main effects of time, condition and sex were found on four out of the five dimensions of food literacy (namely, *origin*, *culinary competencies*, *selection and planning*, and *environmentally safe*), the majority of main results revealed absence of statistical significance. Particularly, the dimensions of *production and quality*, *environmentally safe*, and *origin* had no time × condition interaction. Additionally, despite its statistical significance, this interaction on the remaining dimensions of *culinary competencies* and *selection and planning* demonstrated an erratic trend which were not in line with the hypothesised effect. The illustration of the time × condition interaction in all five dimensions can be found on Figure 7.

Figure 7

Graphic representation of the time \times condition interaction in the five dimensions of food literacy



Regarding motivational and volitional factors, significant main effects of behavioural intention, action planning and action control were found on selection and planning. Action planning and action control had also significant results within culinary competencies, and a significant effect of action control was found on the dimension environmentally safe.

Intervention Mechanisms

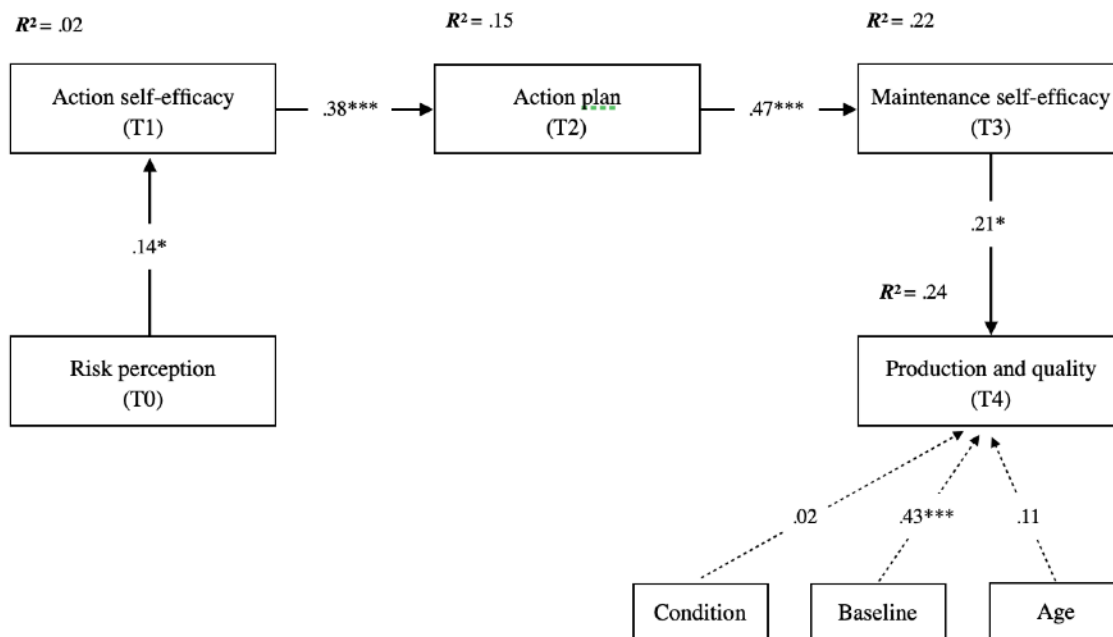
Concerning the study's secondary hypothesis, HAPA-derived cognitive mechanisms were explored as potential mediators of participants' outcomes across all food literacy dimensions. Sequential mediation analyses, partly controlling for baseline behaviour on the

outcome variable, age and condition, were conducted following the trial’s time points (from T0 to T4). Models with statistical significance are presented below.

The first estimated model (Figure 8) explored if the relationship between baseline risk perception (T0) and *production and quality* outcomes at the last time point (T4) was sequentially mediated by post-intervention action self-efficacy (T1) and follow-up action plan (T2) and maintenance self-efficacy (T3). Accounting for 24% of the variance in production and quality outcomes, model fit was fairly close to being acceptable with $\chi^2(21) = 51.68$, $\chi^2/df = 2.46$, $RMSEA = .08$, $CFI = .70$. Action plan was the most significant predictor ($\beta = .47$, $p < .001$), followed by action self-efficacy ($\beta = .38$, $p < .001$). Supported by the HAPA framework, this sequential mediation significantly predicted the outcome variable through all the indirect paths with cognitive mechanisms belonging to both motivation and volition stages of behavioural change.

Figure 8

Sequential model of the effect of risk perception (T0) on production and quality outcomes (T4) by mediation of action self-efficacy (T1), action plan (T2), and maintenance self-efficacy (T3)



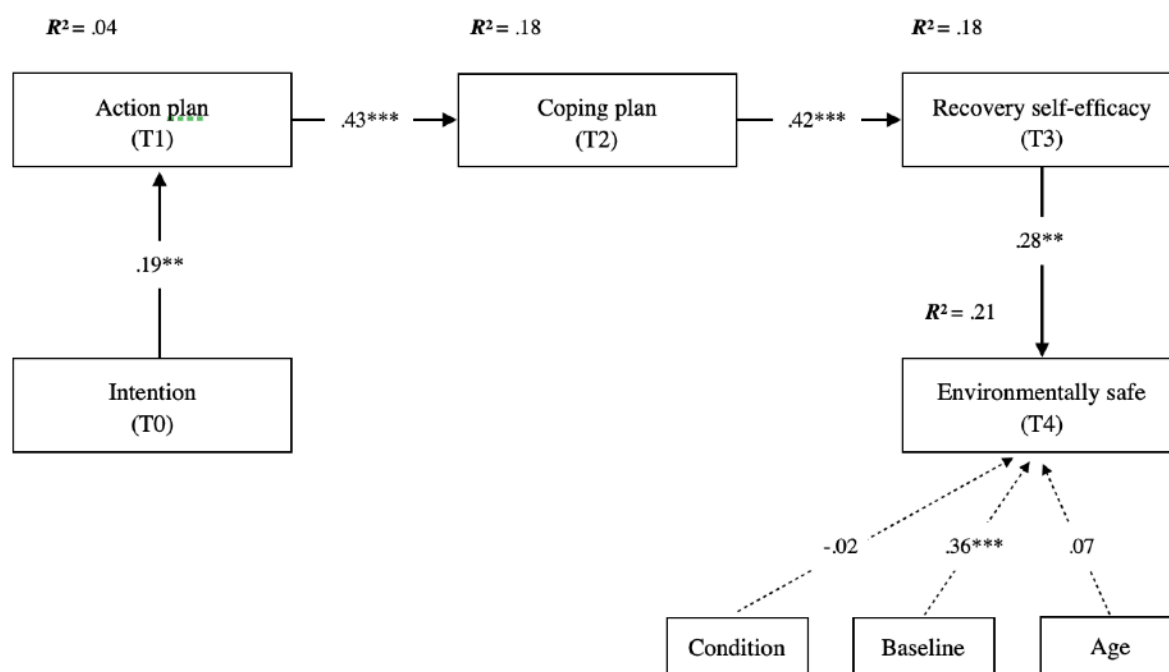
Note. * $p < .05$; ** $p < .01$; *** $p < .001$

The second model (Figure 9) explored the association between baseline intention (T0) and *environmentally safe* outcomes at the last follow-up (T4) by mediation of post-intervention action plan (T1) and follow-up coping plan (T2) and recovery self-efficacy (T3).

Model fit was fair, with $\chi^2(21) = 33.30$, $\chi^2/df = 1.59$, $RMSEA = .05$, $CFI = .84$. Enabling for 21% of explained variance concerning environmentally safe results, stronger predictors were action plan ($\beta = .43$, $p < .001$) and coping plan ($\beta = .42$, $p < .001$). With mediators belonging exclusively to the volition process, in phases of intenders and actors, this sequential model highlights planning-related predictors.

Figure 9

Sequential model of the effect of intention (T0) on environmentally safe outcomes (T4) by mediation of action planning (T1), coping planning (T2), and recovery self-efficacy (T3)

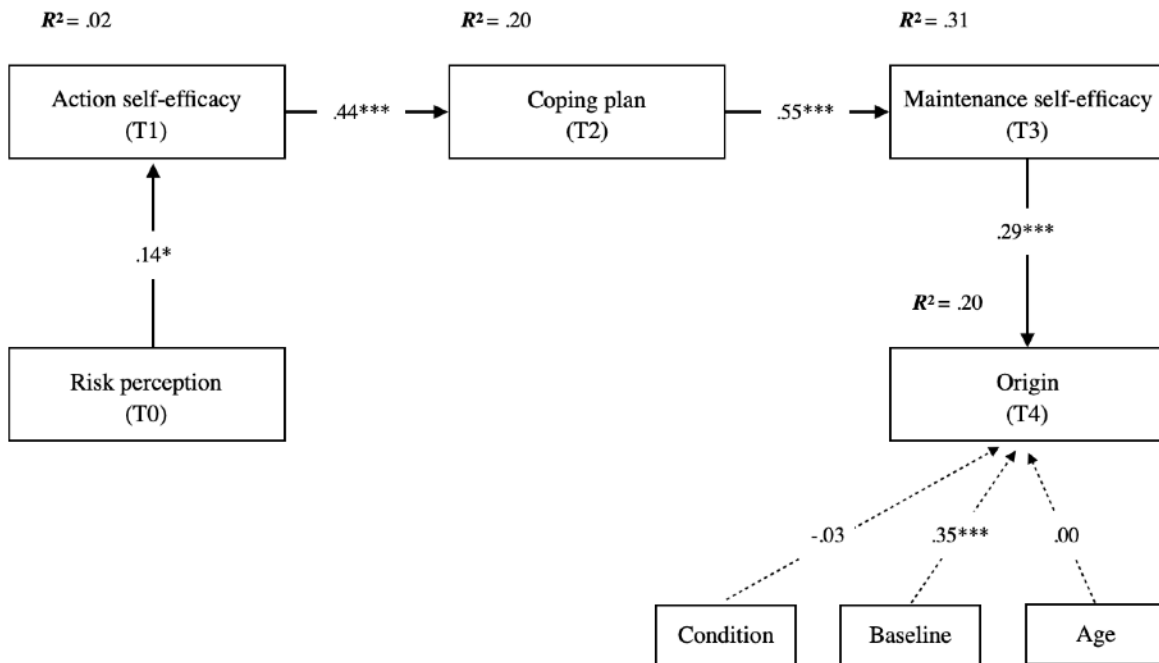


Note. * $p < .05$; ** $p < .01$; *** $p < .001$

The third model (Figure 10) concerns the relationship between baseline risk perception (T0) and *origin* outcomes at the final time point (T4) by mediation of post-intervention action self-efficacy (T1) and follow-up coping plan (T2) and maintenance self-efficacy (T3). Model fit was bearable, with $\chi^2(21) = 47.2$, $\chi^2/df = 2.25$, $RMSEA = .08$, $CFI = .75$. Accounting for 20% of the explained variance on the origin outcomes, the most significant predictors were coping plan ($\beta = .55$, $p < .001$) and action self-efficacy ($\beta = .44$, $p < .001$). Aligned with both motivation and volition stages and similarly to the first and second model, this sequential mediation portrays all the time points of the trial and with two of its mediators concerning action maintenance.

Figure 10

Sequential model of the effect of risk perception (T0) on origin outcomes (T4) by mediation of action self-efficacy (T1), coping planning (T2), and maintenance self-efficacy (T3)



Note. $*p < .05$; $**p < .01$; $***p < .001$

Discussion

This randomised controlled trial aimed to improve adults' food-related knowledge, competencies, and behaviours using an exclusively digital approach during the first year of the COVID-19 pandemic. Theoretically anchored, the FOODLIT-Trial was based on the conceptualisation of food literacy provided by the Food Literacy Wheel (Rosas et al., 2021), measured every domain of perceived food literacy according to the FOODLIT-Tool (Rosas et al., 2022a), applied BCTs purposely customised to the weekly intervention's themes, and was psychologically grounded on the HAPA framework (Schwarzer, 2008; Schwarzer & Luszczynska, 2015). Against the authors' hypothesis, no significant changes were found on the perceived food literacy of either experimental and comparison conditions. While significant results were found on the dimensions of *culinary competencies* and *selection and planning*, these demonstrated irregular trends that did not support the hypotheses. The remaining three dimensions (*production and quality*, *origin*, and *environmentally safe*) revealed lack of statistical significance between both conditions across time. Nonetheless, the dimensions *selection and planning*, *culinary competencies*, and *environmentally safe*

indicated significant and positive associations with the motivational and volitional factors studied (behavioural intention, action planning, and action control). Concerning intervention mechanisms, explorations of sequential mediation led to three main path models entailing the dimensions *production and quality*, *environmentally safe*, and *origin*. As so, results concerning the HAPA-derived predictors of the intervention effects and the achieved mediation models with HAPA variables are discussed below, followed by possible explanations for the obtained null-effects concerning study design and content, as well as its context in order to provide for insights for future trials.

HAPA-derived Predictors

Though not presenting significant intervention effects that support the formulated hypotheses, a few HAPA-derived cognitive predictors were found. Participants with higher behavioural intentions, more action planning skills, and self-regulatory competencies (which reflect action control) presented greater skills of selecting and planning their food routine. Food selection and planning often comprehend competencies and behaviours rooted within mechanisms of action such as intention, goal setting, and decision processes (Carey et al., 2019). Making a shopping list, planning one's food intake, and making feasible food decisions which balance both nutritional needs and available resources (e.g.s ingredients needed for a meal) are some of the skills entailed within the *selection and planning* dimension which are also presented in other food literacy frameworks as planing, selecting, and management competencies. These tasks also characterise different motivational and volitional factors needed in order to be practiced, such as behavioural intention and planning (Thomas et al., 2019; Vidgen & Gallegos, 2014; Rosas et al., 2019; Rosas et al., 2021). Furthermore, as recurrent behaviours in a food routine, self-regulatory efforts encompassed by action control are also inherent into what is food selection and planning. Self-monitoring one's intake, comparing and interpreting food labels in terms of one's nutritional needs, and making informed food choices are behaviours that highlight the concurrent self-regulatory strategies of self-monitoring, awareness of standards, and self-regulatory effort entailed by action control.

Individuals with higher action planning and action control also demonstrated significantly higher culinary competencies. According to both the Food Literacy Wheel framework and the FOODLIT-Tool, this dimension encompasses skills such as easily prepare everything that a meal entails, combining diverse ingredients, cooking with what is available

while different equipment and utensils, and being knowledgeable about different types of preservation suitable to different foods. The majority of these competencies are intrinsically linked with a routine-like structure that implies the planning of multiple tasks — since organising what it takes to prepare a meal to establishing what, when and how to properly storage food — that greatly translate action planning skills. With culinary competencies striving to contribute for an adequate food intake and other healthy eating habits on a daily basis, individuals with more proficiency regarding cooking-related skills may reflect a higher awareness to the need of having a healthy food intake and a consequent effort in achieving it regularly (Thomas et al., 2019; Velardo, 2015; Vidgen & Gallegos, 2014).

Lastly, participants who presented more self-regulatory strategies also demonstrated increased concerns on food-related sustainability and a greater amount of food hygiene and safety practices by scoring higher on the *environmentally safe* dimension. Being knowledgeable about the specific season of the year for diverse foods and having a predominantly local and seasonal-based food intake are competencies that require constant self-regulatory efforts by the consumers. Awareness of the time of year and its seasonal foods, self-monitoring which products can be seasonally acquired and which ones will need to be replaced by other available nutritionally similar options, and constant evaluation of one's food intake in terms of seasonally consumed products are some of the abilities that are put to practice when aiming to eat seasonally and from local trade (Macdiarmid, 2014; Wilkins, 2002). Food handling and hygiene practices were one of many food-related behaviours that, amidst the spread of the COVID-19 pandemic, were altered by fear over one's health (Eger et al., 2021). Entailing skills such as storing food at appropriate temperature and cleaning kitchen utensils regularly, the increased frequency of food-related sanitation behaviours correlated with a worldwide pandemic also highlight the continuous self-regulatory strategies developed in order to maintain these actions.

Intervention Mechanisms

To examine potential mediators of participants' outcomes concerning food literacy, sequential mediation analyses with HAPA-derived cognitive mechanisms were performed. Significant mediation sequences were presented for the dimensions *production and quality*, *environmentally safe*, and *origin*, with the expectation to shed a light on prospective cognitive paths leading to food-related knowledge, competencies, and behaviours. Though not expected

to display its continuum on a testable set of hypotheses, both motivational and volitional stages of the HAPA were entailed by these sequential mediations.

In the first model, action self-efficacy, action plan, and maintenance self-efficacy successfully mediated the longitudinal relation between baseline risk perception and *production and quality* outcomes. Considered a distal predictor, risk perception is stated to have a negligible impact on behaviour change with an additional loss of relevance as to other more dominant proximal predictors of behavioural intention. However, amidst contexts with greater eminence of a health risk, this has already been foreseen to diverge (Schwarzer, 2008; Schwarzer & Luszczynska, 2015). With themes on food production and overall quality being linked to food safety practices, this new finding is suggestive of the validity of this assumption (Durmus et al., 2018; Sumner, 2013; Uhlmann et al., 2018). Comprehending distinct phase-specific self-efficacy beliefs, the temporal sequence highlights the transition from the motivation stage (where action-self efficacy plays a role) to the volitional stage (where maintenance self-efficacy supports the action to cope with incoming barriers on performing the aimed behaviours). This transition is mediated by action planning, which reinforces the need to develop preparatory strategies to go from intention to action and to identify cues in order to act (Schwarzer & Luszczynska, 2015).

