

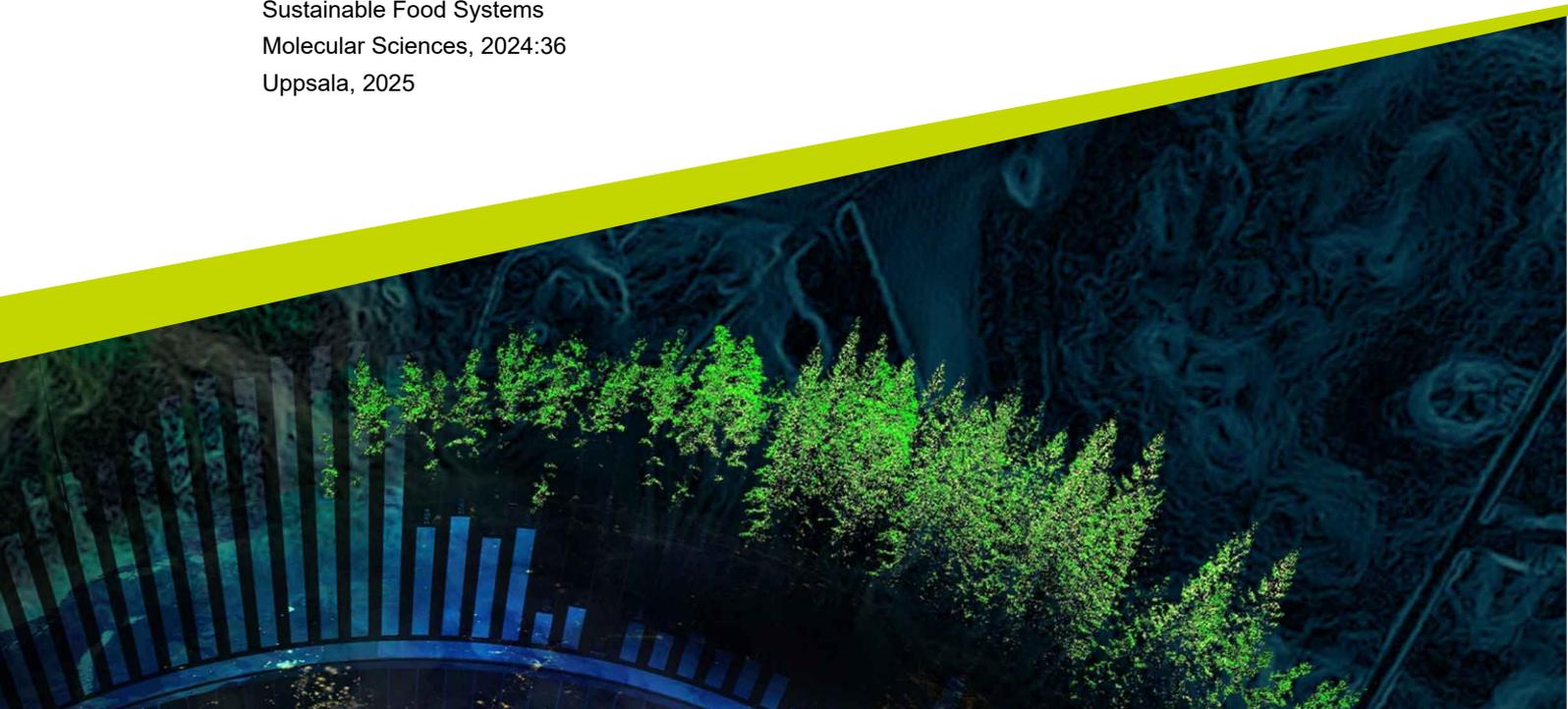


Nudging consumers towards sustainable food choices at dining establishments

A systematized literature map

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Abstract

Background: Out-of-home dining industry accounts for a significant and growing proportion of daily food intake in many Western countries and substantially contributes to food-system-related unsustainability issues. Nudging consumers to influence their food choice is increasingly seen as an effective solution to these issues. Despite that, there have appeared a lack of recent research on food nudging interventions employed at dining establishments. Therefore, the aim of this study was to highlight and fill this knowledge gap by producing a systematic map and narrative evidence synthesis of the academic journal articles available on the topic of choice architecture interventions employed at dining establishments to nudge consumers towards sustainable food choices. The main research question was: *What type of academic research exists on nudging interventions used to promote sustainable food consumption at dining establishments?*

Methods: Collaboration for Environmental Evidence (CEE) guidelines for Evidence synthesis in Environmental Management together with the RepOrting standards for Systematic Evidence Synthesis in environmental research (ROSES) were used as the main methodological guidelines.

The systematic database search was conducted on February 9th, 2024, in two databases: Web of Science and Scopus. The inclusion criteria were limited to peer/reviewed academic journal articles, depicting natural field experiments only; fully written in English and published between 2021 and 2024 February 9th. Additional Inclusion & Exclusion criteria were based on the PICO elements of the main research question. Once the search results have been extracted and duplicates deleted, followed the screening process. It consisted of three stages: 1. Title screening; 2. Abstract screening; 3. Full-text screening. The meta-data extraction and coding have been executed manually to the Excel file and were followed by a narrative data synthesis.

Results: The search identified 895 records through Web of Science and 900 records through Scopus. After the duplicate removal, a total of 1143 records were eligible for the screening process. After the final screening step, 34 articles were found to be eligible and were included in the evidence synthesis and the resulting systematized literature map. The analysis has discovered two big knowledge clusters with potential for a systematic review: 1. Studies involving Information type of nudging techniques; 2. Studies depicting food nudging experiments conducted at dining establishments of educational institutions. A major knowledge gap was identified in usage of non-Information type of nudging techniques at a “Related Objects” and “Wider Environment” focus levels.

Conclusions: There exists a need for future studies employing a much broader array of food nudging techniques than those of Information type. Additional research recommendations also include nudging experiments addressing wider spectrum of food-system-related environmental and social sustainability issues (preferably a combination of both).

Keywords: nudge, food choice, dining establishments, sustainability, systematic map

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Abbreviations

| Abbreviation | Description |
|--------------|---|
| CEE | Collaboration for Environmental Evidence |
| TIPPME | Typology of Interventions in Proximal Physical Micro- Environments |
| WEIRD | Western Educated Individualistic Rich Democratic |

1. Introduction

Contemporary human food consumption patterns have led to an abundance of sustainability problems. Populations of industrialized countries increasingly suffer from such diet-related health issues as obesity, diabetes, cardiovascular diseases, and cancer (Reisch et al. 2013). A combination of food wealth, sedentary lifestyles and modern diets, characterized by excessive consumption of animal protein, salt and sugar together with a very low consumption of vegetables, fruits, legumes and wholegrains, have resulted in large proportion of people being at an increased risk of above mentioned non-communicable diseases (Ensaft 2021; Wyse et al. 2021c).

Unsustainable food consumption encompasses not only the above-mentioned health related problems but also raises other ethical and environmental concerns. Together with the food security and safety issues, topics such as animal welfare and (un)fair working conditions within the food production industry are now an essential part of discussion around ethically responsible food consumption (Reisch et al. 2013). Moreover, food consumption and production processes are causing serious negative environmental consequences such as water scarcity and pollution, eutrophication, soil degradation, and biodiversity loss (ibid.). Not to mention that food consumption is responsible for near one third of global greenhouse gas emissions (Crippa et al. 2021). Last but not the least, food waste is a serious sustainability issue, undetachable from the above-mentioned problems as about one third of food on a global scale is wasted, particularly during its retail and final consumption stages (Dhir et al. 2020).

The dining industry, playing a considerable part in the overall human food consumption, both faces and causes all the mentioned sustainability challenges. Out-of-home food consumption accounts for a significant and growing proportion of food intake in many Western countries and substantially contributes to GHG emissions and food waste (Reisch et al. 2013; Talwar et al. 2023).

A wide range of societal actors – academia, governmental institutions and private businesses, have been putting their efforts to solve the unsustainability challenges resulting from the food consumption. For a long time, however, as Ensaff (2021:196) describes it: “In addressing populations’ diets, much of the emphasis has been on guidance and education, with the principle that advice translates into positive action from citizens. However, behaviour change is notoriously difficult, with translation not always straightforward”.

The phenomena described by Ensaff has been termed by researchers as the “attitude-behaviour gap”. It appeared, that there is a difference between human attitudes towards sustainable food consumption and actual purchasing behaviour (Bălan 2020). In more simple words, people know what healthy and more sustainable food is, however, still make choices towards unsustainable alternatives.

A search for an explanation and solution for the above-mentioned gap between consumer attitudes and real actions has steered academic research away from the classical understanding of food choice as a rational and deliberative act (Ensaff 2021). Instead, Behavioural Economic theories and concepts such as nudging and food choice architecture - "...how a food choice is framed, and the consequences on subsequent food selections" (Ensaff 2021:196) have become central both for the academic community and policy makers aiming to promote sustainable food consumption.

According to the behavioural science, one of the primary reasons for the "attitude-behaviour-gap" is increased complexity of contemporary food choice (consumers constantly being presented with new food options, which is making information search and processing overwhelming). Due to that, purchase-decision-making became more complex for food consumers, leading to many adhering to their habitual (unsustainable) choices (Reisch et al. 2013:11).

Large community of scientists and policy makers all around the globe see nudge interventions as an effective and highly promising tool to interfere with and even break such unsustainable food choice habits (Lehner et al. 2016:167; Goyens 2018:12). Nudges are claimed to promote sustainable food consumption behaviours. As Ensaff (2021:196) has quite well formulated:

"Implementing nudge theory to bring about behaviour change is seemingly an approach more aligned to changing everyday food choice. Effecting change by operating within individuals' automatic responses, nudge strategies do not rely on high cognitive effort and work on the principle of reducing the effort required to get to the designated choice."