In the second model, action and coping planning, along with recovery self-efficacy, were the mediators of the sequential relation between baseline intention and *environmentally safe* results. Although being characterised by a limited predictive value, intention is not only theoretically essential to explain health behaviour change but also contributes to portray the tipping point between pre-intentional motivation processes and post-intentional volition processes (Schwarzer & Luszczynska, 2015; Sheeran, 2002). Additionally, its conceptual specification as a predictor of planning supports this sequential relation towards both action and coping plan. Consuming seasonal and national foods on a regular basis may entail strategic planning as regarding the what to buy, when and where to acquire it, and how to properly cook and store them, among other competencies. Moreover, to come up with feasible alternatives when something does not permit to have a seasonal intake or to acquire from local trade should also be a prospective strategy to develop. Experiencing failure when aiming to achieve these is a real possibility — especially among the COVID-19 pandemic, where lockdowns and home confinements were a constant challenge that required an unusual management of groceries acquisition, with local markets being prohibited and with greater

fears on food safety. Along with a time lag that illustrates these scenarios, having recovery self-efficacy as the most proximal predictor for *environmentally safe* outcomes highlights the required trust in one's competence to regain control on a skill or behaviour after experiencing setbacks.

The third and final model entails action self-efficacy, coping planning, and maintenance self-efficacy mediating the relation between baseline risk perception and *origin*-related outcomes. Taking into account the possible pathway of emergence of COVID-19 via food chain products and its link to food markets, living through a worldwide pandemic has shaken the knowledge on where food comes from and on how it is handled within the process, consequently amplifying the awareness for origin-related risks (WHO, 2021). Following the perception of risk, the mediation of action self-efficacy to coping planning may translate the participants' self-belief in their own capabilities to access information on foods' origin along with the generation of alternative plans for situations where getting this kind of knowledge is not a possibility. For instance, when dealing with products' shortage due to recurrent lockdowns and scarce information on the products' origin and how it has been handled (including manufacturing, transportation quality, etc.), acquiring frozen or canned products may be seen as a safer alternative to buying fresh, perishable foods of unknown sources within an unpredictable reality (Janssen et al., 2021). Following the time sequence, maintenance self-efficacy as the most proximal mediator suggests the validity of this assumption by portraying optimistic beliefs to cope with these barriers that may have emerged in this pandemic context.

The overall findings concerning the sequential mediation analyses provide for insights on the active cognitive ingredients that had favourable impacts on specific dimensions of food literacy, highlighting a time lag that translates an adequate fit between the continuum stage-like path of HAPA and the outcomes on the FOODLIT-Tool dimensions.

Study Design, Content, and Context

Within the possible reasons why the present trial demonstrated no significant intervention effects, the authors shed a light on those which have emerged from a constructive and introspective reflection.

Aiming to provide for compensation to participants for their time and availability throughout the intervention timeline, compensation was ethically considered, designated as

randomly assigned to selected participants regardless of group condition, and delivered in multiple moments of the trial. As a well known strategy among social and health-related research, compensation has been suggested to increase respondents' willingness to participate in interventions. Nonetheless, there is evidence that higher monetary compensations in lower risk studies may influence individuals' behaviours, with records of participants concealing information about restricted activities — such as omitting the consumption of caffeine, alcohol, or medication in trials aiming to study the efficacy of a particular drug (Bentley & Thacker, 2004). Considering this empirical evidence and identifying the FOODLIT-Trial as a low-risk intervention intended to improve food-related competencies and behaviours, the same may have happened but with a mirrored effect and within the spectrum of health promotion. That is, the featured compensation may have influenced individuals' behaviours, as participants may have felt the need to demonstrate proficiency on the self-reported measures. This may have led to overestimated food-related knowledge, competencies, and practices on the trial's assessment moments, potentially contributing to the absence of significant effects across time and to a bias of possible inflation concerning participants food literacy self-perceptions.

A main feature on the resources attributed to both group conditions may also have impacted the obtained results on the trial's effects. In spite of not having a theoretically informed approach, neither the application of BCTs or any form of appearance of the research coordinator, participants allocated to the comparison condition received the same international nutritional guidelines as the participants within the experimental condition - that is, materials developed by the Portuguese Directorate-General for Health and the *EAT-Lancet* Commission on Food, Planet, Health (2020). For the CG, the major distinctions concerning these resources were having a single-time delivery of the materials as well as receiving them in their original displays (which are available online in the entities' official websites). Thus, the CG received these manuals in the first week of the FOODLIT-Trial, having no themed arrangement linking this information to the food literacy dimensions, neither the customisation of this content in the format of videos or infographics. Nonetheless, the sole delivery of evidence-based guidance referent to diverse food-related knowledge and competencies (e.g., examples of seasonal foods, suggestions to set a grocery list within the pandemic context, recommendations for adequate food storage) embodies the definition of two distinct BCTs — *Instruction on how to perform a behaviour* and *Demonstration of the behaviour*, belonging to

the higher-order sets of Shaping knowledge and Comparison of behaviour, respectively (Michie et al., 2013). Providing cues on how to act and supplying for observable samples of the performance of a behaviour, these BCTs are stated to be associated with specific mechanisms of action such as knowledge, skills, and beliefs about capabilities (Carey et al., 2019). Unintentionally, the delivery of these contents may have triggered these mechanisms, consequently enabling the acquisition of knowledge and competencies as well as prompting the sense of self-efficacy, which may have contributed for the CG to demonstrate higher scores in the self-report measures.

Implemented on the third trimester of a very atypical year, the presented trial started amidst a nationwide ‘state of contingency’ in the context of the COVID-19 pandemic. This regime aimed to prepare the country to the return of the face-to-face system in academic settings and of workers into their workplace after months of mandatory lockdowns and working-from-home policies, with additional measures allowing the re-opening of food establishments to meals’ service and the supermarkets having later closing hours (Alto Comissariado para as Migrações, n.d.). However, concurrently with the trial’s timeline, the Portuguese population soon returns to a ‘state of emergency’, with the obligation to comply with teleworking regime as well as with mandatory curfews. This instability on restrictive measures due to the ever-changing epidemiological situation of the country has had repercussions on individuals’ routines — with households’ food consumption and other food-related habits being no exception. Multiple studies state the increase of home cooking across Portuguese families, with more available time providing for the opportunity to invest on culinary activities, along with more awareness towards food hygiene and safety practices (e.g., DGS et al., 2021; Kartari et al., 2021; Molina-Montes et al., 2021; Ribeiro et al., 2022). The combination of new opportunities, available resources provided through an online scientific intervention, and increased concerns on food handling framed by a worldwide pandemic may have also instigated for participants to achieve higher scores on perceived food literacy throughout the trial’s duration.

Strengths, limitations, and future directions

Despite not showing significant intervention effects between group conditions, this study presents valuable strengths and can serve as a source of important insights for future research. To the best of the authors’ knowledge, the FOODLIT-Trial is the first randomised controlled digital trial aiming at improving adults’ food literacy and promoting food-related

behaviour change. Understood as the gold standard for effectiveness research, this theoretically grounded and web-based randomised controlled trial included experimental and comparison conditions that allowed to draw clear conclusions from this research. Integrating the HAPA framework within the intervention and attributing well-defined BCTs to the developed weekly content (Rosas et al., 2022b), this study provides for full transparency on the description of its design, implementation and outcomes, allowing for sufficient detail for its replication within other contexts and/or with different samples. Another strength of this study is its use of innovative and recent conceptualisations within the ambit of food literacy — namely, the conceptual and empirical Food Literacy Wheel framework and the FOODLIT-Tool instrument — hoping to pave new ways of understanding behaviour change linked to food literacy.

However, there are also several limitations to this study. First, the lack of heterogeneity between participants is indisputable, with the sample being broadly characterised as young, highly educated, childless females with affective relationships and normal weight parameters. With a reach out conducted predominantly through digital social platforms, the applied recruitment strategies may have endangered potential sample heterogeneity.

Missing a real time, person-to-person interaction component may also be perceived as a limitation. With all the resources being provided by email and made available on the trial's website, the lack of human interaction and support (beyond that allowed by the introductory weekly videos featuring the research coordinator) may have skewed the trial's potential to promote change, when considering the evidence (e.g., Al-Awadhi et al., 2021; Santarossa et al., 2018). On this note, the absence of a more robust and user-friendly digital platform to deliver the intervention content (e.g., a specific FOODLIT-Trial app) may have prevented not only the development of a greater human interaction but also lower drop-out rates throughout the trial's timeline.

On a narrower feature, the somewhat exploratory nature of analyses concerning the intervention mechanisms may also be pointed as a limitation of this work. Though being rooted on theoretical and empirical frameworks, setting specific paths as potential hypotheses prior to the data analysis would be an unreasonable strategy considering the pioneering character of this trial and its grounding on recent models and assessment tools.

Future studies should consider the recruitment of broader populations, particularly portraying distinct consumer profiles in order to entail richer and more diverse views over individuals' perception of food literacy. The inclusion of face-to-face data collection and further interaction throughout the intervention should also be taken into account in order to promote adherence and prevent high drop-out rates. Moreover, employing an active control group (as it was the comparison condition of this study) lowers the chance to detect group differences whereas a passive control group without any intervention promotes more distinct dissimilarities. As both active and passive control groups have advantages and disadvantages in an experimental research design, future replication studies may consider to employ both types for comparison groups.

Conclusion

Digital, cost-effective resources aiming to promote more adequate and sustainable food-related habits particularly during the COVID-19 outbreak are necessary tools to oppose the rising trends of unhealthy dietary patterns. The FOODLIT-Trial represents the first digital attempt to enhance food literacy and change behaviour by combining validated behavioural theory and international guidelines with recently developed conceptual frameworks on food-related knowledge, competencies, and behaviours. Paving the way within the area, this trial provides for valuable insights concerning the development of a randomised controlled trial on food literacy and behavioural science, contributing with knowledge on effective and sequential cognitive mechanisms.

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Chapter 7

General Discussion

Posing risks to both human and planetary health, unhealthy eating habits can be linked to consumers' inadequate knowledge and competencies to navigate within increasingly complex food systems, as stated in the first chapter. The concept of food literacy has emerged with the cross-cutting purposes of protecting dietary quality and empowering consumers' relationship with food by promoting adequate food-related knowledge, competencies, and behaviours (Vidgen & Gallegos, 2014). Grounded into the wider frame of reference of health literacy and allowing for a more integrative perspective by considering nutritional aspects within multidimensional contexts of food systems, recent efforts have been made towards a shared understanding of what food literacy entails. Although a common thread of themes (knowledge, skills and behaviours, food choices, food systems, culture, and emotions; Truman et al., 2017a) has been identified leading to core subjects of the construct, an increasing number of studies — mainly from Australia and Canada — disclose significant incongruences amidst conceptual frameworks (e.g., Cullen et al., 2015; Perry et al., 2017; Slater et al., 2018; Vidgen & Gallegos, 2014). The absence of theoretical consensus contributed to make measurement a greater challenge, with most assessment tools addressing preparation and selection skills, overlooking hygiene-related practices, and only recently accounting for the impact of food practices on both environmental sustainability and global food systems, and vice versa (Amouzandeh et al., 2019; Teng & Chih, 2022; Yoo et al., 2022). Along with operationalisation, implementation studies demonstrate poor support on food literacy frameworks to design and develop interventions, and a narrow focus on cooking skills as a mean to tackle declining competencies and poor intake quality (e.g., Begley et al., 2017; Reicks et al., 2018). More prominently, the lack of theoretical backdrops concerning behaviour change within food literacy programmes that aim to modify food-related behaviour is, to our knowledge, still to be addressed.

The present dissertation aimed to address these gaps in a number of ways. First, by leading an in-depth exploration of the concept of food literacy and its understanding. To do this, semi-structured interviews were conducted with a multidisciplinary panel of Portuguese food-related experts and qualitative methods were used to identify domains, determinants, and influential factors of food literacy (first step of Stage 1, Chapter 2). Second, by building a conceptual and empirical framework that could illustrate the explored content on the food literacy and provide for new insights on future assessment measures and interventions, whilst paving the way for further multi-sectorial and multilevel actions in the ambit of food literacy.

To achieve this, a quantitative approach was taken to identify intrinsic associations among the qualitative attributes previously gathered and to generate an explanatory model based on those inherent associations (second step of Stage 1, Chapter 3). Third, by developing and validating an instrument, based on the previously assembled framework, that could provide for insight on adults' food literacy, potential enablers or barriers to their proficiency, and inform on which factors were perceived as influencing (or influenced by) food literacy. With a quantitative methodology, psychometric analyses were performed and the required steps to develop and validate the first adaptable food literacy tool were followed (Stage 2, Chapter 4). Finally, by designing and conducting a digital intervention aiming to enhance food literacy and to explore the impact of HAPA-based psychological mechanisms on food literacy outcomes. The web-based randomised controlled trial was designed and implemented to test the main hypothesis of food literacy promotion being more effective when the intervention has weekly delivery format, includes themed behaviour change techniques, and is theoretically supported by a specific behaviour change framework. The hypothesis of food literacy outcomes being mediated by HAPA-derived psychological mechanisms was also explored (Stage 3, Chapters 5 and 6).

In the following sections, each stage's objectives (as initially stated in Chapter 1) will be revisited and a brief review of its respective main findings will be provided. Major findings and contributions to the advance of food literacy conceptual and empirical research will then be discussed, along with implications for both theory and practice. Main limitations of the project's stages will be summarised and recommendations for future studies will be suggested. Lastly, final observations on the contributions of the project for practice and policy making will be presented.

General Discussion

Summary of Findings

The qualitative study in Chapter 2 explored the meaning of food literacy within the Portuguese reality, by conducting deductive-dominant content analysis on semi-structured interviews with experts from diverse food-related fields that investigated the domains of the construct, determinants, and influential factors (Stage 1, Objective 1). Main findings identified a total of 80 manifested codes that were mentioned by at least 10% of the participants, and nested accordingly into 19 themed categories. With no matching content in the selected frameworks used for theoretical comparison, 30 codes were acknowledged as novelty within the field of food literacy. In total, nine categories were found to refer to food literacy domains (e.g., origin, choice and decision, safety, plan, declarative and procedural knowledge), two categories reflected determinants (internal and external), and eight categories portrayed influential factors (e.g., psychological, health, policy, industry, sustainability).

The quantitative approach to these qualitative outcomes presented in Chapter 3 made it possible to develop a conceptual and empirical framework of food literacy (Stage 1, Objective 2). Understanding the qualitative codes as nominal variables, a multiple correspondence analysis was performed with all the content referring to food literacy domains (e.g., seasonality, preparation skills, food safety practices, plan food intake ahead) and with subjects depicting intentional behavioural strategies (e.g., tracking food intake, interpret nutritional labels, seeking specific information, utilise single-use items). Accounting from 9% to 15% of variance *per* factor, a four-dimensional solution showed to be the best suited to represent the definition of food literacy and enabled the explanation of 46% of variability in food literacy understanding. Identifying *cooking skills, preserve and analyse, choice and acquisition, and search and plan* as food literacy dimensions, the invariant domain of *knowledge* was set as part of the achieved definition. As so, the Food Literacy Wheel was built graphically entailing a central core constituted by food literacy's definition, followed by two rings illustrating both internal and external determinants, and a more distal ring representing influential factors.

Chapter 4 described the processes for the development and validation of a quantitative instrument to assess food literacy, including its multiple domains, determinants, and influential factors, in adult samples (Stage 2, Objective 3). Aiming to provide for a tool that

allowed to be tailored according to the purpose of its use, items concerning determinants and influential factors were designed as *single items*, meant to be used when needed. Based on the conceptual and empirical framework previously created, a pool of 40 items was developed with corresponding response scales referring to either frequency or agreement. In total, 26 items reflected the four-dimensional definition of food literacy, five depicted determinants, and nine represented influential factors. As procedures for the instrument development, an exploratory factor analysis performed with a first sample achieved a five-factor structure with 52% of explained variance for the items regarding food literacy's domains. This structure was then validated with a confirmatory factor analysis conducted with a different sample, reaching a second-order model with all 26 items distributed across five factors. Following some theoretically supported decisions (such as retaining the theme of food hygiene and safety practices within the items), a final model for the FOODLIT-Tool's development included 24 items on a five-factor structure. Single items for determinants and influential factors were also evaluated in both samples. For the instrument validation, tests of dimensionality confirmed the previously obtained five dimensional structure, tests of reliability and validity presented favourable indicators, and configural invariance was achieved. The final instrument mirrored the Food Literacy Wheel content; its second-order five-factor structure comprising 24 items depicted all the core dimensions of the framework, and the single items represented the middle rings of determinants and the most distal ring of influential factors.

Chapters 5 and 6 portrayed complementary studies of FOODLIT-PRO's Stage 3. Chapter 5 presented the protocol for the designed randomised controlled trial that aimed to improve food literacy proficiency of Portuguese adults (Objective 4). Chapter 6 displayed the outcomes of the implementation study concerning both food literacy results and the exploration of potential HAPA-derived psychological mechanisms as mediators to the food literacy outcomes (Objective 5). Previously listed at a web-based platform for clinical trials registry maintained by the United States National Library of Medicine at the National Institutes of Health (ClinicalTrials.gov, identifier NCT04806074), the protocol described in great detail the intervention's design, method, and analysis. Informed by the designed framework (Food Literacy Wheel) and using the quantitative measure previously developed (FOODLIT-Tool), the FOODLIT-Trial was characterised as a web-based intervention to promote adults' food literacy by providing weekly evidence-based and customised resources, delivered digitally and in multiple formats, comprising behaviour change techniques and

supported by the HAPA framework. A full description of the 11-week intervention was also given in Chapter 5, entailing all the weekly thematics, the domains (based on the Food Literacy Wheel) or variables (that were HAPA-derived) approached each week, the respective measures (items from the FOODLIT-Tool or based on the HAPA framework) used for weekly assessments to promote participants' engagement, and the behaviour change techniques applied across all the delivered content.

Intervention effects and mechanisms, as well as randomisation and attrition bias verifications, were presented in Chapter 6. Concerning randomisation, no between-conditions (experimental and comparison arms) differences were found in baseline variables. Accounting for continuous participation even when participants missed some assessment time points and taking into account the dropouts during the active period of the trial, attrition bias was examined using two different trial moments (baseline and the last follow-up assessment) with no significant differences between dropouts and remaining participants being reported — with the exception for one food literacy domain (environmentally safe). Regarding intervention effects, linear mixed models demonstrated lack of statistical significance between both conditions across time for three out of the five dimensions (production and quality, environmentally safe, and origin); though presenting significant results, an irregular trend was shown in the dimensions of culinary competencies and selection and planning that did not corroborate the hypothesised effects. Nevertheless, HAPA-derived motivational and volitional factors were identified as significant predictors, explaining additional variance of food literacy outcomes on three different dimensions (namely, selection and planning, culinary competencies, and environmentally safe). Individuals demonstrating more substantial behavioural intentions, action planning skills, and action control competencies indicated greater skills of selecting and planning their food routine. Higher proficiency in culinary competencies were predicted by skilfulness in action planning and self-regulatory competencies, and participants who indicated to be more knowledgeable on food-related environmental concerns and practice food safety behaviours demonstrated higher action control. Regarding mediation mechanisms, three main sequential mediation models presented significant relations between HAPA-derived psychological variables and participants' food literacy outcomes. Including both motivational and volitional stages, baseline risk perception significantly predicted competencies of production and quality at the last assessment point in a sequential relation mediated by action self-efficacy, action plan, and maintenance self-

efficacy. Baseline risk perception also predicted origin-related outcomes at the final time point, in a sequential mediation including action self-efficacy, coping plan, and maintenance self-efficacy. Lastly, pre-trial behavioural intention predicted environmentally safe outcomes at the last follow-up, with sequential mediations of action plan, coping plan, and recovery self-efficacy.

Discussion of Findings and Major Implications

The following segment discusses the findings of the present dissertation and delimits its major implications, drawing suggestions for future studies.

Is it possible for food to be thought beyond our plate? How to make sense of food literacy with wider outlooks?

Food has been portrayed by the WHO as the centre of human, ecosystem, and animal health and wellbeing, with food systems being interrelated with a multitude of anthropogenic practices, along with ecosystems conditions, climate change, and other sustainability-related concerns (WHO, 2021). Taking into account consumers' active role — by choosing where and what food to acquire, prepare, cook, store, and eat — it is decisive that a construct regarding individuals' education and empowerment towards adequate food skills considers the diversity of fields that interplay with food habits. Furthermore, identifying and accounting for factors that may hinder or facilitate the mastery of these food competencies demonstrates an essential aspect to allow for its promotion near individuals, communities, and nations.

FOODLIT-PRO's Stage 1 (including Chapters 2 and 3) provided for useful insights in this rationale. The qualitative study presented in Chapter 2 demonstrated that almost 40% of its findings portrayed new additions to the conceptual understanding of what means to be food literate, what can determine it, and what other major factors can be of influence. On the definition of the construct, our results identified innovative features added to the categories of *origin* and *cook*. Findings concerning both *procedural* and *declarative knowledge* were also unfamiliar to the meaning of food literacy at that time. On the exploration of determinants, our qualitative outcomes exhibited *internal determinants* not yet portrayed in the literature. Finally, influential factors accounted for the most amount of attributes without conceptual or empirical recognition, thus representing the area that provided for more innovative content and contributed to the field's advancement towards broader outlooks. Namely, factors referring to food *policy* and food *industry* depicted entirely new content when compared to the

existing literature. The *psychological* factor also displayed features mostly unacknowledged by contemporary research. With significant contributions to the three layers of the conceptualisation (that is, domains, determinants, and influential factors), a closer look will be taken to the results obtained in Chapter 2 as well as to their framing into the newly developed Food Literacy Wheel presented in Chapter 3.

Within the definition of food literacy, the expansion of the domain *origin* covered the importance of having knowledge about foods' season as well as the relevance of acquiring and eating according to the season. This supports the rationale of how matters related to environmental sustainability (e.g., acquiring local products, respecting seasonal agricultural practices) are associated to being food literate, emphasising the impact of food-derived anthropic actions over global environment (Willett et al., 2019). The *origin* domain was one of the diverse domains included in the quantitative approach taken for the core of the Food Literacy Wheel. A decision was made to also include other attributes that depicted intentional behaviour strategies within the definition of food literacy (even if these were previously categorised as part of influential factors in Chapter 2). This call was taken in order to emphasise individuals' active role in the improvement of their own food-related knowledge, skills, and behaviours. Among the included strategies, those concerning the acquisition of foods from local commerce and the utilisation of single-use food-related items reflect the literature's most recent steps towards strengthening the link between food literacy and sustainability-driven and ecological concerns (e.g., Teng & Chih, 2022; Yoo et al., 2022).

With *knowledge* portraying an invariable domain, its visual expression in the Food Literacy Wheel (as two continuous rings, concerning declarative and procedural knowledge) had two objectives. The first was to provide for the conceptual integration of these attributes within the definition of food literacy, given its impossibility to consider an invariable feature to the quantitative approach. The second was to allow for each attribute within the definition of food literacy to be understood within a *theory and practice* frame. That is, to indicate that competencies improvement might require both the acquisition of theoretical knowledge (e.g., acknowledging the different foods from each season, knowing the right temperatures to correctly store each food item, understanding the language of a recipe) and the practice of specific behaviours (in the same line of the previous examples, this would be: selecting food according to the season, adequately preserve and storage food, successfully follow a recipe). Acknowledging the difference between declarative and procedural knowledge highlights the

need to address both theoretical comprehension and practical performance when aiming towards food-related behaviour change and food literacy improvement.

The Food Literacy Wheel presented in Chapter 3 also integrated both determinants and influential factors. Categorised into *internal* and *external determinants*, these attributes cues for challenges — either related to individual features (such as ‘prioritising food’ and ‘time management’) or contextual specificities (as ‘access to food-related information’ and ‘familial dynamics’) — that should be addressed to facilitate the food literacy proficiency. Within internal determinants, findings concerning the impact that ‘flavour preferences’ and ‘previous food-related habits’ can have over one’s food literacy added up to the limited body of empirical literature, including the works of Truman and Elliott (2018) and Vettori and colleagues (2019). In fact, along with individuals’ socioeconomic and education backgrounds, the review led by Vettori and co-authors identifies and categorises ‘public health policies’, ‘school settings’, ‘marketing’, and ‘social media’ as food literacy determinants. However, aiming to broaden food literacy’s conceptualisation by identifying its intersection with other fields, the research conducted by the author of this dissertation was guided by the following distinct notion: influences sourced by wider contexts that may be associated with food systems but clearly represent adjacent fields — such as public policy, learning environments, industry, or social aspects — were understood as influential factors. Though individual features (such as knowledge and abilities) impact food choices and dietary intake, they do so within larger contexts such as health, policy, and sociocultural backgrounds. With top-down approaches, these backgrounds provide for specific opportunities and conditions that influence individuals’ food decisions and nutritional wellbeing (Beatrice et al., 2017; Swinburn et al., 2013a; Swinburn et al., 2013b). In this rationale, influential factors were empirically explored and conceptualised in order to identify which broader areas may impact and be impacted by food-related knowledge, competencies, and behaviours of individuals and communities.

Our approach to integrate these surrounding contexts is in line with fields of action (such as the political, cultural, health, and environmental fields) that were previously recognised by the literature as crucial to understand food literacy past the individual-focused lens (e.g., Bellotti, 2010; Pendergast et al., 2011). Though absent from most conceptualisations, the identified influential factors were portrayed in Chapter 3 within the Food Literacy Wheel as the most distal ring, integrating nine different factors: nutritional,

psychological, health, learning contexts, policy, industry, sustainability, social, and cultural. Exposing the areas that were the least explored by research in terms of its association to food literacy, factors concerning policy, industry, and psychological features can be considered the most innovative among all influential factors. With the term food literacy being increasingly used in policy without a consensual understanding, policy makers have long been suggesting that lack of food-related education constitutes one of the main reasons for poor diet-related health outcomes (Deer et al., 2014; Kimura, 2011; Ronto et al., 2016). However, to improve outcomes as individual and collective food-related wellbeing, a process with mixed top-down and bottom-up approaches entailing both policy makers and consumers is due to be developed and implemented. Comprising food policy within the multi-faceted Food Literacy Wheel not only aims to draw the attention of policy makers to the drawbacks of inadequate food literacy and its link to food systems' (un)sustainability, but also recognises the conjoint role that both parts take on enhancing food skills and, consequently, improving food-related health (Palumbo et al., 2019). With food illiteracy constituting a policy-related challenge, research has pointed out as imperative the implementation of systemic interventions targeted to (i) improve consumers' ability to navigate within food systems and to accomplish a healthy relationship with food, (ii) shield the negative impacts of economic and social inequalities over dietary choices and regular food intake, along with (iii) transforming this interaction between socio-economic status and food literacy, and (iv) increasing the awareness of both consumers and institutions on the role of food literacy towards individual and collective health and wellbeing (e.g., Cullen et al., 2015; Palumbo, 2016; Palumbo et al., 2019; Widener & Karides, 2014). At the same time, and taking into account the role of food literacy as one of the most significant dimensions to assess the effectiveness of nutrition-related policy programmes, these interventions must be people-centred approaches in order to promote consumers' active involvement in shaping and executing future food policies (Levkoe & Sheedy, 2017; Macdiarmid et al., 2011). The findings presented in Chapter 2 and conceptualised in Chapter 3 are in line with these necessities, and mirror its impact on food literacy by positioning food policy as an influential factor.

Challenged to be transformed in order to step in towards global sustainability, food industry has been stated as a source of information that, ultimately, influences consumers' food behaviours (Truman et al., 2017a; Waxman, 2004). Taking responsibilities as the consumers' satisfaction, the provision of nutritionally adequate and safe foods, the display of

products information, and the maintenance of commercial viability, food industry has long been called out to join forces on tackling food-related diseases. As so, a demand to respond to a list of commitments was made; among them, to reformulate foods to greatly meet nutritional standards, joining in public-private partnerships, actively promoting healthy lifestyles, stepping in on consumers' information, and supporting responsible marketing (Kraak et al., 2019; Mettler, 1986). However, food marketing is often accounted to fall short on this allegiance due to significant control allowed to sponsors and other industry stakeholders — this results in the disclosure of information that does not aim at the benefit of public health (Boyland & Whalen, 2015; Peterson, 2012). In line with this evidence, our findings emphasise the appeal to consumers' emotions, the use of flavour intensifiers, and the reach out through social media as strategies applied to food marketing consequently impacting consumers' choices and behaviours. Nonetheless, the relationship between food industry and the final consumer is evidenced to be a bilateral one: consumer demand, also reflected in our results, plays a leading role on what the industry supplies (e.g., Adebajo & Mann, 2000; Anderson, 2000). Recognising the idiosyncrasy of both consumer and food industry, to frame industry as an influential factor supports distinct purposes. On one hand, it reflects the need to not only educate consumers to be able to navigate through marketised messages and make healthy food decisions, but also to empower consumers in demanding for change within the industry towards more sustainable food systems. On the other hand, it mirrors the industry's responsibility to promote consumers' knowledge, competencies, and behaviours as sources of human health, environmental consciousness, and food systems sustainability.

Inconsistently stated throughout the literature, a varied set of psychological constructs — from emotions to motivation, self-efficacy (or confidence), attitudes, and empowerment — has been associated to food practices and food literacy (Palumbo, 2016; Truman et al., 2017a; Vidgen & Gallegos, 2014). Building self-efficacy through the enhancement of cooking skills or achieving greater psychological wellbeing when improving one's food literacy, psychological attributes have predominantly been reported as outcomes of developing food literacy (e.g., Palumbo, 2016; Thomas & Irwin, 2011; Truman et al., 2017b; Vidgen & Gallegos, 2014). Consequently, scarce research within this field portrays for how psychological variables can impact food literacy, with most of the empirical evidence referring exclusively to the influence over one's dietary choices and intake (e.g., Bublitz et al., 2010; Frayn & Knäuper, 2018; Kemp et al., 2013). Furthermore, as reported in Chapter 1, the

association of behaviour change processes to the development and promotion of food literacy is inexistent in the current literature. As so, the findings concerning the psychological influential factors presented in Chapters 2 and 3 allow to understand the relation between psychological features and food literacy within the process of health behaviour change, as well as to consider how psychological attributes can also impact one's food literacy, emphasising their role in the promotion of food-related education.

Can the contextual complexity of food literacy be translated into adaptability within the assessment process?

Reflecting the state of the art at that time, the majority of food literacy measures — either aiming to assess food literacy or the effectiveness of food literacy interventions — were supported by previously acknowledged conceptual frameworks, as evidenced in Chapter 1 (Amouzandeh et al., 2019; Desjardins et al., 2013; Krause et al., 2016; Vidgen & Gallegos, 2014). As so, most of these measures were short on capturing the contextual richness that interacts with food literacy. Only recently have newly developed tools incorporated broader approaches into the aim of assessing food literacy, including features as psychological attributes (Hemmer et al., 2021), sustainability concerns (Teng & Chih, 2022), and environmental factors (Yoo et al., 2022).

The findings obtained in the study presented in Chapter 3 show that it is possible to reflect a wider and more integrative approach to understand food literacy in a quantitative measurement tool. As FOODLIT-PRO was a project designed with sequential objectives, the development and validation of the FOODLIT-Tool mirrored the conceptual and empirical evidence from Stage 1, that served as basis to build the framework presented in Chapter 2. Although not exhibiting an exact replica of the Food Literacy Wheel's core, the developed measure presents a more detailed five-dimensional structure that allows the specification of each skill into more particularised items and dimensions, providing for a more accurate measurement of the construct.

As a significant contribution to expand the currently available assessment options in the field of food literacy, the outcomes of Stage 2 not only provide for a validated quantitative instrument to assess food literacy but also supply for a way to measure how adults experience its determinants and perceive its influential factors. Evaluating which elements act as enablers or inhibitors to one's food literacy (e.g., access to reliable and valuable information) will help with the identification of challenges required to be tackled in order to promote food literacy.

Addressing these challenges may demand the improvement of skills that, at a first glance, might not seem directly related to food (il)literacy — such as enhancing one’s competencies to search and critically analyse food-related information. However, these determinants directly impact one’s food-related knowledge, competencies, and behaviours. As so, this tool can help flag further obstacles that may hinder the improvement of food literacy which can prove to be particularly useful for future implementation studies.

Features concerning the assessment of perceived influential factors and the tailoring of the instrument according to which single items are used (determinants and/or influential factors) are considered the most innovative of the FOODLIT-Tool. Acknowledging every influential factor within this food literacy measure sheds a light on how areas such as food policy, industry, and sustainability may weight in consumers’ food skills and behaviours and, simultaneously, explores the consumers’ perception about their (in)active role in transforming these fields of action. Tailoring the FOODLIT-Tool by adding items related to determinants and influential factors according to the purpose of the instrument’s application reflects a limitless number of possibilities for the tool’s content. This adaptability allows for future researchers, practitioners, or other professionals from food-related adjacent areas to draw further insights on how their specific field can interact with their subject’s food literacy, or vice-versa. Thus, the findings presented in Chapter 4 reflect our strive to express into a quantitative measure the contextual complexity captured by the project’s Stage 1 and presented in both Chapters 2 and 3.

Can food-related knowledge, competencies, and behaviours be embodied into behaviour change techniques to be digitally delivered?

With their findings characterised as discrepant and predominantly marked by minimal or lack of significant intervention effects (Michie et al., 2018), behaviour change interventions have recently welcomed the inclusion of the systematised behaviour change techniques (BCTs). These active components operate in the causal processes responsible for behavioural regulation, contributing to enable behaviour change (Michie et al., 2013; Michie et al., 2015). Particularly, BCTs’ integration in implementation studies is recommended to directly target mechanisms of action — that is, to target the processes that ‘mediate’ intervention effects and through which a BCT impacts behaviour (e.g., knowledge, beliefs about capabilities, behavioural regulation; Carey et al., 2019). The work developed in Chapter 5 clearly demonstrates that both theoretical HAPA-derived constructs and food literacy subjects can be

translated into BCTs to be digitally delivered. This mapping served to assemble the intervention content for the experimental condition of the FOODLIT-Trial, the digital randomised controlled trial designed and implemented at Stage 3.