As the popularity of nudges as policy tools has been growing over the past few decades, the number of academic studies dedicated to food nudging has been increasing as well. An overview of the published research on the topic has, among others, revealed several relatively recent systematic reviews investigating how nudging interventions influence consumer food and beverage purchasing behaviour towards healthier dietary choices. For example, Slapø et al. (2021) have compared the effectiveness of interventions taking place in grocery stores (both physical and online) which aimed to encourage customers to purchase healthier food items. A similar review was conducted by Harbers et al. (2020) in which authors looked at the effectiveness of nudges used for adult populations and conducted in real-life purchasing environments. Studies they looked at were situated in cafeterias, supermarkets and small food stores, however, excluded sit-down restaurants. Wyse et al. (2021c) in their systematic review and meta-analysis have concentrated exclusively on digital food purchasing environments: online supermarkets and food delivery services etc. While Gynell et al. (2022) tried to evaluate the effectiveness of implicit interventions (aka nudges) employed to promote healthier eating behaviours through menu design. In contrast, Reisch et al. (2021) have produced a

systematic map of existing research on food consumption related choice architecture and nudging interventions which aimed to improve environmental sustainability (decrease GHG emissions). The interventions authors looked at targeted human consumption of animal protein and its substitutes as well as individual and large household food waste.

The above-mentioned systematic reviews and maps have altogether covered a wide range of environments where sustainability aimed food nudging experiments took place: from supermarkets to online food purchasing platforms. However, there appeared to be no systematized knowledge available on existent literature on food nudging experiments conducted at restaurants and similar dining out establishments. This master thesis, therefore, represents an attempt to fill in this knowledge gap by producing a systematized (systematic) map of recent academic literature that focuses on consumer food choice nudging at restaurants, public canteens and similar types of out of home food consumption settings – dining establishments. More precisely, the paper is guided by the following **research aim**:

To produce a systematic map and narrative evidence synthesis of the academic journal articles available on the topic of choice architecture interventions employed at dining establishments to nudge consumers towards sustainable food choices.

The process of systematic mapping was further guided by the following **research question**:

What type of academic research exists on nudging interventions used to promote sustainable food consumption at dining establishments?

The question is based on a modified PICO format, where P stands for study Population(s) and refers to the customers of dining establishments who were exposed to the intervention. I - Intervention(s), refer to food nudges. C – usually standing for Comparator was changed to represent Context/Setting of the research and is defined as a dining establishment where the intervention took place. O stands for Outcome(s) of the intervention and encompasses improvements or decline in social and/or environmental sustainability aspects related to food consumption.

The paper is seen to have the following research and practical **contributions**:

1. Providing an overview of the volume and characteristics of existing research on food nudging experiments conducted at dining establishments, making it easy and convenient for interested actors (researchers, policymakers and business managers) to understand the described research landscape and operate within it.

2. Identifying knowledge gaps and knowledge clusters within the topic which in turn allows for a better understanding of what kind of research is needed within the topic and which subtopics can be investigated in a deeper manner, as for example, through a systematic review.
3. Proposes ideas for future research.

This literature map has been conducted as a master thesis project, which imposed certain scope and resource limitations, which are described in more detail in the Discussion chapter. While the original ambition was to conduct a systematic literature map study, due to the mentioned limitations it was decided to keep it within the scope of a systematized literature map. A more detailed explanation of which will follow later in the Theory chapter. Before moving to the main parts of this paper, it is vital to clarify certain concepts. Below are such:

Dining Establishment: within the scope of this research, Dining Establishment is defined as a physical place where people go to order and purchase prepared food and further enjoy the meal on-site in a social setting while sitting down by the table. A scope of dining establishments ranges from casual eateries like diners, fast-food restaurants and cafes, up to more formal settings like upscale eateries, bistros and restaurants.

Social Sustainability: the concept of Social Sustainability is defined as sustainability dimension which concerns overall well-being, rights and needs of both humans and animals. A positive social sustainability outcome in this case would, for example, be an improved access and/or increased consumption of nutritious food, fairer labour practices for workers within the food industry, improved health or animal welfare, etc.

Environmental Sustainability: defined as sustainability dimension which concerns “the long-term maintenance of ecosystems and other environmental systems for the benefit of future generations” (Oxford University Press n.d.). An outcome that can be classified as an improvement within the environmental sustainability domain of the food consumption can be a decrease in food waste.

Sustainable Food: to define the overall concept of Sustainable Food, this paper uses Reisch’s et al. (2013:8) formulation, who describe Sustainable Food as:

“...that which is safe, healthy, and nutritious for consumers in shops, restaurants, schools, hospitals, and so forth; can meet the needs of the less well off at a global scale; provides a viable livelihood for farmers, processors, and retailers whose employees enjoy a safe and hygienic working environment; respects biophysical and environmental limits in its production and processing while reducing energy consumption and improving the wider environment; respects the highest standards of animal health and welfare compatible with the production of affordable food for all sectors of society; and supports rural economies and the diversity of rural culture, in particular by emphasizing local products that minimize food miles.”

2. Theory

2.1 Behavioural Economics and Choice Architecture

Behavioural economics, as it stems from its name, is a combination of academic disciplines of economics and behavioural sciences (cognitive and social psychology, more precisely) (Lehner et al. 2016; Mallard 2017). In contrast to the mainstream neoclassical economic theory, which views people as rational decision makers, behavioural economics argues for “the less rational nature of the human species and highlights the importance of behavioural biases and the decision context – the environment in which individuals make choices” (Lehner et al. 2016:167). One of the central parts within the discipline is given to the observation of human behaviour and “understanding of the processes involved in our decision-making” (Mallard 2017:39). Most importantly, however, behaviour economics equips its practitioners with a theory and a set of practical tools with the help of which human economic behaviour can be altered in a desired way (ibid.).

Choice architecture – is a concept directly referring to the above-mentioned manipulation of human behaviour. More precisely, it can be explained as a both “naturally occurring” or purposively designed environment in which individuals make choices. Interventions, designed to “architect” human choices can be broadly divided into two main categories: those which use inducements and coercion to achieve the desired behaviour (for example, price incentives and limitation of access to unhealthy food options) and nudges (Kraak et al. 2017). The latter – nudging, is the focus of this paper.

2.2 Nudging (Food)

The concept of nudging stands on the ethical pillars of *Libertarian Paternalism*. As Mallard (2017:75) explains it: “Libertarian in that it does not impinge on our freedoms to choose. Paternalistic in that it increases our welfare by improving the choices we make”. The goal of nudging is to gently push a person towards a choice decision and/or behaviour which is seen as benefitting one’s life, or the whole society at once. At the same time, nudges do not forbid other choice options and are cheap and easy to avoid for the consumer (Karlsen & Andersen 2022). Simply put, most of the nudges are designed with an aim to make human lives safer, simpler, and easier to navigate (Sunstein 2014). Policy instruments of coercive nature, such as economic and fiscal measures (e.g. subsidies, taxes) or laws and regulatory bans are choice architecture tools, however, not nudges (Lehner et al. 2016).

Examples of nudges are warnings and reminders of various kinds, defaults, changes in layout and features of the environment, drawing attention to social

norms etc. Food choice nudging incorporates all the above-mentioned aspects. Particular examples of such would be specifically designed meal presentation in a canteen and wording and layout of options in a menu (Ensaff 2021:197).

In the latest years behaviour economics and choice architecture has been taking more and more prominent role within public policy, where it is used to promote citizen - benefiting behaviour (Ensaff 2021). Policy makers highly appreciate use of food nudges when it comes to improving citizens' health. Such appreciation stems from a usually quite low costs associated with the implementation and maintenance of nudges and ability to deliver effective results promptly (ibid.). Furthermore, since nudging does not rely on income or education levels, it provides potential to decrease health inequalities among different societal groups. Finally, since nudge interventions do not restrict or interfere with the overall number and types of available food options, different business stakeholders, such as catering and food retail sectors, are open and positive towards adopting nudging techniques into their daily business activities (Ensaff 2021).

2.3 Taxonomy of Nudges

There exist numerous taxonomies of nudging techniques. Some of the most well-known probably are classifications developed by R. Sunstein (2014) and Münscher et al. (2016). A few authors have developed frameworks which classify nudging techniques used to alter food choice related behaviour in particular.

For example, Lehner et al. (2016) divide nudges used to influence food consumption into four types: 1. Simplification and framing of information; 2. Changes to the physical environment (includes changes in visibility, accessibility and size of a product); 3. Changes to default option (covers positioning of a food product); 4. Social norms (informing about other's behaviour and ideal-type behaviour). While Kraak et al. (2017) have combined together three already existent choice architecture frameworks and marketing mix principles to develop their own system of nudges. This resulted in a taxonomy of eight distinct strategies which are intended to use by restaurant owners to promote healthy food choice among customers who are at high-risk of diet-related noncommunicable diseases. Authors termed the nudging strategies as "place, profile, portion, pricing, promotion, healthy default picks, prompting or priming and proximity" (Kraak et al. 2017:852).

In this study, however, the choice was made towards a typology developed by Hollands et al. (2017), the full name of which is "Typology of Interventions in Proximal Physical Micro-Environments" (further referred to as TIPPME). TIPPME has appeared to provide the most clear, comprehensive and detailed framework for classification and coding of nudging interventions in comparison to other mentioned taxonomies. Moreover, the typology is specifically developed to be applied for nudges used to influence selection, purchase and consumption of food

by altering physical characteristics of food products itself or proximal (sensorily perceptible) micro-environments (places such as restaurants, workplaces, bars and shops) in which such behaviours take place (ibid.). Due to the above-mentioned reasons, TIPPME has been chosen and used in this paper as an underlying framework according to which food nudging interventions discovered in the analysed literature were categorised and mapped. Section below describes the TIPPME framework in detail.

2.3.1 TIPPME

TIPPME has a matrix classification structure, where intervention types are listed vertically in rows, while different spatial foci are accommodated on a horizontal “axis” as columns (see Table 1). By the spatial foci Hollands et al. (2017:4) mean “differences in the spatial focus of interventions”. Further, interventions are divided into six different types (rows): Availability; Position; Functionality; Presentation; Size; Information. Spatial foci are distinguished into three separate categories: Product (interventions involving changes of the food product itself); Related objects (covers interventions involving changes of objects that are associated with the food product); and Wider environment (involves changing objects and stimuli that are external to the food product and with-it associated objects). As a result, “the combination of rows and columns means there are 18 possible intervention categories (Type X Focus) that can be applied to describe an intervention.” (Hollands et al. 2017:4). The TIPPME matrix is presented below in Table 1 where each of the intervention categories is explained in detail.

Table 1. Typology of Interventions in Proximal Physical Micro-Environments (TIPPME). The table is synthesized from Hollands et al. (2017:2–3).

| Intervention (Spatial) Focus | | PRODUCT | RELATED OBJECTS | WIDER ENVIRONMENT |
|---------------------------------|----------------------|--|--|--|
| | | <i>Interventions that influence behaviour by changing the selected/purchased/consumed product. Product – the substance to be consumed and its immediate packaging and tableware.</i> | <i>Interventions that influence behaviour by changing objects associated with the PRODUCT and are a part of its proximal surroundings.</i> | <i>Interventions that influence behaviour by changing stimuli and objects external to the PRODUCT and RELATED OBJECTS and are not used to display, select, store, purchase or consume the PRODUCT.</i> |
| Sustainability Type | AVAILABILITY | Remove or add products to decrease/increase/alter their variety, number or range. | Remove or add related objects to decrease/increase/alter their variety, number or range. | Remove or add objects that comprise the wider environment to decrease/increase/alter their variety, number or range. |
| | POSITION | Change the proximity, position or accessibility of products. | Change the proximity, position or accessibility of related objects. | Change the proximity, position or accessibility of products that constitute the wider environment. |
| Properties | FUNCTIONALITY | Changes in design or functionality of products to alter their working mechanism, or guide or constrain how people use or interact with the products. | Changes in design or functionality of related objects to alter their working mechanism, or guide or constrain how people use or interact with the objects. | Changes in design or functionality of objects that comprise the wider environment to alter their working mechanism, or guide or constrain how people use or interact with them. |
| | PRESENTATION | Changes in tactile, visual or olfactory properties of products. | Changes in tactile, visual or olfactory properties of related objects. | Changes in tactile, visual, olfactory or other atmospheric properties of objects that comprise the wider environment, or stimuli. |
| | SIZE | Changes in shape or size of products. | Changes in shape or size of related objects. | Changes in shape or size of objects comprising the wider environment. |
| | INFORMATION | On products, remove, add or change symbols, numbers, words or pictures that convey information about the product or its use. | On related objects, remove, add or change symbols, numbers, words or pictures that convey information about the product or its use. | Within the wider environment, remove, add or change symbols, numbers, words or pictures that convey information about the product or its use. |

3. Methods

3.1 A Systematized (Systematic) Literature Map

Given the broad nature of research questions¹ and specificity of the research aims raised in this paper, it was deemed that a systematic literature map is a more appropriate study design than a systematic review. At the same time, due to the human resource and time-frame limitations faced, it is more appropriate to categorize this research project as systematized² literature map. In regard to this, exact methodological requirements which were omitted and its influence on the quality of the research will be discussed later in the Discussion section, under the Limitations of the review methods.

Coming back to the definition of a systematic map, it can be defined as “an evidence synthesis method that aims to provide an accurate description of the evidence base relating to a particular question” (CEE 2022). The output of a systematic map is essentially a descriptive and configurative overview of the pre-existing research on a certain topic where collected data is collated, catalogued, and mapped out based on the different elements of the research question (James et al. 2016). As Booth (2016:14) describes it, systematic map “aims at categorizing, classifying, characterizing patterns, trends or themes in evidence production or publication”. Moreover, systematic maps are used to reveal possible knowledge gaps and to identify more specific questions suitable for Systematic Review types of investigations (Grant & Booth 2009).

CEE Guidelines and Standards for Evidence synthesis in Environmental Management (Collaboration for Environmental Evidence 2022) together with ROSES reporting standards (ROSES 2017) were employed as the main methodological guidelines in accordance to which this systematized literature map was conducted. CEE – Collaboration for Environmental Evidence, is an open community of stakeholders, which seeks to promote and deliver evidence syntheses on topics useful for environmental policy and practice. While ROSES - RepOrting standards for Systematic Evidence Syntheses, contain checklist forms designed specifically for systematic review/map protocols and reports that are conducted in accordance to the CEE guidelines and standards. Such choice of the methods was primarily influenced by two factors: 1. The broad applicability of them to different

¹ *Systematic maps (in contrast to systematic reviews, which are employed to answer quite narrow and specific research questions) are best suited for answering open-framed questions, alternatively, closed framed research questions designed to cover multiple subject populations, intervention types and varied outcomes (Reisch et al. 2021:4)*

² *See Grant and Booth (2009:102) for a detailed explanation of a difference between systematized and systematic map.*

scientific disciplines and both qualitative and quantitative study types; 2. Availability of separate, specifically catered guidelines and checklist forms for systematic maps.

3.2 Search Strategy

The systematic database search was conducted on February 9th, 2024, in two databases: Web of Science and Scopus. These databases were selected due to their broad coverage of academic journals and topics, as well as academic reputability. Both databases were accessed through the Swedish University of Agricultural Science institutional subscription. Another database – AGRIS, was additionally considered for potential use. However, it was decided not to use it, since its search function design was found unsuitable for systematic search. Table 2 below contains full Boolean-style search strings used for the main search for each of the two databases respectively, while Table 3 details each of the strings based on the keywords. The search strings were formulated with help from SLU librarian.

Table 2. Boolean-style full search strings used in Web of Science and Scopus.

| Database | Full search string |
|----------------|--|
| Web of Science | ((TS=(food OR diet* OR eat* OR meal)) AND TS=(sustainab* OR green OR health* OR eco OR ecological OR veg* OR ethical OR responsible OR "(eco OR environment*) friendly" OR "environmentally conscious" OR "fair trade")) AND TS=("behavioural economic*" OR "choice architecture" OR nudg* OR "food choice architecture" OR "architecture of choice" OR "choice NEAR/2 (influenc* OR guid* OR fram*") and Article or Review Article (Document Types) and English (Languages) |
| Scopus | (TITLE-ABS-KEY (food OR diet* OR eat* OR meal)) AND (TITLE-ABS-KEY (sustainab* OR green OR health* OR eco OR ecological OR veg* OR ethical OR responsible OR "(eco or environment*) friendly" OR "environmentally conscious" OR "fair trade")) AND (TITLE-ABS-KEY ("behavioural economic*" OR "choice architecture" OR nudg* OR "food choice architecture" OR "architecture of choice" OR "choice near/2 (influenc* or guid* or fram*)")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "re")) AND (LIMIT-TO (LANGUAGE , "english")) |

As it can be seen in the Table 3 below, keyword searches were limited to the “Topic” search field in Web of Science and “Article title, Abstract, Keywords” search fields in Scopus. At the full string level (see Table 2), the strings were specified to include only such document types as Journal Articles or Review Articles, as well as, to include sources written only in English language. Moreover, the search was limited to include peer-reviewed articles only. Due to the scope and timeframe of the research project it was decided to exclude grey literature from the search and concentrate only on the academic papers.

Table 3. Search strings detailed by keywords.

| Category | Section searched in Web of Science / Scopus | Keywords |
|-------------------|---|--|
| Field of interest | Topic / Article title, Abstract, Keywords | food OR diet* OR eat* OR meal |
| Outcome | Topic / Article title, Abstract, Keywords | sustainab* OR green OR health* OR eco OR ecological OR veg* OR ethical OR responsible OR “(eco OR environment*) friendly” OR “environmentally conscious” OR “fair trade” |
| Intervention | Topic / Article title, Abstract, Keywords | “behavioural economic*” OR “choice architecture” OR nudg* OR “food choice architecture” OR “architecture of choice” OR “choice NEAR/2 (influenc* OR guid* OR fram*)” |

3.3 Screening Strategy

The article screening process has been executed with the help of CADIMA software (CADIMA 2025). CADIMA is a free, open access online tool specifically designed for both systematic mapping and reviews by the CEE and Julius Kühn-Institute. As this research is based on the CEE methodology for systematic data evidence synthesis, CADIMA software, therefore, was viewed as the most suiting choice in comparison to other similar systematic review management tools.

In preparation to the screening process search result extraction and duplicate deletion has been done. All generated results from the database searches were first uploaded to the reference management tool Zotero. From Zotero they were exported to CADIMA in a .ris format, where duplicate screening and deletion was performed. Afterwards, the article screening process was executed. It consisted of three main stages:

4. Title screening
5. Abstract screening
6. Full-text screening

During each stage articles clearly irrelevant and not fulfilling the selection criteria (see Table 4 and Table 5) were discarded. The whole screening process, as the rest of the research, was conducted by one person.

3.3.1 Inclusion & Exclusion criteria

The first two screening stages – at title and abstract level, were conducted in accordance with the inclusion and exclusion criteria set a priori and developed based on the PICO elements of the primary research question. The summary of the criteria is provided in the Table 4 below.

Table 4. Inclusion & exclusion criteria based on the primary research question's key elements.

| Question: “What type of academic research exists on nudging interventions used to promote sustainable food consumption at dining establishments amongst its customers?” | | |
|--|--|--|
| Question key elements | Eligibility criteria | |
| | Included | Excluded |
| Populations (P): Customers of the dining establishment targeted by the intervention. | Everyone: all ages, all genders etc., all socioeconomic groups. | n/a |
| Interventions (I): Nudges | All types of food nudging interventions initiated by both private and public actors. | All other types of interventions aimed at influencing and altering consumer behaviour related to food which are not based on behavioural science theory and don't come under nudge definition. |
| Context/Setting (C): Purchase and/or consumption of food at dining establishments. | Both publicly administered and privately run dining establishments. Food must be purchased at a dining establishment, however, can be consumed elsewhere. The dining establishment is located and the whole intervention takes place in a WEIRD ³ (Western, Educated, Individualistic, Rich, Democratic) country. | Establishments offering only “take-away” option, with no “sitting in”/ dining possibilities. (In order to clearly distinguish between food service and dining establishment). |
| Outcomes (O): Improved Ecological and/or Social Food System sustainability. | More ecologically and socially sustainable food consumption. Improvements in all kinds of social and ecological sustainability aspects of food system. For example, food waste reduction and healthier menu choices etc. | Interventions aiming at increasing solely economic sustainability of the establishment and/or customer. |

³ WEIRD refers to western, educated, industrialized, rich and democratic societies. According to Henrich et.al (2010), a vast majority of behavioural science experiments and studies are conducted on predominantly Western population of our planet, which rises alerts about generalisability of such results to the rest of the world (and the other way around). As authors (Henrich et al. 2010:29) argue: “Much research on human behaviour and psychology assumes that everyone shares most fundamental cognitive and affective processes, and that findings from one population apply across the board. A growing body of evidence suggests that this is not the case. Experimental findings from several disciplines indicate considerable variation among human populations in diverse domains, such as visual perception, analytic reasoning, fairness, cooperation, memory and the heritability of IQ”. Given the mentioned cognitive and psychological differences, it was decided to limit the systematic literature search to studies involving only WEIRD population groups. Research from the rest of the world was seen as irrelevant for this particular systematic map and purposefully excluded to avoid any biases.