As a trial theoretically based on the acknowledged evidence concerning the links between mechanisms of action and BCTs (Carey et al., 2019; Human Behaviour Change Project, n.d.), mapping BCTs with HAPA-derived constructs aimed to facilitate the process of behavioural change throughout the course of the 11-week intervention. This was done by matching mechanisms such as beliefs about capabilities (HAPA's self-efficacy) and consequences (HAPA's outcome expectancies), perceived susceptibility and vulnerability (HAPA's risk perception), and behavioural regulation (related to HAPA's planning variables and action control) with specific BCTs — such as verbal persuasion about capability, comparative imagining of future outcomes, information about health consequences, action plan, and behaviour self-monitoring, respectively. The food literacy content, mirroring the Food Literacy Wheel framework and evaluated with the FOODLIT-Tool, was also mapped with BCTs. Beyond knowledge and skills comprised by food literacy's definition, other mechanisms of action were also identified as essential processes to promote behavioural change within the targeted food literacy features — such as goals, reinforcement, social influences, and attitudes towards the behaviour. These mechanisms (along with the mechanisms of knowledge and skills) were matched with the BCTs of instruction on how to perform the behaviour, graded tasks, behavioural goal setting, social reward, and information about health, social, and environmental consequences, among others. In total, the FOODLIT-Trial was designed with 16 BCTs integrated belonging to nine distinct sets.

To allow for the digital delivery of the intervention, all the selected BCTs were translated into a diversity of materials that were used as resources throughout the trial. This included, but was not limited to, instructive videos demonstrating the aimed behaviour, visual infographics displaying the targeted information or addressing a specific concern, and downloadable materials such as tables to be filled in by the participants. The output provided in Chapter 5 overviews the mapped BCTs across the intervention and a two-week example (with both HAPA and food literacy content) of all resources supplied to the experimental condition. To the author's knowledge, no randomised controlled trials in the ambit of food literacy have been digitally implemented and designed to include BCTs in the experimental condition while omitting them in the comparison or control condition. Notwithstanding the

lack of significant intervention effects that would support the hypothesised assumption, the FOODLIT-Trial demonstrated how not only theoretical constructs but also food literacy content can be embodied into empirically sustained behavioural techniques. Moreover, the designed intervention provided for an example on how to translate these into thematic strategies that are able to be digitally deliverable. These outcomes shed a light on how to map BCTs within the design of an intervention, and the match of these techniques with food literacy features — that are supported by a specific framework and able to be evaluated by a validated quantitative measure — provides for profound insights on how to tackle food illiteracy in the future.

Do the associations between psychological mechanisms mirror what would be theoretically anticipated in the prediction of food literacy practices?

Focusing explicitly on health behaviour change, the HAPA framework presents two distinct phases — pre-intentional motivation phase and post-intentional volitional phase — from where social cognitive predictors emerge within acknowledged patterns. Allowed by its open architecture framework, HAPA's predictors have been applied within a multitude of fields by using specific subsets of constructs in path analytic designs to study psychological mechanisms that can explain or predict health-related behaviours (Schwarzer, 2008; Schwarzer & Luszczynska, 2015). The findings presented in Chapter 6 display different sets of cognitive variables towards the prediction of distinct food literacy features, that are in line with the continuum layer of the HAPA framework.

Pointed out as a distal antecedent in the health behaviour change process, risk perception is stated as insufficient to warrant intention formation. However, the role of risk perception has been described as enabling for a contemplation process, where thoughts about consequences and personal competencies are elaborated (Schwarzer & Luszczynska, 2015). Our results provide support for this claim, given that baseline risk perception was found to significantly predict action self-efficacy post-intervention in two out of the three mediation models obtained in Stage 3. Within the field of food literacy, these findings not only emphasise risk perception as a facilitator for reflecting about one's competencies but also illustrate that perceiving food production-related risks during the COVID-19 pandemic might have enabled a greater self-belief of consumers about having an active role in changing food-related behaviours.

Representing the change from the motivational to the volitional phase, intention significantly predicted action planning on a sequential path in the second model. Also in line with the HAPA's continuum, this pattern acknowledges the need to set the stage for the development of preparatory strategies that will aid to bridge the intention-behaviour gap (Schwarzer, 2008; Schwarzer & Luszczynska, 2015). Furthermore, both action and coping planning serve as a mediator, along with recovery self-efficacy, between intentions and food-related environmental and food hygiene practices. This finding is in line not only with the mechanisms theorised in HAPA but also with previous research from diverse fields, that indicate planning as a mediator between intentions and behaviour with a concomitant negligible direct effect between intentions and behaviour (Fleig et al., 2013; Scholz et al., 2008; Schwarzer et al., 2007).

As self-regulatory processes that are crucial to goal-striving, the development of planning strategies 3 months post-intervention significantly predicted volitional self-efficacy (including both maintenance and recovery) at the second follow-up of the FOODLIT-Trial. Thus, developing action and coping strategies appears to have prompted participants' self-beliefs on facing the challenges inherent to evaluating foods' quality, identifying its origin, practicing conducts of food hygiene and safety, and considering environmental and sustainability concerns during the COVID-19 pandemic. This notion can be supported by current evidence that demonstrates that food sourcing, processing, sustainability, and safety practices were concerns increased by the context of the COVID-19 crisis (e.g., Eriksson et al., 2021; Filimonau et al., 2021; Rodrigues et al., 2021).

Finally, higher proficiency in the attributes concerning foods origin, quality and environmental issues at the last follow-up was significantly predicted by stronger maintenance and recovery self-efficacy measured three months earlier. With the first referring to optimistic beliefs about one's capability to cope with challenges that may hinder the maintenance period and the second addressing the experience of getting back on track after relapsing, high self-efficacious individuals have been reported to respond with better strategies, more persistently and with increased self-confidence to hurdles in the behaviour change process. In line with the HAPA's principles, self-efficacious participants demonstrated a higher tendency to translate the plans previously made at the first follow-up into actions at the end of the trial (Schwarzer & Luszczynska, 2015). Thus, regardless of the inability of the FOODLIT-Trial to successfully promote food literacy, the sequential mechanisms identified as significant mediators of

diverse food literacy outcomes emphasise how the distinct theory-driven phases of behaviour change have translated into practice. Chronologically portraying both motivational and volitional phases, the serial mediations presented in Chapter 6 are, to the author's knowledge, the first step on the identification of important psychological mechanisms to prompt food literacy practices. This significant development sheds a light on what cognitive features need to be cautioned when striving for food literacy proficiency.

Limitations and Future Directions

The development and implementation of health-related research is not without its challenges. As a project designed to reflect a variety of studies in a crescendo of complexity, the FOODLIT-PRO entails some limitations that need to be addressed. Transversal to all studies from the three stages, non-random convenience sampling was used resulting in samples mostly composed by highly educated young women. Considering that food-related responsibilities are still expected to fall upon women within their societal roles and that male participation in food-related routines is yet a minority, future studies should seek to integrate more heterogeneous samples when studying food literacy phenomena. Within the first stage of this project, the lack of a Delphi study might be viewed as a limitation. Providing for a flexible yet complex approach to gather experts' views on a particular subject, a Delphi technique is usually applied when aiming for consistency and consensus on a concept's understanding (e.g., Vidgen & Gallegos, 2014). However, this approach was opted not to be undertaken in the study described in Chapter 2 due to its time-consuming nature as well as the high risk of leading to drop-outs (Barrett & Heale, 2020).

Another limitation is the inclusion of a single item per influential factors in the study portrayed in Chapter 4, referring to the Stage 2 of the project. The inclusion of a unique item for each of the nine influential factors fell short to the aim of capturing not only the perceived influence of areas such as policy and sustainability on one's food literacy but also the consumers' perception on their active role over such areas. Nonetheless, decisions regarding the pool of items were taken in order to avoid the development of a lengthy questionnaire. As the assessment of influential factors was not the core aim of the FOODLIT-Tool, risking the development of a time demanding measure could compromise participants' compliance with the study, potentially reflecting on significant drop out rates and affecting response accuracy as well. Future studies may seek to address the assessment of the impact caused by influential

factors and consumers' role to transform these effects in a deeper level, increasing the reach of the current questionnaire.

The absence of significant intervention effects regarding what was hypothesised in Stage 3 also represent a drawback taking into account the study's purpose. Acknowledging the process of health behaviour change as a path primarily emotional that then turns into a cognitive course of action, humans are understood as self-determined agents guided by intentionality (Bandura, 2001; Schwarzer & Luszczynska, 2015). However, dietary choices are often characterised as challenging to change, led by impulsivity, prompted by contextual stimuli, and conducted with no conscious reflection (Veling et al., 2017). Furthermore, lockdowns and other restrictions consequent to the recent pandemic scenario have also promoted changes within food-related habits, such as purchase and consumption; though contradictory records on these impacts can be found on the literature, emotional aspects are identified as cue for these alterations (e.g., Marty et al., 2021; Powell et al., 2021; Scacchi et al., 2021).

Within this rationale, a previous identification of participants' mindset concerning food-related behaviour change could guide the intervention to specifically address emotional or cognitive aspects according to the participants' necessities. As so, developing a more tailored intervention by performing a segmentation of the audience according to HAPA's stage layer could potentially benefit its effectiveness. Requiring an initial assessment to determine whether individuals could be characterised as pre-intenders, intenders, or actors, and a posterior adequacy of the intervention content considering this early evaluation, stage-matched interventions are more complex and have a greater degree of intricacy than one-size-fits-all trials (Schwarzer & Luszczynska, 2015). Given the distinct layers that may exist within a single food literacy feature (e.g., having knowledge of foods seasonality versus eating according to the season) and how these might be associated with the current phase of action of an individual (pre-intender, intender, or actor), future studies should consider stage-tailored interventions when aiming to promote food literacy.

In spite of these limitations, FOODLIT-PRO entailed distinct stages with specific objectives and methodologies that led to valuable findings. This research team believes that these make for relevant evidence-based contributions not only to the food literacy state of art but also to the field of health psychology.

Conclusion

Though becoming clearer that both our food choices and our ability to navigate food environments matter beyond our dietary intake and its health outcomes, there is still a significant path to be made towards global food literacy and sustainability. With the purpose to make this path briefer and somewhat more knowledgeable, the FOODLIT-PRO was designed as a sequential project that aimed to provide for theoretical and empirical contributions in the field of food literacy. Perspectives on the meaning of food literacy, its determinants, and factors of influence according to Portuguese food-related experts were explored in-depth. A conceptual and empirical framework was further developed based on this qualitative exploration, with an additional quantitative approach to ensure a dimensional structure for the definition of food literacy. Determinants and influential factors of food literacy were also integrated within the developed framework, portraying — to the author's knowledge — a first attempt to integrate a multidisciplinary overview within a food literacy conceptualisation. An innovative quantitative measure was subsequently built and validated with the purpose to provide for adaptability to the assessment of food literacy, respective determinants and influential factors, to be used with adult populations. A web-based randomised controlled trial was then designed with matched behaviour change techniques and customised resources with the purpose to enhance adults' food literacy. Social cognitive predictors were identified and the impact of HAPA-based psychological mechanisms on food literacy outcomes was explored.

Additionally to these conceptual and empirical contributions, relevant implications for practice and policy making can also be identified. The recognition of how psychological attributes relate to food-related knowledge, competencies, and behaviours is worthy of note and should be accounted in future strives to modify food literacy, along with the acknowledged determinants. Researchers, practitioners, and other professionals can now reach for further insights on how their fields of action can interact with individuals' food literacy, and gain awareness on how to tackle food illiteracy using behaviour change techniques. The identification of psychological mechanisms as predictors of the different food literacy features also depicts an important first step in cueing cognitive attributes that require to be addressed when attempting to improve adults' food literacy. As the deficiency to make conscious food decisions and the inability to adequately navigate within food systems are expected to the long-term impairment of food-related sustainability, food illiteracy must be

faced as a policy- and industry-related concern. These findings emphasise the need for the development of people-centred approaches that promote the active engagement of consumers in the design and implementation of food policies; however, consumers' education and empowerment, as well as the awareness of the role that both policy and industry play to it, is crucial to this synergy success.

It is our aspiration that this work can encourage further evidence-based research within this subject, but also serve to strengthen the association between food literacy and other fields, and motivate multidisciplinary calls to action towards global food-related sustainability.

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Chapter 8

Appendices

Appendix 1. Interview Protocol

(Chapters 2 and 3 - Stage 1)



FOODLIT-PRO: Food Literacy Project

FOODLIT-PRO: Projecto em Literacia Alimentar

Protocolo de Entrevista

1. Na sua opinião, o que acha que é necessário para que as pessoas façam uma alimentação adequada às suas necessidades?
2. O que entende por/O que é para si literacia alimentar?
3. Na sua opinião, que domínios ou componentes entende que possam integrar/fazer parte de literacia alimentar?
 - 3.1. E conhecimento (*factos, informação adquirida através da experiência ou de educação*), o que acha que as pessoas têm de saber para fazer uma alimentação adequada às necessidades do próprio?
 - 3.2. E competências (*técnicas, habilidades*), o que acha que as pessoas têm de saber fazer para terem uma alimentação adequada às necessidades do próprio?
 - 3.3. E confiança e percepção de eficácia (*convicção sobre funcionamento, crença de ser eficaz*), o que acha que as pessoas têm de dominar ou sentir que dominam para fazer uma alimentação adequada às necessidades do próprio?
4. Que recursos individuais (como rendimentos e outros recursos) acha que promovem uma alimentação adequada às necessidades do próprio?
5. Que características sociais acha que possibilitam uma alimentação adequada às necessidades do próprio características?
6. Que características culturais, acha que possibilitam uma alimentação adequada às necessidades do próprio características?

7. Que directrizes políticas acha que possibilitam uma alimentação adequada às necessidades do próprio?
8. Que aspectos ambientais e de desenvolvimento sustentável (*equilíbrio social, económico e ambiental*) acha que viabilizam uma alimentação adequada às necessidades de uma pessoa?
9. O que acha que as pessoas têm de fazer a nível de comportamento alimentar para terem uma alimentação adequada às necessidades do próprio?
10. E emoções, o que acha que as pessoas têm de saber reconhecer e gerir para fazerem uma alimentação adequada às necessidades do próprio?
11. Para além destes domínios que abordámos — competências, comportamentos, etc. — que outros domínios (relacionados com a pessoa ou externos ao indivíduo) acha que deveriam integrar literacia alimentar? E porquê?
12. Na sua opinião, que barreiras ou obstáculos existem a fazer alimentação adequada às necessidades do próprio?
13. O que é que a sua instituição/a instituição da qual faz parte faz para promover e melhorar a literacia alimentar dos seus consumidores finais/utentes?
14. O que é que a sua instituição/a instituição da qual faz parte poderia fazer para promover e melhorar a literacia alimentar dos seus consumidores finais / utentes?