Table 5. Additional inclusion and exclusion criteria added and used only during the full text screening process.

| Type of criteria | Included | Excluded |
|---------------------------------------|---|---|
| Year of publishing | 2021 - 2024 | < 2021 |
| Study design | Natural field experiments | <ul style="list-style-type: none"> • Hypothetical, laboratory or/and simulated dining environment studies • Review articles |
| Context: Food type focus of the study | Full meals; snacks and beverages – only when purchased/chosen along with the main dish. | Beverages only |

During the full text screening stage, it became clear that additional exclusion criteria are needed in order to limit the number of selected articles to an analysis-feasible size (given the timeframe and human resources available for this research project). Therefore, it was decided to include articles published only between the years of 2021 - 2024. Such choice of the timeframe was dictated by a relatively large amount of systematic review articles discovered during the screening process, which were published during years 2020 and 2021. Most of these articles have already been mentioned in the introduction to this study and together constitute a great coverage of the previous research done on the topic investigated in this paper. At the same time, there were no relevant systematic reviews found which were published after year 2021. Therefore, it was deemed logical to limit this systematic map to include studies published during year 2021 and after.

Furthermore, it was decided to exclude all review articles, as they do not present their own empirical data. Additionally, studies covering only beverages, as well as any type of hypothetic, laboratory studies with simulated dining environment were excluded. Only papers depicting natural field experiments were included. Table 5 above summarizes the additional inclusion and exclusion criteria used during the full text screening process.

3.4 Meta-data extraction and coding strategy

All the meta – data has been first extracted to an Excel sheet according to the categories presented in the Table 6 below. At this stage the extracted data usually represented quotes from the articles with relevant information. First category of data extracted represented descriptive details of articles itself: article authors, title, journal and its volume, and year of publishing were recorded for each of the articles. Further, data on study design and the country in which the study/ies have been

conducted was recorded. The last two categories of the extracted data were guided by the research question posed in this study: data related to the Population, Intervention and Setting/Context elements of the main research question together with the information on the sustainability angle of each of the studied articles has been recorded in the initial Excel sheet. Afterwards, the data on the intervention types, context and sustainability objectives of each article was coded. Nudging interventions were coded in accordance to the TIPPM categories, while in the case of the Setting/Context of the study, the type of the dining establishment was recorded. In the case of the sustainability angle the main codes were: “environmental” or “social” or “both”.

Table 6. Meta-data extraction and coding categories.

| Data type | Details |
|---|---|
| <i>Article-related descriptive data</i> | Author(s); Title; Journal; Year of publication; Volume (Issue). |
| <i>Study-related descriptive data</i> | Study country; Study (Experiment) design. |
| <i>Data related to the primary research question (PIC)</i> | Population; Intervention(s); Setting/Context. |
| <i>Data on sustainability focus/objectives of the article</i> | Sustainability objective(s) |

3.5 Data synthesis and mapping methods

Narrative data synthesis has been employed for the extracted data analysis and for the presentation of the results. In most of the cases, the findings have been presented in a tabular form, enhanced by a narrative description and detailing of the findings, which in turn was guided by the following questions:

1. *What food system sustainability objectives do article authors address?*
2. *How are these objectives defined?*
3. *At what categories of dining establishments did the interventions take place?*
4. *Who were the subjects of the intervention?*
5. *What are the relationships between sustainability objectives and context/setting categories of the studied articles?*
6. *Which sustainability concerns/aims are prevalent at each of the dining establishment categories?*
7. *What types/categories of food nudges (interventions) were used amongst the articles?*
8. *What are the relationships between sustainability objectives of the articles and categories of nudges used in them?*

9. *Which food nudging technique/category dominated amongst the articles with the same sustainability objective?*
10. *What are the most often used categories of nudges amongst each of the context types?*

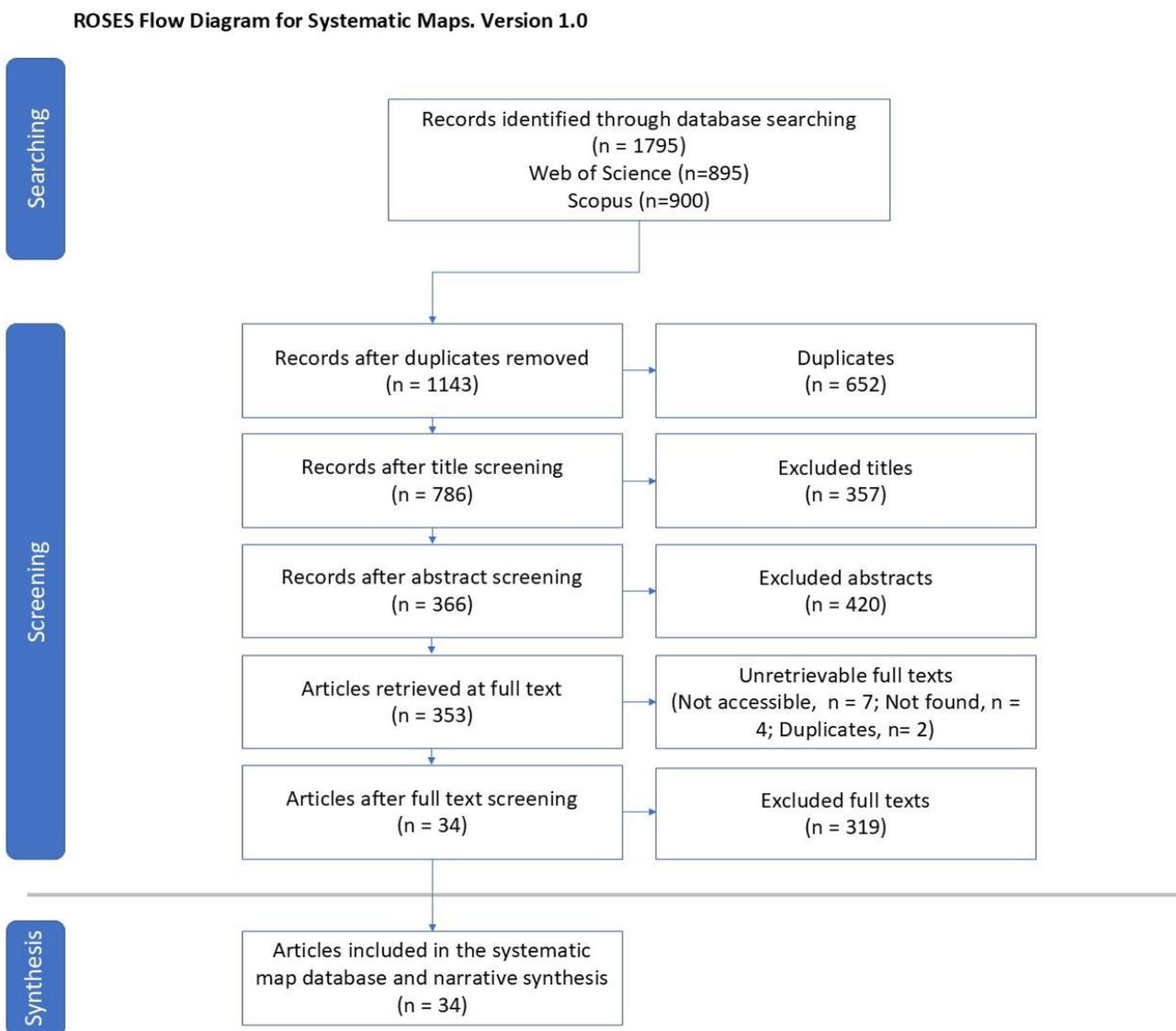
ROSES Flow diagram has been used to visually present literature search and screening results. To visualise country-wise distribution of the evidence base, and the distribution of articles by years of publishing, Microsoft Word Chart function has been used. To visually showcase relationships between some of the findings' categories Excel Pivot tables were employed. Tabulation, including Excel pivot tables, was used to present and identify knowledge gaps and clusters as well.

4. Results

4.1 Systematic literature search and screening

Figure 1 presented below depicts results of the executed systematic literature search and screening.

Figure 1. ROSES Flow Diagram depicting the literature search and screening results.



4.1.1 Search Results

As it can be seen in the Figure 1, 895 articles have been identified through the search in Web of Science, while Scopus gave 900 results. The total combined number (prior to duplicate removal) of the articles retrieved from these databases equalled to 1795. Out of this total number, automated duplicate scanning in CADIMA identified 496 unique records and 1298 records as potential duplicates. Once the manual duplicate removal has been completed, 647 records have been kept, and 652 records have been deleted by the reviewer. As a result, a total of 1143 records were identified as eligible for the screening process.

4.1.2 Screening Results

The first screening step – title screening, resulted in 357 excluded and 786 retained records. During the next step – abstract screening, 420 additional records were removed, leaving a total of 366 records retained for the full text screening. Out of these 366 records, it was possible to retrieve full text articles to 353 records, while 13 articles were unretrievable (see Appendix 1 for detailed list of unobtained articles). Finally, at the end of the third step – the full text screening, 319 articles have been excluded resulting in a total of 34 articles selected for the analysis. A full list of the selected articles is presented in the Table 7.