Appendix 2. Adaptation of the HAPA instrument (Chapters 5 and 6 - Stage 3)

Outcome Expectancies

Se eu fizesse uma alimentação adequada às minhas necessidades... *

	Muito improvável	Improvável	Provável	Muito provável
Melhoraria a minha saúde.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Comeria menos de outros alimentos menos adequados.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sentir-me-ia mais atraente.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Seria capaz de controlar o meu peso.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sentir-me-ia saudável.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sentiria satisfação e prazer.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Os outros ao meu redor iriam ver que eu valorizo a minha saúde.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preveniria diversas doenças (doenças cardiovasculares, cancro, etc.).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sentir-me-ia melhor.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Risk Perception

Se eu não fizer uma alimentação que seja adequada às minhas necessidades... *

	Muito improvável	Improvável	Provável	Muito provável
Arrisco-me a ter uma doença cardiovascular.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Estarei a prejudicar a minha saúde.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Poderei ficar fisicamente menos atraente.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Action Self-efficacy**Acredito que consigo fazer uma alimentação adequada às minhas necessidades regularmente... ***

	Discordo totalmente	Discordo	Concordo	Concordo totalmente
Mesmo se tiver de estabelecer um plano alimentar detalhado.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mesmo que seja financeiramente dispendioso.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mesmo que esteja cansada/o e não me apeteça muito escolher, comprar, preparar, confeccionar, e/ou comer o que é mais adequado para mim.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mesmo que os outros que me rodeiam não o façam.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mesmo que tenha de ultrapassar os meus hábitos de escolher, comprar, preparar, confeccionar, e/ou comer alimentos menos saudáveis para mim.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Maintenance Self-efficacy

Acredito que consigo manter uma alimentação adequada às minhas necessidades mesmo se... *

	Discordo totalmente	Discordo	Concordo	Concordo totalmente
Precisar de bastante tempo para desenvolver as rotinas necessárias.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tiver de recomeçar várias vezes até conseguir.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Estiver preocupada/o com outros aspectos da minha vida.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
As pessoas à minha volta não alterarem os seus hábitos alimentares.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mesmo que não veja mudanças positivas imediatamente.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mesmo que custe algum dinheiro extra.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Intention

	Discordo totalmente	Discordo	Concordo	Concordo totalmente
Tenciono fazer uma alimentação adequada às minhas necessidades regularmente.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pretendo fazer uma alimentação adequada às minhas necessidades todos os dias.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tenciono fazer uma alimentação adequada às minhas necessidades em, pelo menos, 6 dias da semana.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Action Planning

Já tenho planos concretos sobre... *

	Discordo totalmente	Discordo	Concordo	totalmente
Que alimentação fazer para ir ao encontro das minhas necessidades (por ex., evitar consumo excessivo de sal, evitar consumo excessivo de álcool).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quando praticar uma alimentação adequada às minhas necessidades (por ex., quando almoço num restaurante, quando compro alimentos no hipermercado, quando planeio o que vou comer durante a semana).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Onde implementar uma alimentação mais adequada às minhas necessidades (por ex., em casa, no trabalho, quando como fora).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Como fazer uma alimentação mais adequada às minhas necessidades (por ex., comparando rótulos quando vou às compras, usando receitas personalizadas, percebendo como cada alimento impacta o meu bem-estar).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Com quem fazer uma alimentação mais adequada às minhas necessidades (por ex., com os amigos, com familiares, com colegas de trabalho).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Coping Planning

Para lidar com situações que possam dificultar a manutenção de uma alimentação adequada às minhas necessidades, tenho planos concretos sobre... *

	Discordo totalmente	Discordo	Concordo	Concordo totalmente
O que fazer se algo interferir com o meu objectivo (de fazer uma alimentação adequada às minhas necessidades).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
O que fazer se não tiver recursos suficientes para ter uma alimentação adequada às minhas necessidades.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Como organizar a minha rotina para minimizar o risco de consumir alimentos menos saudáveis para mim.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
O que fazer se as pessoas à minha volta não alterarem os seus hábitos alimentares.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Como lidar em caso de recaída, isto é, sobre como deverei agir se deixar de fazer uma alimentação adequada às minhas necessidades durante algum tempo.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Como manter uma alimentação adequada às minhas necessidades apesar de outras obrigações ou interesses.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Recovery Self-efficacy

	Discordo totalmente	Discordo	Concordo	Concordo totalmente
Tenciono fazer uma alimentação adequada às minhas necessidades regularmente.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pretendo fazer uma alimentação adequada às minhas necessidades todos os dias.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tenciono fazer uma alimentação adequada às minhas necessidades em, pelo menos, 6 dias da semana.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Action Control**Durante a última semana... ***

	Discordo totalmente	Discordo	Concordo	Concordo totalmente
Tenho avaliado regularmente quando, onde e como fazer uma alimentação adequada às minhas necessidades.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tenho avaliado o meu comportamento diariamente para verificar se estou a fazer uma alimentação adequada às minhas necessidades.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tenho tido sempre consciência da alimentação que é necessária para as minhas necessidades.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tenho tido sempre presente a intenção de fazer uma alimentação adequada às minhas necessidades.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tenho-me esforçado bastante por fazer uma alimentação adequada às minhas necessidades regularmente.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tenho tido o cuidado de fazer uma alimentação adequada às minhas necessidades tanto quanto eu tenciono.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Appendix 3. Study presentation and participants' informed consent form

(Chapters 2 and 3 - Stage 1)



FOODLIT-PRO: Food Literacy Project

Descrição do estudo

O estudo de doutoramento designado “FOODLIT-PRO: Food Literacy Project” (ou “FOODLIT-PRO: Projecto em Literacia Alimentar”), no âmbito da especialidade de Psicologia da Saúde, é financiado pela FCT – Fundação para a Ciência e a Tecnologia (referência SFRH/BD/128528/2017), orientado pela Prof. Doutora Isabel Leal (WJCR – William James Center for Research, ISPA – Instituto Universitário), e co-orientado pela Prof. Dra. Filipa Pimenta (WJCR, ISPA) e pelo Prof. Doutor Ralf Schwarzer (Freie Universität Berlin, Alemanha). Esta investigação estuda as características da literacia alimentar – área temática composta por várias componentes relacionadas com a alimentação, que visam promover o bem-estar físico e psicológico – em adultos Portugueses. Nesta primeira etapa, o objectivo do estudo é explorar a forma como profissionais Portugueses de áreas relacionadas com a alimentação entendem e percebem esta temática.

Informações e Procedimentos

Neste momento, convido-a/o a participar nesta etapa da investigação através da participação numa entrevista (com duração aproximada de 35 minutos) e do preenchimento das questões sócio-demográficas, de saúde, e de hábitos alimentares. Sublinha-se que a sua participação é voluntária, sendo possível desistir da sua participação a qualquer momento e sem que tal possa ter qualquer dano ou prejuízo. Assegura-se que todos os dados são totalmente confidenciais, sendo armazenados de acordo com a Lei da Protecção de Dados em vigor. Um código alfabético e numérico será atribuído de forma a identificar a/o entrevistada/o em todos os materiais (escritos e em formato audio). Se o desejar, poderá ter acesso aos resultados da investigação contactando a investigadora responsável por e-mail. Alguma questão adicional sobre os objectivos e/ou procedimentos do estudo, por favor, contacte a psicóloga e investigadora responsável.

Muito obrigada pela sua participação.

A Equipa FOODLIT-PRO,

Dra. Raquel Rosas (rrosas@ispa.pt)

Prof. Dra. Filipa Pimenta

Prof. Doutora Isabel Leal

Prof. Doutor Ralf Schwarzer

FOODLIT-PRO: Food Literacy Project

Website: <https://foodlitpro.wixsite.com/foodlitpro>

Email: foodlitpro@gmail.com / participantefoodlitpro@gmail.com

Consentimento Informado

No âmbito da presente investigação (referência SFRH/BD/128528/2017), na especialidade de Psicologia da Saúde, da responsabilidade da Dra. Raquel Rosas (William James Center for Research, ISPA - Instituto Universitário), declaro ter compreendido a explicação que me foi proporcionada acerca do estudo que se tenciona realizar, os seus objetivos, métodos, e benefícios previstos. Mais ainda, foi-me informada a total confidencialidade dos dados e dada a possibilidade de contactar a investigadora responsável para esclarecer qualquer questão.

Tomei conhecimento do carácter voluntário da participação neste estudo, bem como da possibilidade de poder desistir da minha participação a qualquer momento sem que tal possa ter qualquer dano ou prejuízo para mim.

Li o consentimento informado e aceito as suas condições.

___ Sim

___ Não

Appendix 4. Written authorisation for audio recording

(Chapters 2 and 3 - Stage 1)



FOODLIT-PRO: Food Literacy Project

Autorização para gravação de áudio

No âmbito da presente investigação (referência SFRH/BD/128528/2017), na especialidade de Psicologia da Saúde, da responsabilidade da Dra. Raquel Rosas (William James Center for Research, ISPA - Instituto Universitário), declaro ter compreendido a explicação que me foi proporcionada acerca do estudo que se tenciona realizar, os seus objectivos e procedimentos. Mais ainda, foi-me informada a total confidencialidade dos dados e dada a possibilidade de contactar a investigadora responsável para esclarecer qualquer questão.

Pelo acima indicado, autorizo a recolha de dados através da gravação áudio da minha entrevista sem nenhuma recompensa financeira ou de outro carácter. Esta autorização é concedida mediante o comprometimento da investigadora responsável em garantir-me os seguintes direitos:

- Poderei, se o desejar, ler a transcrição da minha entrevista;
- Os dados recolhidos são confidenciais, serão utilizados para fins exclusivamente relacionados com a presente investigação e publicações científicas decorrentes (p.ex., revistas científicas, congressos nacionais e internacionais);
- O armazenamento dos dados será feito de acordo com a Lei da Protecção de Dados em vigor;
- A minha identificação não será revelada em nenhuma das vias de disseminação científica (serão utilizados códigos para identificar os meus dados).

Consentimento Informado

Li o consentimento informado e aceito as suas condições.

___ Sim

___ Não

Appendix 5. Study presentation and participants' informed consent form

(Stage 2 - Chapters 4)



FOODLIT-PRO: Food Literacy Project

Descrição do estudo

O estudo de doutoramento designado FOODLIT-PRO: Food Literacy Project / FOODLIT-PRO: Projecto de Literacia Alimentar, no âmbito da especialidade de Psicologia da Saúde, é financiado pela FCT – Fundação para a Ciência e a Tecnologia (referência SFRH/BD/128528/2017), orientado pela Prof. Doutora Isabel Leal (WJCR – William James Center for Research, ISPA – Instituto Universitário), e co-orientado pela Prof. Dra. Filipa Pimenta (WJCR, ISPA) e pelo Prof. Doutor Ralf Schwarzer (Freie Universität Berlin, Alemanha).

Esta investigação estuda as características da literacia alimentar – área temática composta por várias componentes relacionadas com a alimentação, que visam promover o bem-estar físico e psicológico – em adultos Portugueses.

O objectivo deste estudo é compreender quais os conhecimentos e competências que os adultos Portugueses têm relativamente à sua alimentação - isto é, qual o nível de literacia alimentar.

Informações e Procedimentos

Ao preencher este questionário (que tem duração de aproximadamente 15 minutos) irá não só contribuir para a expansão do conhecimento científico nacional, como também ficar a conhecer um pouco mais sobre o seu próprio nível de literacia alimentar. No fim do preenchimento, receberá um breve perfil sobre os seus conhecimentos e competências de Literacia Alimentar.

Sublinha-se que a sua participação é voluntária, sendo possível desistir da sua participação a qualquer momento e sem que tal possa ter qualquer dano ou prejuízo.

Assegura-se que todos os dados são totalmente confidenciais, sendo armazenados de acordo com a Lei da Protecção de Dados em vigor. Um código numérico será atribuído de forma a

identificar a sua participação. Se o desejar, poderá ter acesso aos resultados da investigação contactando a investigadora responsável por e-mail.

Alguma questão adicional sobre os objectivos e/ou procedimentos do estudo, por favor, contacte a psicóloga e investigadora responsável.

Muito obrigada pela sua participação.

A Equipa FOODLIT-PRO,

Dra. Raquel Rosas (rrosas@ispa.pt)

Prof. Dra. Filipa Pimenta

Prof. Doutora Isabel Leal

Prof. Doutor Ralf Schwarzer

FOODLIT-PRO: Food Literacy Project

Website: <https://foodlitpro.wixsite.com/foodlitpro>

Email: foodlitpro@gmail.com / participantefoodlitpro@gmail.com

Consentimento Informado

No âmbito da presente investigação (referência SFRH/BD/128528/2017), na especialidade de Psicologia da Saúde, da responsabilidade da Dra. Raquel Rosas (William James Center for Research, ISPA - Instituto Universitário), declaro ter compreendido a explicação que me foi proporcionada acerca do estudo que se tenciona realizar, os seus objectivos, métodos, e benefícios previstos. Mais ainda, foi-me informada a total confidencialidade dos dados e dada a possibilidade de contactar a investigadora responsável para esclarecer qualquer questão.

Tomei conhecimento do carácter voluntário da participação neste estudo, bem como da possibilidade de poder desistir da minha participação a qualquer momento sem que tal possa ter qualquer dano ou prejuízo para mim.

Li o consentimento informado e aceito as suas condições.

___ Sim

___ Não

Appendix 6. Study presentation and participants' informed consent form (Stage 3 - Chapters 5 and 6)



Intervenção FOODLIT-PRO: Literacia Alimentar durante a Pandemia (COVID-19)

Consentimento Informado

Natureza e Objectivos da Intervenção

O “FOODLIT-PRO: Food Literacy Project” (ou “FOODLIT-PRO: Projecto em Literacia Alimentar”) é um estudo no âmbito da especialidade de Psicologia da Saúde, financiado a nível nacional pela FCT – Fundação para a Ciência e a Tecnologia (ref. SFRH/BD/128582/2017), que tem como missão a promoção de hábitos alimentares adequados na população adulta portuguesa.

A intervenção FOODLIT-PRO “Literacia Alimentar Durante a Pandemia (COVID-19)” é um estudo experimental, que tem como objectivo promover (i) a literacia alimentar – isto é, um conjunto de conhecimentos, competências e comportamentos relacionados com a alimentação - de adultos portugueses, bem como (ii) estratégias psicológicas associados à mudança de comportamentos de saúde.

Responsáveis pelo Estudo

Este projecto é desenvolvido por uma equipa de Psicólogos, especialistas na área da Saúde. A equipa integra a Dra. Raquel Rosas (WJCR – William James Center for Research, ISPA), a Prof. Doutora Isabel Leal (WJCR, ISPA), a Prof. Dra. Filipa Pimenta (WJCR, ISPA), e o Prof. Doutor Ralf Schwarzer (Freie Universität Berlin).

Duração e Entrega da Intervenção

Sendo um estudo longitudinal (isto é, com vários momentos ao longo do tempo), a intervenção FOODLIT-PRO compreende:

- Uma primeira fase, com duração de 11 semanas (a iniciar no dia 14 de setembro de 2020) que compreende a entrega de estratégias de mudança de comportamentos e de materiais informativos;

- Uma segunda fase, com três momentos de monitorização posteriores à intervenção; estes três momentos compreendem uma breve recolha de dados e serão realizados após 3, 6, e 9 meses do final da primeira fase.

Todas as componentes da intervenção (entrega de materiais e recolha de dados) decorrerão exclusivamente através de canais digitais e tecnológicos. Todos os materiais a ser entregues estão cientificamente suportados pela literatura no âmbito da Psicologia da Saúde.

Benefícios Associados à Participação

A intervenção FOODLIT-PRO: Literacia Alimentar Durante a Pandemia (COVID-19) tem como expectativa melhorar a literacia alimentar dos participantes.

Todos os participantes estão automaticamente inscritos em dois sorteios aleatórios, sendo que cada sorteio irá oferecer um Cartão Presente Sonae Sierra com o valor de 50 EUROS.

- O primeiro sorteio será realizado no final da primeira fase (após as 11 semanas), e participarão no sorteio todos os participantes que finalizarem as 11 semanas de intervenção;
- O segundo sorteio será realizado após o último momento de monitorização posterior à intervenção (9 meses após o final da primeira fase), e participarão no sorteio todos os participantes que finalizem as 11 semanas de intervenção e os três momentos de monitorização (3, 6, e 9 meses após a primeira fase).

Todos os participantes – incluindo Grupo Experimental e Grupo de Controlo – participarão nos sorteios, se verificados os critérios acima mencionados.

Crítérios de Inclusão dos Participantes

Para participar na intervenção, os critérios de inclusão são: ter idade igual ou superior a 18 anos, e ter alguma experiência na selecção, aquisição, e confecção de alimentos.

Grupo Experimental e Grupo de Controlo

Todos os participantes serão aleatoriamente distribuídos a um dos dois grupos: Grupo Experimental ou Grupo de Controlo.

- Todos os participantes terão acesso a materiais gratuitos relacionados com conhecimentos, competências e comportamentos alimentares; os participantes do Grupo Experimental terão também acesso a materiais referentes a estratégias e

mecanismos de mudança comportamental, bem como a ferramentas digitais adicionais.

- Após a conclusão da segunda fase da intervenção, os participantes atribuídos ao Grupo de Controlo poderão ter acesso gratuito a todos os materiais e ferramentas digitais disponibilizadas ao Grupo Experimental, se assim o solicitarem e sem qualquer encargo ou requerimento.

A fim de evitar o enviesamento dos resultados da intervenção, não será permitido qualquer contacto – que não o previamente estipulado como parte da intervenção – ou qualquer forma de mediação entre a Equipa FOODLIT-PRO (equipa de Psicólogos responsável pelo projecto) e os participantes (de Grupo Experimental e Grupo de Controlo).

Mecanismos Digitais, Notificações e Dados Pessoais

Para fins de tratamento de dados, a identificação de todos os participantes é codificada pelos próprios através do **Código Pessoal de Participante** (que tem por base as iniciais do nome completo e os últimos dois dígitos do ano de nascimento). A confidencialidade dos dados é assegurada, sendo os mesmos codificados e garantindo o anonimato para a divulgação dos resultados obtidos em meios exclusivamente científicos.

Para concretizar a entrega da intervenção online e digital a todos os participantes, os seguintes dados são necessários: contacto telefónico e endereço de email.

- Contacto telefónico: esta forma de contacto será utilizada para o envio de mensagens escritas (SMS) a notificar a disponibilização de materiais, bem como a notificar os momentos de monitorização. O contacto telefónico será também utilizado para permitir ao participante a interação voluntária, através da aplicação de mensagens instantâneas “WhatsApp”, com outros participantes (Grupo Experimental). Apesar do contacto telefónico ser visível a outros participantes na utilização da aplicação “Whatsapp”, é da escolha do participante o nome e imagem com que se apresenta na aplicação - podendo utilizar, por exemplo, o Código Pessoal de Participante ou um nome fictício para a sua identificação.
- Endereço de email: esta forma de contacto será utilizada para o envio do link de acesso aos materiais da intervenção, bem como para o envio dos materiais necessários aos momentos de monitorização.

Qualquer participante pode interromper a sua participação a qualquer momento na intervenção, sem quaisquer penalizações ou prejuízos.

Realça-se que a sua participação é de elevada importância para a expansão do conhecimento científico nacional, e sublinha-se que a sua participação é voluntária.

Para quaisquer questões adicionais ou esclarecimentos **prévios à participação na intervenção**, contacte a Psicóloga e Investigadora Responsável (Dra. Raquel Rosas).

Muito obrigado pelo seu interesse e disponibilidade.

A Equipa FOODLIT-PRO,

Dra. Raquel Rosas (rrosas@ispa.pt)

Prof. Dra. Filipa Pimenta

Prof. Doutora Isabel Leal

Prof. Doutor Ralf Schwarzer

FOODLIT-PRO: Food Literacy Project

Website: <https://foodlitpro.wixsite.com/foodlitpro>

Email: foodlitpro@gmail.com / participantefoodlitpro@gmail.com

Consentimento Informado

Li o consentimento informado e aceito as suas condições.

Sim

Não

Appendix 7. Socio-demographic questionnaire (all Stages - from Chapters 2 to 6)



Questionário sócio-demográfico

Data de nascimento: ____ / ____ / ____ (dia/mês/ano)

Idade:

Sexo: Feminino ____ Masculino ____

Nacionalidade: _____

Estado civil: Solteira/o ____ União de Facto ____ Casada/o ____
Separada/o ____ Divorciada/o ____ Viúva/o ____

Mantém actualmente uma relação afectivo-sexual? Sim ____ Não ____

Número de filhos: _____

Habilitações literárias completas: Sem escolaridade ____ 4.^a classe ____

7.º ano ____ 9.º ano ____

12.º ano ____ Bacharelato ____

Licenciatura ____ Mestrado ____

Doutoramento ____ Outro: _____

Situação profissional: Activa/o ____ Desempregada/o ____

Reformada/o ____ Outro: _____

Profissão: _____

Rendimento anual familiar: Até 10.000€ ____ entre 10.001€ a 20.000€ ____

entre 20.001€ a 37.500€ ____ entre 37.501€ a 70.000€ ____

superior a 70.001€ ____

Teve recentemente alguma(s) doença(s)? Sim _____ Não _____

Se sim, qual (quais)? _____

Qual é o seu peso actual? _____ kg

Qual é a sua altura? _____ cm

Se é do sexo feminino, está actualmente grávida? Sim _____ Não _____

Se é do sexo feminino, está actualmente a amamentar? Sim _____ Não _____

Se é do sexo feminino, já teve a menopausa (última menstruação, seguida de 12 meses sem menstruação)? Sim _____ Não _____

É fumador(a)? Sim _____ Não, sou ex-fumador(a) _____ Não, nunca fumei _____

Caso seja fumador(a), fuma todos os dias? Sim _____ Não _____

Caso seja fumador(a), que quantidade de cigarros fuma? _____ cigarros por semana

Consome bebidas alcoólicas? Sim _____ Não _____

Se sim, com que frequência?

De 1 a 2 vezes por semana _____ De 3 a 5 vezes por semana _____

De 6 a 7 vezes por semana _____ Mais de 7 vezes por semana _____

Se sim, que quantidade consome em cada ocasião?

Entre 1 a 2 copos _____ Entre 3 a 5 copos _____ Mais de 5 copos _____

Consome café? Sim _____ Não _____

Se sim, quantos cafés costuma tomar?

Menos de 1 café por dia _____ De 1 a 2 cafés por dia _____

De 3 a 5 cafés por dia _____ Mais de 5 cafés por dia _____

Considerando a sua própria alimentação, é responsável por:

(selecione **qual ou quais as opções** que se aplicam ao seu caso)

Escolha dos alimentos _____ Compra dos alimentos _____
Preparação dos alimentos _____ Confeção dos alimentos _____

Está actualmente em algum regime alimentar específico?

(por ex., dieta mediterrânea, dieta paleolítica, vegetarianismo, veganismo)

Sim _____ Não _____

Se sim, que tipo de regime? _____

Se sim, é um regime prescrito por um profissional de saúde?

(p. ex., médico, nutricionista)?

Sim _____ Não _____

Se sim, qual a razão do regime? _____

Com que frequência recorre a serviços de restaurantes/cantinas/snack-bar/take-away?

Nunca _____ Menos de 1 vez por semana _____ De 1 a 2 vezes por semana _____
De 3 a 5 vezes por semana _____ Mais de 5 vezes por semana _____

Pratica algum tipo de actividade física?

(p.ex., caminhadas, ginásio)

Sim _____ Não _____

Se sim, que tipo de actividade? _____

Se sim, quantas vezes por semana? _____

Se sim, durante quanto tempo é que exercita por cada sessão? _____ minutos

Appendix 8. Framework A, adapted from Amouzandeh et al. (2019) and Vidgen and Gallegos, (2014)

(Chapter 2 - Stage 1)

Categories	Attributes
1 - Plan and Management	1.1 Prioritise money and time for food
	1.2 Plan food intake (formally and informally) so that food can be regularly accessed through some source, irrespective of changes in circumstances or environment
	1.3 Make feasible food decisions which balance food needs (e.g. nutrition, taste, hunger) with available resources (e.g. time, money, skills, equipment)
2 - Select	2.1 Access food through multiple sources and know the advantages and disadvantages of
	2.2 Determine what is in a food product, where it came from, how to store it and use it
	2.3 Judge the quality of food
3 - Prepare	3.1 Make a good tasting meal from whatever food is available. This includes being able to prepare commonly available foods, efficiently use common pieces of kitchen equipment and having a sufficient repertoire of skills to adapt recipes (written or unwritten) to experiment with food and ingredients
	3.2 Apply basic principles of safe food hygiene and handling
4 - Eat	4.1 Understand food has an impact on personal wellbeing
	4.2 Demonstrate self-awareness of the need to personally balance food intake. This includes knowing foods to include for good health, foods to restrict for good health, and appropriate portion size and frequency
	4.3 Join in and eat in a social way

Appendix 9. Framework B, adapted from Perry et al. (2017) and Thomas et al. (2019)**(Chapter 2 - Stage 1)**

Categories	Attributes
1 - Food and Nutrition Knowledge	1.1 Food knowledge
	1.2 Nutrition knowledge
	1.3 Food and nutrition language
2 - Food Skills	2.1 Food skills
3 - Self-efficacy and Confidence	3.1 Nutrition literacy
	3.2 Food and nutrition self-efficacy
	3.3 Cooking self-efficacy
	3.4 Food attitude
4 - Ecologic Factors	4.1 Food systems
	4.2 Social determinants of health
5 - Food Decisions	5.1 Dietary behaviour

Appendix 10. Framework C, adapted from Truman and Elliot (2018)**(Chapter 2 - Stage 1)**

1 - Knowledge (lack of information)

2 - Attitudes (lack of interest)

3 - Skills/Abilities (lack of acquisition/application skills)

4 - Resources (lack of time)

5 - Environmental conditions (context-specific limitations of home, school, food-choice environment, and social norms)

Appendix 11. FOODLIT-Tool (Rosas et al., 2021) - English version

(Chapters 4, 5 and 6 - Stages 2 and 3)

Food literacy dimension	Item	Response scale	
Culinary competencies	I easily prepare everything that is necessary to make a	Frequency (0 - <i>never</i> ; 1 - <i>sometimes</i> ; 2 - <i>frequently</i> ; 3 - <i>always</i>)	
	I combine different ingredients to create a suitable meal.		
	I adapt recipes to be more to my taste.		
	I use kitchen equipment and utensils (e.g., oven, blender) efficiently.		
	I cook adequate meals with what I usually have at home.		
	I cook in different ways (e.g., stewing, baking).		
	I enjoy cooking.		
Production and quality	I have knowledge of different types of preservation (e.g., freezing, salting) suitable for different foods.	Agreement (0 - <i>totally disagree</i> ; 1 - <i>disagree</i> ; 2 - <i>agree</i> ; 3 - <i>totally agree</i>)	
	I recognise the impacts of pesticides and/or herbicides on food.	Agreement (0 - <i>totally disagree</i> ; 1 - <i>disagree</i> ; 2 - <i>agree</i> ; 3 - <i>totally agree</i>)	
	I know what organic products are (e.g., food grown without pesticides).		
Selection and planning	I know the impact that organic products have on food-related sustainability (e.g., less soil contamination).	Frequency (0 - <i>never</i> ; 1 - <i>sometimes</i> ; 2 - <i>frequently</i> ; 3 - <i>always</i>)	
	I control the calories and/or other nutritional characteristics of the food I eat daily.		
	I read and interpret food labels to select the most appropriate foods.		
	I make informed food choices		
	I dedicate time and invest in food selection (e.g., when I go shopping).		
	I can easily substitute one food for another nutritionally equivalent one.		Agreement (0 - <i>totally disagree</i> ; 1 - <i>disagree</i> ; 2 - <i>agree</i> ; 3 - <i>totally agree</i>)
	I plan various aspects of my diet.		Frequency (0 - <i>never</i> ; 1 - <i>sometimes</i> ; 2 - <i>frequently</i> ; 3 - <i>always</i>)
I plan my meals in advance.	Frequency (0 - <i>never</i> ; 1 - <i>sometimes</i> ; 2 - <i>frequently</i> ; 3 - <i>always</i>)		

Environmentally safe	I apply food hygiene and safety practices (e.g., storing food at appropriate temperatures, cleaning utensils).	Frequency (0 - <i>never</i> ; 1 - <i>sometimes</i> ; 2 - <i>frequently</i> ; 3 - <i>always</i>)
	I buy local/national trade products to support local/national business.	
	I eat food according to its seasonality.	
Origin	I am aware of the time of year of each food.	Agreement (0 - <i>totally disagree</i> ; 1 - <i>disagree</i> ; 2 - <i>agree</i> ; 3 - <i>totally</i>)
	I can identify the origin of a food (that is, where a food comes from). I can identify how a food is produced and processed (that is, how it is manufactured, how it is packaged).	Frequency (0 - <i>never</i> ; 1 - <i>sometimes</i> ; 2 - <i>frequently</i> ; 3 - <i>always</i>)
Food literacy determinants	Item	Response scale
Internal and external determinants	My financial resources influence my eating habits.	Agreement (0 - <i>totally disagree</i> ; 1 - <i>disagree</i> ; 2 - <i>agree</i> ; 3 - <i>totally agree</i>)
	It is hard to find time to invest in my diet.	
	It is important that my diet is practical and convenient.	
	Having an adequate diet is a priority for me.	
	The available information on food is excessive and/or contradictory.	
Food literacy influential	Item	Response scale
Nutritional	In my diet, I take into account my nutritional needs.	Frequency (0 - <i>never</i> ; 1 - <i>sometimes</i> ; 2 - <i>frequently</i> ; 3 - <i>always</i>)
Social	It is important for me to have the support of those around me (family, friends) regarding my diet.	Agreement (0 - <i>totally disagree</i> ; 1 - <i>disagree</i> ; 2 - <i>agree</i> ; 3 - <i>totally agree</i>)
Health	My health is influenced by what I eat.	
Sustainability	My food decisions have an impact on the climate's sustainability.	
Learning contexts	When I have questions about food, I know where to find reliable information.	Frequency (0 - <i>never</i> ; 1 - <i>sometimes</i> ; 2 - <i>frequently</i> ; 3 - <i>always</i>)
Cultural	Moments with my family or with my friends are always accompanied by food.	

Industry	As a consumer, my food decisions influence the food industry (e.g., availability of food outside its season, importation of food).	Agreement (0 - <i>totally disagree</i> ; 1 - <i>disagree</i> ; 2 - <i>agree</i> ; 3 - <i>totally agree</i>)
Policy	Food policies (e.g., tax on sugary drinks) influence my eating decisions.	
Psychological	My emotions influence my eating habits.	Frequency (0 - <i>never</i> ; 1 - <i>sometimes</i> ; 2 - <i>frequently</i> ; 3 - <i>always</i>)

Appendix 12. FOODLIT-Tool (Rosas et al., 2021) - Versão Portuguesa

(Chapters 4, 5 and 6 - Stages 2 and 3)

Dimensão literacia	Item	Escala de resposta
Competências culinárias	Preparo facilmente tudo o que é necessário para fazer uma refeição.	Frequência (0 - <i>nunca</i> ; 1 - <i>algumas vezes</i> ; 2 - <i>frequentemente</i> ; 3 - <i>sempre</i>)
	Combino diferentes ingredientes para criar uma refeição adequada.	
	Adapto receitas para ficarem mais ao meu gosto.	
	Utilizo equipamentos e utensílios de cozinha (por ex., forno, varinha mágica) de forma eficiente.	
	Cozinho refeições adequadas com o que geralmente tenho em casa.	
	Cozinho de diferentes maneiras (por ex., estufar, assar).	
	Sinto prazer a cozinhar.	
Produção e qualidade	Tenho conhecimentos sobre diferentes tipos de conservação (por ex., congelar, salgar) adequados a diferentes alimentos.	Concordância (0 - <i>discordo totalmente</i> ; 1 - <i>discordo</i> ; 2 - <i>concordo</i> ; 3 - <i>concordo totalmente</i>)
	Reconheço os impactos dos pesticidas e/ou herbicidas nos alimentos.	Concordância (0 - <i>discordo totalmente</i> ; 1 - <i>discordo</i> ; 2 - <i>concordo</i> ; 3 - <i>concordo totalmente</i>)
	Sei o que são produtos biológicos (por ex., alimentos cultivados sem pesticidas).	
Sei o impacto que os produtos biológicos têm na sustentabilidade da alimentação (por ex., menor contaminação do solo).		
Produção e qualidade	Controlo as calorias e/ou outras características nutricionais dos alimentos que consumo diariamente.	Frequência (0 - <i>nunca</i> ; 1 - <i>algumas vezes</i> ; 2 - <i>frequentemente</i> ; 3 - <i>sempre</i>)
	Leio rótulos alimentares para seleccionar quais os alimentos mais adequados.	
	Faço escolhas alimentares informadas.	

Seleção e planejamento	Dedico tempo e invisto na seleção de alimentos (por ex., quando vou às compras).	
	Consigo substituir um alimento por outro nutricionalmente equivalente com facilidade.	Concordância (0 - <i>discordo totalmente</i> ; 1 - <i>discordo</i> ; 2 - <i>concordo</i> ; 3 - <i>concordo totalmente</i>)
	Planeio vários aspectos da minha alimentação.	Frequência
	Planeio as minhas refeições antecipadamente.	(0 - <i>nunca</i> ; 1 - <i>algumas vezes</i> ; 2 - <i>frequentemente</i> ; 3 - <i>sempre</i>)
Sustentável e seguro	Aplico práticas de higiene e segurança alimentar (por ex., armazenar alimentos a temperaturas adequadas, limpar utensílios).	Frequência
	Consumo produtos de comércio local/nacional, para apoiar negócios locais/nacionais.	(0 - <i>nunca</i> ; 1 - <i>algumas vezes</i> ; 2 - <i>frequentemente</i> ; 3 - <i>sempre</i>)
	Consumo alimentos de acordo com a época do ano em que estou.	
	Tenho conhecimento sobre qual é a época do ano de cada alimento.	Concordância (0 - <i>discordo totalmente</i> ; 1 - <i>discordo</i> ; 2 - <i>concordo</i> ; 3 - <i>concordo totalmente</i>)
Origem	Consigo identificar a origem de um alimento (isto é, de onde vem um alimento).	Frequência
	Consigo identificar como é que um alimento é produzido e processado (isto é, como é fabricado, como	(0 - <i>nunca</i> ; 1 - <i>algumas vezes</i> ; 2 - <i>frequentemente</i> ; 3 - <i>sempre</i>)
Determinantes de literacia	Item	Escala de resposta
Determinantes internos e externos	Os meus recursos financeiros influenciam a alimentação que faço.	
	É difícil arranjar tempo para investir na minha	
	É importante que a minha alimentação seja prática e conveniente.	Concordância (0 - <i>discordo totalmente</i> ; 1 - <i>discordo</i> ; 2 - <i>concordo</i> ; 3 - <i>concordo totalmente</i>)
	Ter uma alimentação adequada é uma prioridade para	
	A informação disponível sobre alimentação é excessiva e/ou contraditória.	
Factores de influência de literacia	Item	Escala de resposta

Nutricional	Tenho em conta as minhas necessidades nutricionais na minha alimentação.	Frequência (0 - <i>nunca</i> ; 1 - <i>algumas vezes</i> ; 2 - <i>frequentemente</i> ; 3 - <i>sempre</i>)
Social	É importante para mim ter o apoio dos que me rodeiam (família, amigos) em relação à minha alimentação.	
Saúde	A minha saúde é influenciada pela alimentação que	Concordância
Sustentabilidade	As minhas decisões alimentares têm impacto na sustentabilidade do ambiente.	(0 - <i>discordo totalmente</i> ; 1 - <i>discordo</i> ; 2 - <i>concordo</i> ; 3 - <i>concordo totalmente</i>)
Contextos de aprendizagem	Quando tenho dúvidas sobre alimentação, sei onde encontrar informação fiável.	
Cultural	Momentos com a minha família ou com os meus amigos são sempre acompanhados por comida.	Frequência (0 - <i>nunca</i> ; 1 - <i>algumas vezes</i> ; 2 - <i>frequentemente</i> ; 3 - <i>sempre</i>)
Indústria	Enquanto consumidor(a), as minhas decisões alimentares influenciam a indústria alimentar (por ex., disponibilidade do alimento fora da sua época do ano, importação de alimentos).	Concordância (0 - <i>discordo totalmente</i> ; 1 - <i>discordo</i> ; 2 - <i>concordo</i> ; 3 - <i>concordo totalmente</i>)
Política	As políticas alimentares (por ex., imposto nas bebidas açucaradas) têm influência nas minhas decisões alimentares.	
Psicológico	As minhas emoções influenciam a alimentação que faço.	Frequência (0 - <i>nunca</i> ; 1 - <i>algumas vezes</i> ; 2 - <i>frequentemente</i> ; 3 - <i>sempre</i>)



Como preparar o que é necessário para fazer uma refeição?