Overall, these 34 articles are distributed among 25 different academic journals. As it can be seen in the Table 7, most of the journals appear only once. There are, however, a few exceptions. The journal titled “*BMC Public Health*” published two articles from the list, while three articles have been published in “*Nutrients*”. Elsevier’s “*Appetite*”, however, is the most represented journal from the list with six published articles.

When we look at the years when these articles were published (see Figure 2), most of the articles appeared in year 2022 (n = 15). A few articles less (n = 12) were published in 2021. Year 2023 is represented by six (n = 6) articles from the list and only one (n = 1) article from 2024 has been included for the analysis in this systematic map. It is, however, not surprising, as the literature search was conducted in the beginning of the 2024 (February 8th).

Figure 2. Distribution of articles by years of publishing.

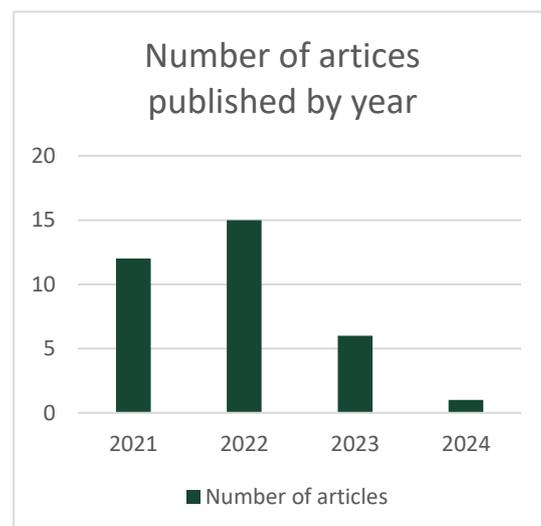


Table 7. Final list of articles eligible for the systematic mapping.

| <i>No.</i> | <i>Author(s)</i> | <i>Title</i> | <i>Journal</i> | <i>Year</i> | <i>Vol. (Issue)</i> |
|------------|--------------------------|---|--|-------------|---------------------|
| 1 | Andersson and Nelander | Nudge the Lunch: A Field Experiment Testing Menu-Primacy Effects on Lunch Choices | Games | 2021 | 12 (1) |
| 2 | Bauer et al. | Nudging healthier food choices in a cafeteria setting: A sequential multi-intervention field study | Appetite | 2021 | 160 |
| 3 | Buratto and Lotti | Encouraging sustainable food consumption through nudges: An experiment with menu labels | Ecological Economics | 2024 | 216 |
| 4 | Buscemi et al. | A pilot study of a school lunchroom intervention in a predominantly Latinx sample | Contemporary Clinical Trials | 2021 | 111 |
| 5 | Byker Shanks et al. | School Lunch Advisory Councils' use of behavioural economics influences vegetable selection and waste | Health Education Journal | 2023 | 82(5) |
| 6 | Cesareo et al. | The effectiveness of nudging interventions to promote healthy eating choices: A systematic review and an intervention among Italian university students | Appetite | 2022 | 168 |
| 7 | Cozzio et al. | Minimising plate waste at hotel breakfast buffets: an experimental approach through persuasive messages | British Food Journal | 2021 | 123 (9) |
| 8 | Delaney et al. | The efficacy of a multi-strategy choice architecture intervention on improving the nutritional quality of high school students' lunch purchases from online canteens (Click & Crunch High Schools): a cluster randomized controlled trial | International Journal of Behavioural Nutrition and Physical Activity | 2022 | 19 (1) |
| 9 | De Visser-Amundson, Anna | A multi-stakeholder partnership to fight food waste in the hospitality industry: a contribution to the United Nations Sustainable Development Goals 12 and 17 | Journal of Sustainable Tourism | 2022 | 30 (10) |
| 10 | Erjavec et al. | Nudge with caution: targeting fruit and vegetable consumption in primary schools | European Journal of Clinical Nutrition | 2021 | 75 (4) |
| 11 | Gavrieli et al. | Appealing dish names to nudge diners to more sustainable food choices: a quasi-experimental study | BMC Public Health | 2022 | 22 (1) |
| 12 | Gravert and Kurz | Nudging à la carte: a field experiment on climate-friendly food choice | Behavioural Public Policy | 2021 | 5 (3) |
| 13 | Griesoph et al. | Guess What ...? — How Guesed Norms Nudge Climate-Friendly Food Choices in Real-Life Settings | Sustainability | 2021 | 13 (15) |
| 14 | Kawa et al. | Effects of a Nudging Cue Targeting Food Choice in a University Cafeteria: A Field Study | Healthcare | 2023 | 11 (9) |
| 15 | Kee et al. | Appealing to generosity to reduce food calorie intake: A natural field experiment | Food Policy | 2022 | 110 |
| 16 | Lohmann et al. | Do carbon footprint labels promote climatarian diets? Evidence from a large-scale field experiment | Journal of Environmental Economics and Management | 2022 | 114 |
| 17 | Meeusen et al. | Nudging strategies to improve food choices of healthcare workers in the workplace cafeteria: A pragmatic field study | Clinical Nutrition ESPEN | 2023 | 53 |
| 18 | Migliavada et al. | Is purchasing of vegetable dishes affected by organic or local labels? Empirical evidence from a university canteen | Appetite | 2022 | 173 |
| 19 | Palmer et al. | The Efficacy and Cost-Effectiveness of Replacing Whole Apples with Sliced in the National School Lunch Program | International Journal of Environmental Research and Public Health | 2021 | 18 (24) |
| 20 | Radnitz et al. | Application of optimal defaults to increase selection of sustainable menu choices | Food Quality and Preference | 2023 | 110 |

| | | | | | |
|----|------------------------------|---|--------------------------------------|------|---------|
| 21 | Rantala et al. | Sensory Appeal and Routines Beat Health Messages and Visibility Enhancements: Mixed-Methods Analysis of a Choice-Architecture Intervention in a Workplace Cafeteria | Nutrients | 2022 | 14 (18) |
| 22 | Reinholdsson et al. | Nudging green food: The effects of a hedonic cue, menu position, a warm-glow cue, and a descriptive norm | Journal of Consumer Behaviour | 2023 | 22 (3) |
| 23 | Rosi et al. | Nutritional Composition and Environmental Impact of Meals Selected in Workplace Canteens before and after an Intervention Promoting the Adherence to the Mediterranean Diet | Nutrients | 2022 | 14 (21) |
| 24 | Schindler-Ruwisch and Gordon | Nudging healthy college dining hall choices using behavioral economics | Journal of American College Health | 2021 | 69 (7) |
| 25 | Schneider et al. | Nudging and boosting children's restaurant menus for healthier food choice: a blinded quasi-randomized controlled trial in a real life setting | BMC Public Health | 2022 | 22 (1) |
| 26 | Spence et al. | The Effect of a Product Placement Intervention on Pupil's Food and Drink Purchases in Two Secondary Schools: An Exploratory Study | Nutrients | 2022 | 14 (13) |
| 27 | Taufik et al. | A reversal of defaults: Implementing a menu-based default nudge to promote out-of-home consumer adoption of plant-based meat alternatives | Appetite | 2022 | 175 |
| 28 | Van Rookhuijzen and De Vet | Nudging healthy eating in Dutch sports canteens: a multi-method case study | Public Health Nutrition | 2021 | 24 (2) |
| 29 | Venema and Jensen | We meat again: a field study on the moderating role of location-specific consumer preferences in nudging vegetarian options | Psychology & Health | 2023 | |
| 30 | Vidal-Mones et al. | From evaluation to action: Testing nudging strategies to prevent food waste in school canteens | Waste Management | 2022 | 140 |
| 31 | Wyse et al. | Long-term Effectiveness of a Multistrategy Behavioral Intervention to Increase the Nutritional Quality of Primary School Students' Online Lunch Orders: 18-Month Follow-up of the Click & Crunch Cluster Randomized Controlled Trial | Journal of Medical Internet Research | 2021 | 23 (11) |
| 32 | Wyse et al. | Effectiveness of a Multistrategy Behavioral Intervention to Increase the Nutritional Quality of Primary School Students' Web-Based Canteen Lunch Orders (Click & Crunch): Cluster Randomized Controlled Trial | Journal of Medical Internet Research | 2021 | 23 (9) |
| 33 | Wyse et al. | The effectiveness of canteen manager audit and feedback reports and online menu-labels in encouraging healthier food choices within students' online lunch orders: A pilot cluster randomised controlled trial in primary school canteens in New South Wales, Australia | Appetite | 2022 | 169 |
| 34 | Yi et al. | Nudging food service users to choose fruit- and vegetable-rich items: Five field studies | Appetite | 2022 | 173 |

4.2 Study-related results

4.2.1 Country-wise distribution of studies

Figure 3 shows country-wise distribution of the studies. Exactly half (n=17) of the articles are depicting studies which have been conducted in the Anglo-Saxon part of the Western world (USA n=7; Australia n=5; UK n=4; Canada n=1). The other half of the articles are describing studies which were conducted within the European continent. Germany, Italy and Netherlands are represented by four (n=4) articles each. Three (n=3) articles describe studies conducted in Sweden, while the rest of the articles mention studies from Finland (n=1), Denmark (n=1) and Spain (n=1). For exact country information for each of the 34 articles, please see Appendix 2.

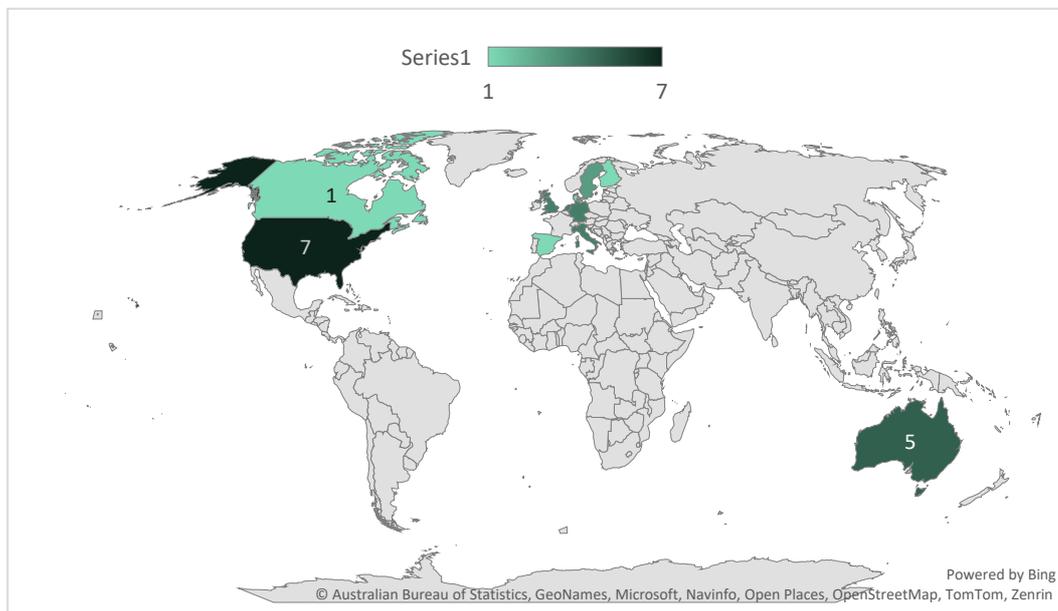


Figure 3. Country-wise distribution of studies.

4.2.2 Study (Experiment) Design

Twenty (n=20) studies found to represent a type of a pretest-posttest field experiment (see Appendix 2 for exact articles employing this design), where data is first collected prior to the intervention (so called baseline/control period), and second time towards the end of/after the intervention. An example of such is a field experiment conducted by Erjavec et al. (2021) where authors tested effectiveness of a combination of nudging interventions aimed at increasing primary school pupils' fruit and vegetable consumption during lunchtime. Children's lunchtime food consumption data was measured twice: before the intervention took place (pretest) and in the final week of the intervention (posttest). Each of the measuring periods lasted one day and involved photographing children's plate servings and plate waste (Erjavec et al. 2021).

Another, often repeating, types of study design present among the selected list of studies are between-subject/group field experiments (Cozzio et al. 2021; Griesoph et al. 2021; Taufik et al. 2022; Venema & Jensen 2023); and quasi-experiments (Schindler-Ruwisch & Gordon 2021; Gavrieli et al. 2022; Migliavada et al. 2022; Rantala et al. 2022; Byker Shanks et al. 2023; Kawa et al. 2023).

Furthermore, there appeared to be a series of similar and in a way connected cluster randomized controlled trials conducted by Delaney et al. (2022) and Wyse et al. (2021a; b; 2022). All the three studies were conducted in New South Wales, Australia and involved a similar set of multi-strategy choice architecture interventions applied within an online lunch ordering software used by local schools. The overarching aim of these studies was to improve the nutritional quality of children's school meals. A parallel-group cluster randomized controlled trial conducted by Delaney et al. (2022) involved 9 high-schools, which were randomized at 1:1 ratio. First group of schools received a set of nudging interventions (Click & Crunch project) for two months, while the second group of schools had a usual online ordering, with no interventions for the same period of time. Wyse et al. (2021b) employed the same experimental design to a total of 17 primary and secondary schools. The data was collected 12 months after the intervention was in place. Another study by Wyse et al. (2021a) is essentially a "continuation" of the already mentioned experiment. The paper looks into a long-term effectiveness of the intervention, and reports results measured 18 months after the start of the intervention. Information detailing study design of each of the 34 articles can be found in the Appendix 2.

4.2.3 Sustainability Type

As it can be seen from Table 8, in half of the articles, n=17 (50%), studies were driven solely by Social Sustainability aspects of the Food System. In all of the cases, nudging interventions were aimed at improving health and nutrition quality of the subjects. Twelve, n=12 (35%), of the articles had solely an Environmental sustainability focus. The overarching environmental focus can further be divided into two themes which were uncovered during the analysis: 1. Focus on decreasing Greenhouse gas emissions; 2. Focus on decreasing food waste. Furthermore, in five (n=5) articles interventions were focused on increasing both social and environmental sustainability. In all these cases, social sustainability has been seen in terms of human health and nutrition quality, while two articles in addition focused on decreasing GHG emissions and another two articles aimed to decrease food waste (see Table 8). One article, by Rosi et al. (2022) has raised wider environmental sustainability objectives (to be detailed later in this section) in addition to the aims of improving the quality of human nutrition and health.

Table 8. Classification of reviewed articles based on their sustainability objectives.

| Sustainability Type in focus | | | | |
|--|---|---|--|--|
| <i>Social</i> | <i>Environmental</i> | | <i>Both</i> | |
| <i>Focus on improving human health and nutrition</i> | <i>Focus on decreasing food waste</i> | <i>Focus on decreasing GHG emissions</i> | <i>Social + GHG emissions</i> | <i>Social + Food waste</i> |
| Bauer et al. (2021); Buscemi et al. (2021); Cesareo et al. (2022); Delaney et al. (2022); Erjavec et al. (2021); Kawa et al. (2023); Kee et al. (2022); Meeusen et al. (2023); Rantala et al. (2022); Schindler-Ruwisch and Gordon (2021); Schneider et al. (2022); Spence et al. (2022); Van Rookhuijzen and De Vet (2021); Wyse et al. (2021a; b; 2022); Yi et al. (2022). | Cozzio et al. (2021); De Visser-Amundson (2022); Vidal-Mones et al. (2022). | Andersson and Nelander (2021); Buratto and Lotti (2024); Gravert and Kurz (2021); Griesoph et al. (2021); Lohmann et al. (2022); Radnitz et al. (2023); Reinholdsson et al. (2023); Taufik et al. (2022); Venema and Jensen (2023). | Gavrieli et al. (2022); Migliavada et al. (2022); | Byker Shanks et al. (2023); Palmer et al. (2021). |
| | | | <i>Social + Wider Environmental objectives</i> | |
| | | | Rosi et al. (2022). | |

Social Sustainability

When it comes to how a “healthy diet” was understood and defined in each of these studies, authors such as Delaney et al. (2022) and Wyse et al. (2021a; b; 2022), who have conducted their studies in the New South Wales (NSW) Australia, have anchored their nudging interventions on the state’s “Healthy School Canteen Strategy” - which is a set of governmental guidelines to improve the nutrition quality at local school canteens. The NSW Healthy School Canteen Strategy is in turn aligned with the Australian National Dietary Guidelines.

A few more authors have based their definition of a healthy meal upon local governmental dietary guidelines: Buscemi et al. (2021), Byker Shanks et al. (2023), and Palmer et al. (2021) have designed their nudging interventions in accordance with a USA “Smarter Lunchrooms” movement which is a part of US National School Lunch Program and follows National Dietary Guidelines for Americans; while Meeusen et al. (2023) have employed Dutch Healthy Food Guidelines in their nudging experiment to improve food choices of healthcare workers. Rantala et al. (2022) has used a nutrition label in their nudging intervention which was developed by the Finnish Heart Association and the Finnish Diabetes Association in accordance to the Finnish nutrition recommendations.

Rosi et al. (2022) have argued for a Flexitarian dietary model, more precisely – Mediterranean Diet, which represents plant-based meals with small quantities of fish, meat and dairy products. Their choice and subsequent nutritional analysis of the menus was based on “the planetary health plate” concept developed by the EATLancet Commission and further adopted by the Barilla Centre for Food and Nutrition (BCFN) in their “Double Pyramid” model.

In contrast to the studies mentioned above, other articles have defined “healthy meal” based on more of a general knowledge assumption backed by relevant academic research. For example, Erjavec et al. (2021) and Yi et al. (2022) aimed to nudge their intervention subjects to choose more vegetable and fruit rich food items, as according to the previous research cited in these articles, fruit and vegetable consumption among the targeted population was quite insufficient. In a similar manner, Kawa et al. (2023) and Kee et al. (2022) promoted low-calorie diet choices by their nudges in order to tackle obesity problem among US populations. Other authors, who used a combination of general knowledge and previous research to define what is a healthy food include: Schindler-Ruwisch and Gordon (2021), Spence et al. (2022), Gavrieli et al. (2022), Migliavada et al. (2022), and Bauer et al. (2021).

The last category of authors has each consulted nutrition experts to select the most healthy and sustainable meal alternative for their research. Cesareo et al. (2022) have delegated the task of designing intervention menus adhering to the Mediterranean diet’s principles to the cafeteria’s quality control managers – a team consisting of nutritionists and dietetics professionals. Schneider et al. (2022) have closely collaborated with a dietician from the German Federal Research Institute of Nutrition and Food to create a new dish. While Van Rookhuijzen and De Vet (2021) used help of sports dietician to prepare healthier snack alternatives to be consumed before and after training. Previously mentioned Delaney et al. (2022) and Wyse et al. (2021a; b; 2022) have also consulted a team of dietitians and health behaviour practitioners in order to select their nudging strategies.

Environmental Sustainability: Decreasing Food Waste

When it comes to studies that aimed at decreasing food waste, Vidal-Mones et al. (2022), Cozzio et al. (2021) and De Visser-Amundson (2022) have anchored their aim for decrease in food waste upon UN SDG goal n.12 “Responsible Consumption and Production”, target 12.3: “By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses” (United Nations n.d.).

Studies described in Cozzio et al. (2021) and De Visser-Amundson (2022) have taken place within the hospitality sector. While Cozzio et al. (2021) have conducted their nudging experiment at a hotel restaurant in Italy involving a local ecolabel Legambiente, De Visser-Amundson’s (2022) article presents results from a much

broader study involving 172 restaurants in the Netherlands. The latter describes results from a “Food Waste Challenge” – a multi-stakeholder partnership initiative, led by one of Europe’s largest commercial corporate banks - Rabobank (as a part of its’ Rabo Food Forward” programme) and involving other actors, such as the foundation against food waste (Samen Tegen Voedselverspilling), Dutch Hotel Management University, small technology start-up (Wastewatchers), Dutch Government department (Netherlands Nutrition Centre), and the restaurant business sector in the country.