Antes de começar a confeção da refeição, prepare tudo o que será necessário:

- verifique se tem todos os **ingredientes** que quer utilizar (e em quantidades suficientes);
- se vai utilizar uma **receita**, leia-a do início ao fim antes de começar a "parte prática";
- verifique se tem todos os **utensílios** necessários para a confeção (por ex., espiralizador);
- antes de começar a cozinhar, **prepare** todos os ingredientes que irá utilizar:
(lavar, descascar, cortar legumes/frutas, arranjar peixe/carne, cozer ou escoar e lavar leguminosas, etc.)

SABIA QUE... *Mise en place* é o termo profissional que designa a prática de organizar ingredientes e utensílios antes de iniciar a confeção de uma refeição.

Veja as imagens e o vídeo que se seguem:



Como combinar diferentes ingredientes para criar uma refeição?

Actualmente, são várias as plataformas gratuitas que nos ajudam a combinar um conjunto de ingredientes para fazer uma refeição completa a partir de um ingrediente que queiramos utilizar.

Para este desafio, aconselhamos que utilize o site **24Kitchen.pt** que lhe irá dar múltiplas opções de refeições (por ex., entrada, prato principal, sobremesa) de diversos regimes alimentares (por ex., cozinha portuguesa, italiana, vegetariana) e de vários Chefes nacionais e internacionais (por ex., Filipa Gomes, Henrique Sá Pessoa, Jamie Oliver).

Siga este breve tutorial e boas confeções!



1

USE O BOTÃO DE PESQUISA

2

PROCURE UM INGREDIENTE QUE QUEIRA UTILIZAR

Como preparar uma sopa | EIPAS
Alimentação Saudável (PNPAS-DGS)

3

ESCOLHA INGREDIENTES, PRATOS, TIPOS DE COZINHA OU CHEFES

4

TENHA ACESSO À RECEITA, LISTA DE INGREDIENTES E MODO DE PREPARAÇÃO.

Week 4: Cooking

Como utilizar equipamentos e utensílios de cozinha de forma eficiente?

Para que integre na sua rotina o uso de diversos utensílios de cozinha, seleccionámos alguns vídeos que mostram, de forma simples e prática, **receitas** (de pequeno-almoço/lanche, almoço/jantar, e sobremesa) **com recurso a diferentes utensílios e equipamentos de cozinha.**

Veja os vídeos que se seguem e espereite as restantes sugestões:

1 BOLINHO = 22 Kcal
120g de grão-de-bico cozido
CONTÉM FIBRA
CONTÉM VITAMINA A
CONTÉM POTÁSSIO

150g DE GRÃO DE-BICO COZIDO

ALMOÇO / JANTAR
Bolinhos de bacalhau e grão-de-bico
Para ver o vídeo clique aqui

PEQUENO-ALMOÇO / LANCHE
Torradas saudáveis de batata-doce
Para ver o vídeo clique aqui

Tenha acesso a outras sugestões de receitas que utilizam diversos equipamentos e utensílios de cozinha

SOPA DE COENTROS (VEJA AQUI)

SALADA DE ABÓBORA ESPIRALIZADA (VEJA AQUI)

CANELONES DE BACALHAU (VEJA AQUI)

BOLO DE CENOURA E LARANJA (VEJA AQUI)

Como cozinhar mais de diferentes maneiras?

A nossa cozinha permite-nos, por norma, inúmeras possibilidades de dar asas à nossa criatividade. Especialmente no que diz respeito à forma como cozinhamos as nossas refeições!

Assim, propomos-lhe como desafio **cozinhar, pelo menos, de 3 diferentes maneiras** as suas refeições.

Para inspiração, deixamos alguns métodos de confeção que pode utilizar:

- assar (utilizando o forno)
- cozer a vapor (utilizando um escoaador de metal; veja como aqui)
- estufar ou guisar (utilizando uma panela)
- saltar (utilizando uma frigideira anti-aderente)
- grelhar (utilizando um grelhador)

Veja as imagens que se seguem e... bons cozinhados!

COVID-19

UTILIZE DIFERENTES MÉTODOS DE CONFEÇÃO

NO FORNO, AO VAPOR, SALTEADOS OU APENAS TEMPERADOS

COVID-19

DÊ DIFERENTES FORMAS AOS PRODUTOS HORTÍCOLAS

BASTA USAR A IMAGINAÇÃO

GOVERNAMENTO DA REPÚBLICA
RESTAURACION
#MERCADOVERDE

GOVERNAMENTO DA REPÚBLICA
RESTAURACION
#MERCADOVERDE

Accede a estas e outras informações da DGS - Direção-Geral da Saúde em <https://www.facebook.com/dgscogerasaude/photos/?fbclid=IwAR1...>

Week 5: Choice and selection

Como fazer escolhas alimentares informadas ?

Para ajudar a fazer decisões informadas na sua alimentação, partilhámos consigo algumas dicas sobre a escolha de alimentos.

Veja a infografia que se segue e aplique estas dicas nos seus momentos de escolha alimentar.

A que alimentos deve ser dada preferência?

A escolha dos alimentos para cada um destes grupos deve ter em consideração a capacidade de armazenamento (refrigeração e congelação), bem como as preferências pessoais.

Dos alimentos do grupo dos **cereais e derivados e tubérculos**, a compra de pão poderá ser uma opção caso exista capacidade de armazenamento no domicílio para congelar o pão. Poderá optar por comprar farinha e fazer o seu próprio pão.

CEREAIS DE PEQUENO-ALMOÇO
Boa durabilidade
Elevada riqueza nutricional
Não necessitam de ser armazenados no frigorífico

PÃO
Boa durabilidade
Elevada riqueza nutricional
Não necessitam de ser armazenados no frigorífico

Do grupo dos **hortícolas e da fruta** deve ser dada preferência aos que apresentam uma maior durabilidade, mas ao mesmo tempo devem ser privilegiados os produtos frescos que são importantes para manter uma alimentação equilibrada nestas situações.

Para os hortícolas destacam-se os seguintes: cenoura, cebola, courgette, abóbora, brócolos, couve-flor, feijão-verde e alho. Os hortícolas de folha verde e o tomate, também poderão fazer parte da lista de compras mas em menor quantidade e deverão ser consumidos nos primeiros dias da quarentena. Mediante a capacidade de armazenamento à temperatura de congelação, os produtos hortícolas congelados podem também ser uma boa opção.

Para a fruta destacam-se as seguintes variedades: maçã, pera, laranja e tangerina. Outras variedades com menor durabilidade podem ser também adquiridas mas em menor quantidade.

HORTÍCOLAS COM MAIOR DURABILIDADE
Cenoura, cebola, courgette, abóbora, brócolos, couve-flor, feijão verde, produtos hortícolas congelados (mediante a capacidade de congelador)

FRUTA COM MAIOR DURABILIDADE
Maçã, pera, laranja, tangerina

Outros alimentos não referidos anteriormente podem ser considerados na lista de compras, nomeadamente tomate pelado, frutos oleaginosos (nozes, amêndoas...), manteiga/creme vegetal, compostos e café.

FRUTOS OLEAGINOSOS (nozes, amêndoas, aveia)
Podem ser uma boa opção como snack.
Elevada densidade nutricional, fonte de fibra, ricos em vitaminas como a vitamina E e minerais.
Produtos com elevada durabilidade

OUTROS PRODUTOS ALIMENTARES
Café
Tomate pelado
Compostos

Do grupo da **carne, pescado e ovos**, destacam-se os ovos como alimentos que apresentam uma boa durabilidade, uma elevada riqueza nutricional e que não necessitam de estar armazenados no frigorífico.

As conservas de pescado também podem ser utilizadas para algumas das refeições e o pescado e carne poderão ser adquiridos quer em congelado ou fresco, contudo o pescado e a carne frescos devem ser utilizados para os primeiros dois dias.

Se ao final do 3º dia não tiver utilizado toda a carne fresca adquirida, para aumentar a sua durabilidade, pode congelá-la ou então confeccionar para consumir mais tarde. Os alimentos confeccionados conservam-se bem e com qualidade por um período de 3 dias no frigorífico.

OVOS
Boa durabilidade
Elevada riqueza nutricional
Não necessitam de ser armazenados no frigorífico

CONSERVAS DE PESCADO
Boa opção para algumas refeições

PESCADO CONGELADO
Boa durabilidade (gerir quantidades de acordo com a capacidade de armazenamento)

PESCADO FRESCO
Deve ser utilizado para consumo em 2/3 dias após a compra

CARNE CONGELADA
Boa durabilidade (gerir quantidades de acordo com a capacidade de armazenamento)

CARNE FRESCA
Deve ser utilizado para consumo em 2/3 dias após a compra

Deve ter-se atenção aos alimentos perecíveis, sendo importante ir avaliando as suas características ao longo do tempo. Não consuma nenhum alimento cuja aparência, cor, sabor ou odor tenham características diferentes do habitual.

Para as **leguminosas** (feijão, grão, ervilhas, lentilhas...), tanto as vendidas em conserva como as secas podem ser opções a considerar. As leguminosas têm proteínas de elevada qualidade, que podem ser alternativas à carne e pescado. Assim, pode sempre experimentar fazer algumas refeições sem carne ou pescado.

Para o **grupo dos laticínios**, a escolha de laticínios para este Kit Alimentar de Quarentena deverá depender da capacidade de armazenamento no frio de cada domicílio.

Nesta list não fazemos referência à água, pois a água da rede pública é adequada para consumo. Pode assim ser um produto a economizar neste carrinho de compras.

LEGUMINOSAS
Secas ou em conserva
Podem ser alternativas à carne, pescado e ovos

LEITE
Boa durabilidade
Igualares (avaliar capacidade de armazenamento no frigorífico)

ÁGUA
A água da rede pública é adequada para consumo
Pode assim ser um produto a economizar neste carrinho de compras

Por último, para os agregados familiares que apresentem **crianças pequenas**, poderá ser importante não esquecer alguns alimentos exclusivos para os mais pequenos, como as papas de cereais infantis e os bolões de fruta.

Aceda a estas e outras informações da DGS - Direção-Geral da Saúde em <https://nutrimento.pt/noticias/covid-19-orientacoes-na-area-da-alimentacao/>

FOODLIT-PRO

O que deve ser tido em consideração no momento da compra?

No momento da compra, deve-se ter também alguns cuidados:

- **Verificar e cumprir a lista de compras**, sempre que os alimentos que necessita estiverem disponíveis. Comprar apenas o que precisa!
- **Optar por alimentos que tenham um prazo de validade mais longo.**
- **Garantir que o seu cesto de compras tem um bom equilíbrio entre alimentos com menor e maior durabilidade.** Os alimentos com menor durabilidade podem ser adquiridos, contudo devem estar presentes em menor quantidade e deverão ser os primeiros a consumir.
- **Preferir alimentos de elevado valor nutricional em detrimento de alimentos com elevada densidade energética** (ou seja, reduzir o consumo de alimentos que fornecem muita energia, mas poucas nutrientes).
- **Assegurar a compra de produtos frescos**, como fruta e hortícolas, preferindo aqueles que apresentarem uma maior durabilidade (nos produtos congelados para o caso dos hortícolas e mediante a capacidade de armazenamento).

Aceda a estas e outras informações da DGS - Direção-Geral da Saúde em <https://nutrimento.pt/noticias/covid-19-orientacoes-na-area-da-alimentacao/>

Week 7: Nutrition and intake

Como controlar o meu consumo alimentar diário ?

Para ajudar na monitorização do seu consumo alimentar, partilhámos consigo alguns materiais que o pode usar.

Veja as infografias que se seguem e **analise os diferentes alimentos nas porções oficiais recomendadas.**

Utilize estes materiais para ajudar na monitorização da sua ingestão alimentar.

* Mas não se esqueça de consultar a infografia sobre a importância da ingestão alimentar adequada e a importância da ingestão alimentar adequada e a importância da ingestão alimentar adequada.

DIA ALIMENTAR COMPLETO, EQUILIBRADO E VARIADO

ACORDO COM O PLANO NACIONAL DE ALIMENTAÇÃO E NUTRIÇÃO (2018-2030) E O PLANO NACIONAL DE ALIMENTAÇÃO E NUTRIÇÃO (2018-2030)

Este infográfico apresenta as porções oficiais recomendadas para cada grupo alimentar, de acordo com o Plano Nacional de Alimentação e Nutrição (2018-2030).

As porções são apresentadas em unidades de medida padronizadas, de acordo com o Plano Nacional de Alimentação e Nutrição (2018-2030).

As porções são apresentadas em unidades de medida padronizadas, de acordo com o Plano Nacional de Alimentação e Nutrição (2018-2030).

Meta 1 Dietas Saudáveis

Uma dieta saudável deve equilibrar e variar, dividida como um prato de comida bem-estar físico, mental e social e não apenas a ausência de doenças. Deve obedecer aos princípios da alimentação saudável e regular, com variedade e equilíbrio de nutrientes.

Figura 1
Um prato de comida saudável deve conter um volume de aproximadamente meio prato de vegetais e frutas, a outra metade, nomeadamente uma variedade de cereais, carne, peixe ou ovos, e uma pequena quantidade de produtos lácteos e leguminosas. Deve ser acompanhado por uma pequena quantidade de alimentos ricos em gordura, como azeite ou manteiga.



Para conhecer em maior detalhe o carácter nutricional dos alimentos que consome diariamente, indicamos-lhe também um recurso digital:

a app (ou site) FatSecret

Disponível na App Store, Google Play e Microsoft, este recurso tecnológico permite-lhe não só saber o valor nutricional de cada alimento, como também fazer o registo do seu próprio Diário Alimentar.

Explore o **FatSecret** e saiba mais sobre a sua ingestão alimentar.



Como ler e interpretar rótulos alimentares ?

Para ajudar a seleccionar alimentos, a leitura e interpretação de rótulos é muito importante.

Os descodificadores de rótulos vão ajudar a seleccionar, com mais facilidade, alimentos e bebidas.

Guarde os descodificadores no seu smartphone e tome as suas escolhas alimentares mais fáceis e adequadas!



Como cozinhar refeições com o que geralmente tenho em casa ?

Para ajudar a criar uma refeição adequada com o que tem disponível em casa, mostramos-lhe dois materiais em forma visual.

Analisar as infográficas como compor uma refeição com alimentos de todos os grupos alimentares.

Com estas informações, crie as refeições que mais gosta de forma adequada às suas necessidades!

"Mas eu já vi esta infográfica."

Deixe ver, analise a infográfica dando especial atenção às diferenças entre os dois grupos alimentares!



1 A sua chave para o sucesso

fatsecret

2

Acceda a estas e outras informações em:

"Pluribus da Nova Roda dos Alimentos" do Programa Nacional para a Promoção da Alimentação Saudável (PNPAS), DGCS - Direcção-Geral de Saúde: <https://alimentacaosaudavel.dgcs.pt/themes/pt/pt/pt/>

"Dieta Saudável a partir de Sistemas Alimentares Sustentáveis" da Comissão EAT-Lancet: https://www.eatforum.org/content/uploads/2019/04/EAT-Lancet_Commission_Summary_Booklet_portugues.pdf

DESCODIFICADOR DE RÓTULOS **ALIMENTOS por 100g**

	COSEIRA (Lipídios)	COSEIRA 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.alimentacaosaudavel.dgcs.pt

DESCODIFICADOR DE RÓTULOS **BEBIDAS por 100ml**

	COSEIRA (Lipídios)	COSEIRA SATURADA	AÇÚCARES	SAL
ALTO	mais de 8,75g	mais de 2,5g	mais de 11,25g	mais de 0,75g
MÉDIO	entre 3,125g	entre 0,75-2,5g	entre 3,75-11,25g	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.alimentacaosaudavel.dgcs.pt

DIA ALIMENTAR COMPLETO: EQUILIBRADO E VARIADO

Este gráfico apresenta como exemplo uma refeição equilibrada e variada, com alimentos de todos os grupos alimentares.