Another two studies, which were concerned with decreasing food waste – Byker Shanks et al. (2023) and Palmer et al. (2021) have already been mentioned under the Social Sustainability section above. As in the case of dietary recommendations, the concern for food waste decrease in school canteens has been inspired and guided by the “Smarter Lunchrooms” movement, which is a part of the US National School Lunch Program.

Environmental Sustainability: Decreasing Greenhouse Gas Emissions

All of the eleven (n=11) studies aiming to decrease the GHG (including those which in addition strived to improve human nutrition) have focused on designing nudging interventions which promote purely vegetarian/vegan meal options over the meat-based alternatives. Only two of these eleven studies have actually calculated the carbon footprint of meals used in their research: Andersson and Nelander (2021) have retrieved their CO₂ emissions data from a software called CarbonAte, while Lohmann et al. (2022) have outsourced the task to a sustainability consulting company which in turn took emissions data from three different Life-cycle Assessment Databases. The rest of the authors have operated on the general idea of exclusively plant-based food having much lesser carbon footprint than meat-containing food alternatives. In each of the cases the argument has been anchored upon previous research.

Environmental Sustainability: Wider Objectives

As mentioned previously, Rosi et al. (2022) have employed the “Double Pyramid” model to define concept of sustainable diet in their research. The model conceptualises sustainable diet as a balance between “the nutritional value of a food and the environmental impact generated during its production and consumption, measured as the ecological footprint” (Rosi et al. 2022:2). When it comes to the measurement of the environmental consequences of a diet in particular, the model incorporates such indicators as: resource exploitation, terrestrial acidification, water pollution, deforestation, climate change, and biodiversity loss. That said, Rosi et al. (2022) have assessed carbon, water and ecological footprints of the menus used in their nudging experiment to determine the overall environmental impact.

4.2.4 PICO: Population and Context

As the data extraction and subsequent synthesis processes have shown, the type of customers subjacent to the nudging interventions were most often directly linked to the type/category of the dining establishment. Therefore, it was decided to present the Population and Context results together.

Educational Institutions

In 19 of the total 34 analysed articles nudging experiments have taken place at an Educational Institution (see Table 9). Out of which, nine (n=9) articles have described experiments executed in cafeterias/canteens located at a university campus. In such cases, the Population of the experiments primarily consisted of university students, intermixed with a small number of university staff members and eventual campus visitors.

Furthermore, two articles (n=2) have described studies conducted in High School canteens, three (n=3) articles have had experiments taken place in Secondary school canteens/cafeterias, while seven (n=7) of the articles have had nudging experiments taken place at canteens of Elementary/Primary schools. In all of these cases the studied population has been school pupils of the corresponding ages/school grades.

Workplace Cafeteria/Canteen

Another discovered category of the Context are studies that have been set in Workplace cafeterias/canteens (see Table 9). Studies with such setting have been described in six (n=6) out of the total 34 articles. For example, Bauer et al. (2021) have conducted their nudging experiment in a corporate cafeteria of a medium-sized family owned enterprise with about 5300 employees working at the site. The study has been focused on four population groups: regular employees, trainees, interns, and guests. Rantala et al. (2022) have experimented in a workplace cafeteria of a Finish municipal office building, where nudges were primarily applied to the employees of the office, however also included employees from other nearby workplaces and some senior citizens and students. Rosi et al. (2022) have used food nudges in two worksite canteens of the Barilla G & R. F.lli S.p.A. food company, based in the Parma region of Italy. The studied population included all canteen users, which were of both genders, between 19 and 67 years-old, blue-collar or office workers. Meeusen et al. (2023) have conducted their study at a hospital workplace cafeteria in a Dutch academic medical centre involving healthcare workers as the studied population. Similarly, a study by Venema and Jensen (2023) included an experiment involving a Danish hospital canteen customers: hospital staff members and visitors.

Restaurants

In seven (n=7) out of the total 34 analysed articles food nudging experiments were conducted in different kinds of restaurants, altogether involving a very broad variation of population. For example, in her large-scale field experiment, De Visser-Amundson (2022) has involved 172 restaurants located all over the Netherlands and featuring different concepts, target markets, menus and cuisines. While Schneider et al. (2022) have concentrated their attention on families with kids and their food decision making at one restaurant in Mannheim, Germany. In two cases, the restaurants were located inside and belonged to a hotel: Buratto and Lotti (2024) have set their experiment in two restaurants of a five-star hotel in the UK; while Cozzio et al. (2021) have conducted their study during breakfast buffe in an Italian four star holiday hotel.

Sports Club Canteens

An article by Van Rookhuijzen and De Vet (2021) describes a rather distinct study conducted in two separate football clubs' canteens. The subjects of the experiment in this case were football players and spectators.

Online ordering systems

Among some of the above-mentioned studies' there were six (n=6) nudging experiments/articles that can be characterized by an additional "level" of the Context – all of these studies have applied nudges within a digital meal ordering system. Five of such digital food nudging experiments were conducted at Educational Institutions, while one of such studies has been conducted at a restaurant. In Table 9 each of the articles with the additional "digital context" are highlighted in yellow.

For example, Reinholdsson et al. (2023) have applied different "green" nudging techniques to the digital menu presented in the express ordering stations located at physical Swedish fast food restaurants MAX. In a similar manner, Migliavada et al. (2022) have added nudges to a University canteen menu showed on screens of digital ordering stations. While Wyse et al. (2021a; b; 2022) and Delaney et al. (2023) have applied nudging techniques within the online lunch ordering system at school canteens.

Table 9. Mapping of studies based on the Setting/Context of the intervention.

| Cafeterias/Canteens at Educational Institutions | | | | Workplace Cafeteria/Canteen | Restaurants | Sports Club Canteen |
|--|---|---|--|--|--|------------------------------------|
| University | High School | Secondary School | Elementary/Primary School | | | |
| Andersson and Nelander (2021); Cesareo et al. (2022); Griesoph et al. (2021); Kawa et al. (2023); Lohmann et al. (2022); Migliavada et al. (2022); Radnitz et al. (2023); Schindler-Ruwisch and Gordon (2021); Yi et al. (2022). | Byker Shanks et al. (2023); Delaney et al. (2022). | Spence et al. (2022); Vidal-Mones et al. (2022); Wyse et al. (2021a). | Buscemi et al. (2021); Erjavec et al. (2021); Palmer et al. (2021); Vidal-Mones et al. (2022); Wyse et al. (2021a; b; 2022). | Bauer et al. (2021); Gavrieli et al. (2022); Rantala et al. (2022); Rosi et al. (2022); | De Visser-Amundson (2022); Gravert and Kurz (2021); Kee et al. (2022); Reinholdsson et al. (2023); Schneider et al. (2022); Taufik et al. (2022). | Van Rookhuijzen and De Vet (2021). |
| | | | | <i>Located at a hospital</i> | <i>Hotel Restaurants</i> | |
| | | | | Meeusen et al. (2023); Venema and Jensen (2023) | Buratto and Lotti (2024); Cozzio et al. (2021). | |

Table 10. Number of articles per each of the context categories based on the article sustainability objective.

| Sustainability Objective | Educational Institutions | Other | Restaurant(s) | Workplace Cafeteria/Canteen | Total per Sustainability Objective |
|-------------------------------|--------------------------|----------|---------------|-----------------------------|------------------------------------|
| <i>Environmental</i> | 5 | | 6 | 1 | 12 |
| <i>Social</i> | 11 | 1 | 2 | 3 | 17 |
| <i>Both</i> | 3 | | | 2 | 5 |
| Total per Setting type | 19 | 1 | 8 | 6 | 34 |

4.2.5 Context X Sustainability

Table 10 shows the relationship between the sustainability objective of the examined articles and the context/setting of the nudging experiments described in each of the articles. In other words, we can see how many articles with Environmental sustainability focus had nudging experiments conducted at, for example, Educational Institutions and so on and vice versa. As it can clearly be seen, social sustainability concerns strongly dominated among articles/studies set at educational institutions - 11 out of total 19 articles describing studies conducted at educational institutions had social sustainability focus. In contrast, studies conducted at restaurants had majorly been focused on environmental sustainability objectives (six out of eight). Moreover, none of the food nudging experiments conducted at a restaurant(s) had been designed to fulfil/improve both social and environmental sustainability goals.

4.2.6 PICO: Interventions

Table 11 shows each of the analysed articles sorted out according to the TIPPME categories of nudges they have used. Quite a lot of studies (n=22) have employed food nudges belonging to only one TIPPME category. At the same time, that does not mean that only one type of nudging techniques has been used – some studies have employed several nudging techniques belonging to the same TIPPME category. Nudges used by Byker Shanks et al. (2023) were sorted/matched with the largest number of TIPPME categories - nine different categories. While the rest of the articles employed between two to five TIPPME categories.

When it comes to the intervention focus, nudges at the “Related Objects” level were found to be used in the largest number of studied articles (n=27). Such result is majorly due to the “Information X Related Objects” category which is the most widely used TIPPME category of food nudges among the studied articles. Nudging techniques involving the food “Product” itself or its’ “Wider Environment” appear to be less popular, with thirteen (n=13) articles employing nudging techniques at a Product level, and twelve (n=12) articles employing nudges at a “Wider Environment” level.

As it can also be seen from Table 11, the majority of instances when authors employed nudges at “Related Objects” and “Wider Environment” levels is related to nudges of the “Information” type. While articles/instances when nudges were used at the food “Product” level are more evenly spread out across the different nudge types.