Acceda a estas e outras informações em:

"Pluribus da Nova Roda dos Alimentos" do Programa Nacional para a Promoção da Alimentação Saudável (PNPAS), DGCS - Direcção-Geral de Saúde: <https://alimentacaosaudavel.dgcs.pt/themes/pt/pt/pt/>

Pinho, J., Silva, S., Borges, C., Santos, C., Santos, A., Guerra, A., Graça, P. Alimentação vegetariana em idade escolar: Programa Nacional para a Promoção da Alimentação Saudável - Direcção-Geral de Saúde (2014): <https://nutricao.pt/manuais-prospas/alimentacao-vegetariana-em-idade-escolar/>

Silva, S., Pinho, J., Borges, C., Santos, C., Santos, A., Graça, P. Linhas de orientação para uma alimentação vegetariana saudável. Programa Nacional para a Promoção da Alimentação Saudável - Direcção-Geral de Saúde (2018): <https://nutricao.pt/manuais-prospas/linhas-de-orientacao-para-uma-alimentacao-vegetariana-saudavel/>

Silva, S. Como evitar os défices nutricionais numa dieta de base vegetal (ebook). 2018. Disponível em: <http://vegetariano.pt/ebook/>



LECUMINOSAS (ex: feijão, grão-de-bico, lentilhas ou favas)

CEBES E TUBERCULOS (ex: arroz, massa, batata, batata-doce)

HORTICOLAS (que inclui as legumes e hortícolas, como couve, brócolos, cenoura, etc.)

Acceda a estas e outras informações em:

"Pluribus da Nova Roda dos Alimentos" do Programa Nacional para a Promoção da Alimentação Saudável (PNPAS), DGCS - Direcção-Geral de Saúde: <https://alimentacaosaudavel.dgcs.pt/themes/pt/pt/pt/>

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Silva, S. Como evitar os défices nutricionais numa dieta de base vegetal (ebook). 2018. Disponível em: <http://vegetariano.pt/ebook/>

Week 8: Planning and cooking pleasure



COZINHAR

Cozinhar como actividade prazerosa... Como?

Confeccionar as nossas próprias refeições é **empoderador**: a sensação de **objectivo cumprido**, o sentimento de **capacidade e competência**, o prazer de comer algo confeccionado pelas **próprias mãos**...

Mesmo quando a vontade não parece ser muita, aposte em si e no seu bem-estar.

No final, a refeição vai saber-lhe ainda melhor!




WhatsApp

Esta semana, partilhe em formato texto, imagem, ou vídeo pelo menos uma refeição cozinhada por si no grupo de WhatsApp em que está inserida/o.



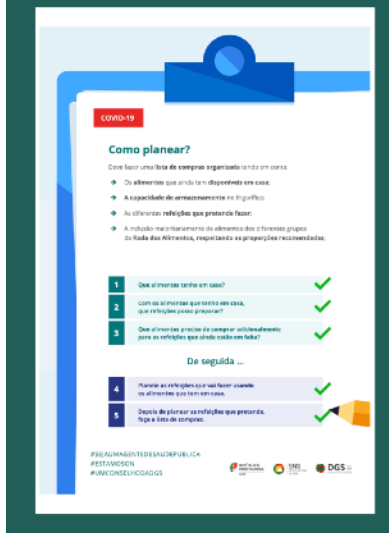
COZINHAR

Como planear a minha alimentação?

No que toca à alimentação, planear o que compramos para ter em casa é um passo essencial para conseguir fazer uma alimentação adequada às nossas necessidades.

Nesta fase de pandemia, assegurar a disponibilidade de alimentos que permitem uma alimentação adequada durante um período mais longo de tempo é crucial.

Veja a infografia que se segue e comece a planear a sua alimentação!



COVID-19

Como planear?

Considere uma lista de compras organizada tendo em conta:

- Os alimentos que ainda tem disponíveis em casa.
- A capacidade de armazenamento no frigorífico.
- As diferentes refeições que pretende fazer.
- A rotatividade/alternância de alimentos dos diferentes grupos da Tabela dos Alimentos, respeitando as preparações recomendadas.

- 1 Que alimentos tenho em casa? ✓
- 2 Com que alimentos que tenho em casa, que refeições posso preparar? ✓
- 3 Que alimentos preciso de comprar adicionalmente para as refeições que estão em falta? ✓

De seguida ...

- 4 Planear as refeições que vai fazer usando os alimentos que tem em casa. ✓
- 5 Depois de planear as refeições que pretende, faça a lista de compras. ✓

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COVID-19

COMO PLANEAR E COMPRAR ALIMENTOS

Numa situação de isolamento, é importante **garantir a disponibilidade de alimentos que permita assegurar as necessidades alimentares por um período mais longo de tempo**, sendo a optimização do momento de ida aos supermercados essencial para evitar situações frequentes às compras. **A compra responsável, nas quantidades adequadas e sem desperdícios será essencial neste período.**

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COVID-19

O que deve ser tido em consideração no momento da compra?

Nas idas às compras devem ser asseguradas todas as precauções para assegurar a traça de refeição para si e para os outros, necessariamente:

- Evitar o contacto directo dos alimentos, e não se permitir colocar no contacto de compra.
- Cumprir as condições de segurança, se a excepção permitir a utilização de uma máscara.
- Evitar tocar nos olhos, nariz e boca com as mãos.
- Higienizar adequadamente as mãos antes e depois de ida às compras.
- Atender as necessidades de alguns ingredientes para usar as mãos ao tocar ou separar, usar um tempo de papel ou antiabragos.

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ALIMENTOS	QUANTIDADE POR PESSOA PARA 14 DIAS*
1. Cereais e derivados, tubérculos	
1.1 Alimentos para refeições de pequeno-almoço e merenda	
Devido ao regime alimentar normal ou dietético, mas com um nível de ingestão moderado	50g
Devido ao regime alimentar normal ou dietético, mas com um nível de ingestão moderado a elevado	100g + 100g + 100g
1.2 Alimentos para refeições principais	
Arroz, milho ou batata	30g
3. Hortícolas	
Hortícolas (legumes, hortícolas...)	150g
4. Leite	
Leite	30g
5. Lacticínios	
Leite + Queijos (queijo com fermento)	10 + 100g
Leite + Queijo (queijo com fermento) + iogurte	10 + 100g + 10 iogurtes
6. Carne, peixe e ovos	
Carne, peixe e ovos	20g (para 100g de carne) + 100g (para 100g de carne) + 10g (para 100g de carne) + 10g (para 100g de carne) + 10g (para 100g de carne)
7. Oligoelementos	
Salgaminhos (chips, bolachas, biscoitos)	10g (para 100g de carne) + 100g (para 100g de carne)
8. Gorduras e óleos	
Óleo	300 ml
9. Outros alimentos	
Carb. simples (açúcar), frutos desidratados, sal, gelado	100g (açúcar)

* As quantidades devem ser ajustadas em função do número de pessoas do agregado familiar.

Para a saúde e outras informações do DGS - Direção-Geral da Saúde em <https://www.facebook.com/SejaUmAgenteDaSaudePublica/>

Week 9: Hygiene and safety

COVID-19

HIGIENE E SEGURANÇA ALIMENTAR

Como garantir higiene e segurança alimentar em casa?

Assegurar a higiene e segurança alimentar em casa é crucial para uma alimentação saudável e adequada às nossas necessidades.

Veja as infografias que se seguem e assegure a higiene e segurança alimentar em sua casa!

COVID-19

HIGIENE E SEGURANÇA ALIMENTAR

Lave as mãos muito bem antes e enquanto está a preparar e confeccionar

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COVID-19

HIGIENE E SEGURANÇA ALIMENTAR

Evitar a contaminação entre comida crua e cozinhada

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HIGIENE E SEGURANÇA ALIMENTAR

Lavar adequadamente os alimentos crus

Cozinhar e empratir a comida a temperaturas adequadas

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HIGIENE E SEGURANÇA ALIMENTAR

Não partilhar comida ou objetos durante a sua preparação, confeção e consumo

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COVID-19

HIGIENE E SEGURANÇA ALIMENTAR

Durante a preparação, confeção e consumo adote as medidas de etiqueta respiratória

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INFORMAÇÃO PÚBLICA SNS DGS

Acete a estas e outras informações da DGAD - Direção-Geral de Saúde em <https://www.facebook.com/direcçãogeraldaagricultura/?fbclid=IwAR1...>

O que são "produtos biológicos"? Qual o impacto destes na sustentabilidade alimentar?

Os produtos biológicos estão cada vez mais presentes nos sistemas alimentares.

Consulta as infografias e saiba mais sobre estas produtos alimentares, a sua produção e o seu impacto.

A Produção Biológica

É um sistema global de gestão dos ecossistemas agrícolas e de produção de géneros alimentícios que combina as melhores práticas em matéria ambiental e cultural, um elevado nível de biodiversidade, a preservação dos recursos naturais e a aplicação de normas exigentes em matéria de bem-estar dos animais e de normas exigentes em matéria de produção em ambientes com a presença, por parte de um número crescente de consumidores de produtos produzidos através da utilização de substâncias e processos naturais.

A produção biológica desenvolve, assim, uma dupla função social: por um lado, assegura um mercado específico que responde à procura de produtos biológicos por parte dos consumidores e, por outro, fornece bons exemplos para o público em geral que contribuem para a proteção do ambiente e do bem-estar dos animais, bem como para o desenvolvimento rural.

Objetivos da produção biológica

Estabelecer um sistema de gestão agrícola sustentável:

- Respeitar os princípios éticos de equidade
- Manter a saúde e a vida dos solos, a água, os animais e os recursos naturais
- Contribuir para a sustentabilidade biológica e para a conservação dos recursos naturais

Produzir com ampla variedade de produtos agrícolas e géneros alimentícios de elevada qualidade:

- Para garantir a produção, por via de métodos tradicionais de conservação de produtos agrícolas através da diversificação de culturas e sistemas naturais
- Aplicar a biologia dos genes, das sementes, das plantas, dos animais e dos solos
- Utilizar os recursos locais disponíveis e a produção em pequena escala
- Manter a diversidade genética e a qualidade dos produtos biológicos
- Manter a diversidade genética e a qualidade dos produtos biológicos
- Manter a diversidade genética e a qualidade dos produtos biológicos

Princípios gerais de produção biológica

Pratizar a utilização dos recursos naturais inerentes ao sistema:

- Evitar o uso de produtos químicos de síntese
- Evitar o uso de organismos geneticamente modificados
- Evitar o uso de produtos químicos sintéticos

Respeitar a utilização dos recursos naturais:

- Respeitar a utilização dos recursos naturais
- Respeitar a utilização dos recursos naturais
- Respeitar a utilização dos recursos naturais

Adaptar às condições, sempre que necessário, no âmbito do respeito pelas regras da produção biológica:

- Evitar o uso de produtos químicos de síntese
- Evitar o uso de produtos químicos de síntese
- Evitar o uso de produtos químicos de síntese

Consciência do consumidor e produção biológica

A agricultura biológica é uma forma de produção responsável de produtos agrícolas e géneros alimentícios que respeita o meio ambiente, os animais e os recursos naturais.

Para saber mais e apoiar a produção agrícola biológica, consulte o site www.dgs.gov.pt e procure o logótipo de produtos biológicos, que garante a qualidade e a segurança dos produtos biológicos.

Equipamento regulamentar - Símbolo de aplicação

Os produtos biológicos são regulamentados e controlados pelo Estado.

- Trabalhar apenas com equipamentos regulamentados
- Respeitar as regras de aplicação
- Respeitar as regras de aplicação
- Respeitar as regras de aplicação

Regras aplicáveis aos regimes de produção de agricultura biológica e produtos biológicos, sempre que sejam utilizados em qualquer fase:

- Trabalhar apenas com equipamentos regulamentados
- Respeitar as regras de aplicação
- Respeitar as regras de aplicação
- Respeitar as regras de aplicação

Regas aplicáveis aos regimes de produção de agricultura biológica e produtos biológicos, sempre que sejam utilizados em qualquer fase:

- Trabalhar apenas com equipamentos regulamentados
- Respeitar as regras de aplicação
- Respeitar as regras de aplicação
- Respeitar as regras de aplicação

De produtos de origem animal, sempre que sejam utilizados em qualquer fase:

- Trabalhar apenas com equipamentos regulamentados
- Respeitar as regras de aplicação
- Respeitar as regras de aplicação
- Respeitar as regras de aplicação

Acete a estas e outras informações da DGAD - Direção-Geral de Agricultura e Desenvolvimento Rural em <https://mpb.dgadr.gov.pt>

Week 11: Actors

Como conseguir o controlo da acção?

Para conseguir o controlo da acção, existem algumas estratégias que são essenciais.

Com este material, vai pôr em prática:

- A auto-monitorização do seu comportamento;
- O desenvolvimento de metas que quer atingir;
- A auto-regulação na tentativa de atingir as suas metas.

Nas páginas seguintes encontra o material necessário para exercer o controlo da sua acção!

(1.º) **Observe na Tabela:** os dias da semana indicados, as metas estabelecidas para cada dia, e a auto-avaliação das metas.
 (2.º) **Observe no Glossário:** todos os comportamentos e as competências que pode estipular como as suas metas a atingir.
 (3.º) **Após ver o exemplo,** use a Tabela em branco disponibilizada (Terceiro Material) - ou crie a sua tabela (como explicado nas últimas páginas) - para desenvolver o seu controlo da acção!

?

Como preencho a tabela?

De seguida, encontra um exemplo de uma tabela semanal preenchida com metas a atingir.

Preencho a tabela com que conteúdo?

Podemos preencher a tabela com as metas que você quiser atingir.

Podemos consultar metas pré-definidas no Glossário FOODLIT-PRO (página seguinte à Tabela).

Quantas metas posso ter num único dia?

Podemos ter as metas que quiser para um único dia.

Não se esqueça: as metas que estabelecer são os comportamentos e/ou as competências que quer atingir nesse dia!

Quando faço a minha avaliação das metas que estabeleci?

Podemos fazer a sua avaliação ao longo do dia, no final de cada dia, no final da semana... a escolha é sua!

Exemplo de preenchimento da tabela

As minhas metas semanais	O que quero fazer é...	A minha avaliação do que fiz
2.ª Feira	Planejar as minhas refeições antecipadamente (Semana 8) Cozinhar de maneiras diferentes (Semana 4)	✓ ✗
3.ª Feira	Substituir um alimento por outro nutricionalmente equivalente (Semana 7)	✓
4.ª Feira	Controlar as calorias do que como (Semana 7)	✗
5.ª Feira	Aplicar práticas de higiene e segurança alimentar (Semana 9)	✓
6.ª Feira	Reconhecer a origem de um alimento (Semana 2)	✓
Sábado	Combinar diferentes ingredientes para criar uma refeição adequada (Semana 3)	✗
Domingo	Dedicar tempo e investir na selecção de alimentos (Semana 5)	✗

GLOSSÁRIO



Quais os comportamentos ou as competências que quero atingir ?

Identificar a **origem** de um alimento (Semana 2)

Identificar como é que um alimento é produzido e **processado** (Semana 2)

Utilizar diferentes tipos de **preservação** (por ex., congelar, salgar) (Semana 2)

Preparar tudo o que é necessário para fazer uma refeição (Semana 3)

Combinar diferentes ingredientes para criar uma refeição (Semana 3)

Adaptar **receitas** para ficarem mais ao meu gosto (Semana 3)

Utilizar diferentes equipamentos e **utensílios** de cozinha (Semana 4)

Cozinhar de diferentes maneiras (por ex., estufar, assar) (Semana 4)

Dedicar tempo e investir na **selecção** de alimentos (Semana 5)

Fazer **escolhas** alimentares informadas (Semana 5)

GLOSSÁRIO



Quais os comportamentos ou as competências que quero atingir ?

Controlar as **calorias** (ou outra característica) do que como (Semana 7)

Substituir um alimento por outro **nutricionalmente equivalente** (Semana 7)

Cozinhar refeições com o que tenho em casa (Semana 7)

Ler **rótulos** alimentares para seleccionar os alimentos (Semana 7)

Sentir **prazer** a cozinhar (Semana 8)

Planejar vários aspectos da minha alimentação (Semana 8)

Planejar as minhas refeições **antecipadamente** (Semana 8)

Aplicar práticas de **higiene e segurança** alimentar (Semana 9)

Reconhecer impacto dos produtos **biológicos** (Semana 9)

Consumir produtos de comércio **local / nacional** (Semana 10)

Identificar a **sazonalidade** de cada alimento (Semana 10)

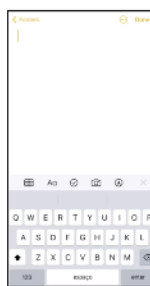
Consumir alimentos de acordo com a **época** do ano em que estou (Semana 10)

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Quero fazer este desafio semanal no meu smartphone... Como faço?

Em alternativa a utilizar a tabela na versão Excel ou PDF, pode fazer este exercício no seu smartphone. Para isso, indicamos os seguintes métodos alternativos:

(1) Nas **Notas** do seu smartphone: Cria uma tabela nas Notas do seu smartphone e preenche com o seu conteúdo, incluindo dias semanais, metas a atingir, e a sua avaliação do seu desempenho. Outra forma de colocar em prática este desafio nas Notas é fazer por "bullet points" (tópicos). Veja o exemplo nas imagens e no vídeo do Primeiro Material.



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(2) Nos **Lembretes** do seu smartphone: Estabeleça, em diferentes lembretes, as suas metas de cada dia da semana. Para fazer a sua avaliação do seu desempenho, indique cada lembrete como "concluído" (caso considere que conseguiu, com sucesso, atingir a sua meta) ou mantenha-o como "não concluído" (caso considere que não atingiu a meta a que se propôs). Veja o exemplo nas imagens e no vídeo do Primeiro Material.