Table 11. Articles mapped out based on the TIPPME category(ies) of nudges they used.

| Class | Intervention Focus | | | |
|------------|--------------------|--|---|--|
| | Product | Related Objects | Wider Environment | |
| Placement | Availability | AVAILABILITY X PRODUCT (n=5) Byker Shanks et al. (2023); Meeusen et al. (2023); Rosi et al. (2022); Schindler-Ruwisch and Gordon (2021); Van Rookhuijzen and De Vet (2021). | AVAILABILITY X RELATED OBJECTS (n=1) Byker Shanks et al. (2023). | AVAILABILITY X WIDER ENVIRONMENT (n=1) Bauer et al. (2021). |
| | Position | POSITION X PRODUCT (n=8) Byker Shanks et al. (2023); Cesareo et al. (2022); Meeusen et al. (2023); Rantala et al. (2022); Spence et al. (2022); Van Rookhuijzen and De Vet (2021); Venema and Jensen (2023); Yi et al. (2022). | POSITION X RELATED OBJECTS (n=2) Byker Shanks et al. (2023); Yi et al. (2022). | POSITION X WIDER ENVIRONMENT (n=0) |
| Fu | Fu | FUNCTIONALITY X PRODUCT (n=0) | FUNCTIONALITY X RELATED OBJECTS (n=0) | FUNCTIONALITY X WIDER ENVIRONMENT (n=0) |
| | Presentation | PRESENTATION X PRODUCT (n=5) Buscemi et al. (2021); Byker Shanks et al. (2023); Cesareo et al. (2022); Erjavec et al. (2021); Venema and Jensen (2023). | PRESENTATION X RELATED OBJECTS (n=1) Byker Shanks et al. (2023). | PRESENTATION X WIDER ENVIRONMENT (n=3) Bauer et al. (2021); Byker Shanks et al. (2023); Kawa et al. (2023). |
| | Size | SIZE X PRODUCT (n=3) Byker Shanks et al. (2023); Palmer et al. (2021); Yi et al. (2022). | SIZE X RELATED OBJECTS (n=0) | SIZE X WIDER ENVIRONMENT (n=0) |
| Properties | Information | INFORMTATION X PRODUCT (n=1) Venema and Jensen (2023); | INFORMATION X RELATED OBJECTS (n=27) Andersson and Nelander (2021); Buratto and Lotti (2024); Buscemi et al. (2021); Byker Shanks et al. (2023); Cesareo et al. (2022); Cozzio et al. (2021); De Visser-Amundson (2022); Delaney et al. (2022); Erjavec et al. (2021); Gavrieli et al. (2022); Gravert and Kurz (2021); Kee et al. (2022); Lohmann et al. (2022); Meeusen et al. (2023); Migliavada et al. (2022); Radnitz et al. (2023); Rantala et al. (2022); Reinholdsson et al. (2023); Rosi et al. (2022); Schindler-Ruwisch and Gordon (2021); Schneider et al. (2022); Taufik et al. (2022); Venema and Jensen (2023); Wyse et al. (2021a; b; 2022); Yi et al. (2022). | INFORMATION X WIDER ENVIRONMENT (n=9) Buscemi et al. (2021); Cesareo et al. (2022); Erjavec et al. (2021); Griesoph et al. (2021); Rantala et al. (2022); Rosi et al. (2022). Van Rookhuijzen and De Vet (2021); Vidal-Mones et al. (2022); Yi et al. (2022). |

Most widely used category of food nudges among the analysed articles are nudging techniques of the “Information” type with a total of 30 different articles employing such nudging techniques. While nudges of “Functionality” type were found to be completely non-present among the studies. In a similar manner, nudges of a “Size” type were quite rare, with only three (n=3) articles mentioning techniques which involved alternations in size of the food product. The rest of the TIPPME nudging types: Availability, Position, and Presentation have been employed in six (n=6), eight (n=8) and seven (n=7) different articles correspondingly. Examples of nudges belonging to the two most widely used TIPPME categories are provided below.

Information X Related Objects

Nudges belonging to this category often represented marking/distinguishing the nudged option(s) inside the menu with a visual label/sign, sometimes accompanied by the explanatory text at the end. For example, Cesareo et al. (2022) have labelled all healthy options in the menu with a green sign “So Good” to make them more salient. At the end of the menu customers could find an inserted extra sheet with the written explanation of the label. While Andresson and Nelander (2021) have displayed the amount of CO₂ emissions near each of the menu options, as well as added icons indicating allergens where relevant. Other authors employing similar nudging technique include: Buratto and Lotti (2024), Kee et al. (2022), Migliavada et al. (2022), Reinholdsson et al. (2023), Rosi et al. (2022), Schneider et al. (2022) and Wyse et al. (2021a; b; 2022).

Another common technique involved showcasing posters with information and/or label signs directly at a serving counter near the nudged food item. For example, Lohmann et al. (2022) have placed carbon footprint labels above cafeteria meals during lunch and Rantala et al. (2022) have used heart symbol labels together with informative posters near the targeted foods along the serving line. Articles with similar nudging techniques include: Cesareo et al. (2022), Meeusen et al. (2023), Schindler-Ruwisch and Gordon (2021), Venema and Jensen (2023), Yi et al. (2022).

Other authors have employed nudges which involved manipulations with the order/position of the menu options. For example, Andersson and Nelander (2021), Delaney et al. (2022), Reinholdsson et al. (2023), and Schneider et al. (2022) have listed the desired option as 1st on the menu. Radnitz et al. (2023) and Taufik et al. (2022) have used the default menu option nudge for vegan/plant based dishes. Gravert and Kurz (2021) have added vegetarian option as a standard menu option and took out the previously standard meat option from the menu, making it the “on request” option instead.

Finally, Buscemi et al. (2021), Erjavec et al. (2021), Gavrieli et al. (2022), and Schneider et al. (2022) have tried new appealing dish names for the target foods.

For example, Schneider et al. (2022) have labelled fruits and vegetables with fun and creative names and even employed comic characters to mark the meal of the menu, in order to nudge children.

Information X Wider Environment

Interventions belonging to this category have almost solely represented posters with a certain kind of information (healthy menu options; descriptions of the label; paintings of fruits etc.) being placed around the dining establishment (usually at the entrance to the establishment or near the checkout counter). For example, Cesareo et al. (2022) have placed menu poster featuring only the healthiest options and posters with pictures of such at the entrance to the cafeteria. While Erjavec et al. (2021) have placed posters announcing the vegetable and fruit of the day around the canteen.

Cesareo et al. (2022) have also used a unique among the other authors nudging technique – they have placed footprint stickers on the cafeteria floor guiding visitors towards the fruit station.

4.2.7 Intervention X Sustainability

Table 12 below summarizes and shows the number of articles (grouped based on their sustainability objective) which used the listed intervention types in their studies. As we can see, articles with solely Environmental sustainability focus predominantly used Information type of nudging techniques. In fact, in each of such articles the Information type nudging was used (12 out of 12). Nudging techniques employed in articles focusing on social sustainability goals and by authors who aimed to improve both of the “sustainabilities” are rather well spread across all types of the interventions. At the same time, even amongst the latter two, there is a domination of Information type of nudges. Which corresponds well with the fact that Information nudges are the most widely used nudging type among all the analysed articles.

Table 12. Number of articles which used each of the TIPPME Intervention types, grouped based on the article Sustainability objective.

| Intervention Type used | Article Sustainability Objective | | |
|------------------------|----------------------------------|-----------------------------|-------------------|
| | <i>Social (n=17)</i> | <i>Environmental (n=12)</i> | <i>Both (n=5)</i> |
| Availability | 4 | 0 | 2 |
| Position | 6 | 1 | 1 |
| Functionality | 0 | 0 | 0 |
| Presentation | 5 | 1 | 1 |
| Size | 1 | 0 | 2 |
| Information | 14 | 12 | 4 |

4.2.8 Context X Intervention

Table 13. Number of articles which used each of the TIPPMIE Intervention types based on the Setting/Context of the articles.

| Setting / Context | Intervention Type | | | | | |
|---|-------------------|----------|---------------|--------------|------|-------------|
| | Availability | Position | Functionality | Presentation | Size | Information |
| Cafeterias/Canteens at Educational Institutions (n=21) | 2 | 4 | 0 | 5 | 3 | 18 |
| Restaurant(s) (n=8) | 0 | 0 | 0 | 0 | 0 | 8 |
| Sports Club Canteen (n=1) | 1 | 1 | 0 | 0 | 0 | 1 |
| Workplace Cafeteria/Canteen (n=6) | 3 | 3 | 0 | 2 | 0 | 5 |

Table 13 above shows number of articles which used each of the Intervention Types based on the Setting/Context of the articles. As it can be clearly seen, articles describing experiments conducted at restaurants have only used Information type of nudges. Moreover, nudges of the Size type were only used in experiments conducted at Educational Institutions. Eighteen out of the total 21 articles describing studies conducted at Educational Institutions have used Information type of nudges. Similarly, majority of the articles belonging to the “Workplace Cafeteria” context group have as well employed Information nudges in their studies – five out of six. It can be therefore said that Information type of nudging techniques is the most widely spread type of nudges among all the discovered study contexts.

5. Discussion

This section will begin with the discussion of the limitations of this literature map: First, limitations of the literature review methods will be presented in detail; next, limitations related to the evidence base will be discussed.

Afterwards, will follow the discussion of the most important findings, which have resulted from a capture of 34 articles into a systematized literature map. More precisely, it will describe knowledge gaps (underrepresented and unrepresented subtopics) and knowledge clusters (well-represented subtopics) uncovered during the analysis of the given evidence base. Based on such, recommendations for future primary research will be given and potential for a more detailed evidence synthesis will be highlighted.

5.1 Limitations of the review methods

Due to the nature and scope of this research project (an individual master's thesis), there were two leading limitations which affected the methods of this study: the limitation in time and the limitation in human resources. As such, certain methodological steps required by the CEE Guidelines and Standards for Evidence Synthesis in Environmental Management had to be omitted, making this literature map a systematized one, rather than systematic. The omitted steps were: 1. Engaging eventual stakeholders throughout the review process (mainly in the formulation of the research question) and 2. Consistency checks during screening and meta-data extraction and coding stages. While the former step had to be skipped primarily due to the time limitations, the latter was not possible, since the whole research has been conducted by one person only.

Furthermore, during the map execution stage it became evident that there exists one additional limitation in the design of the study. It is concerned with the initial design of the search and screening strategy, when additional inclusion and exclusion criteria had to be added during the full text screening stage (described in detail on p.21). Including/having these criteria in the initial protocol, before the beginning of the whole search and screening processes could have shortened the total time spent for executing these steps. At the same time, adding the inclusion and exclusion criteria at a later stage is believed to have not affected the overall quality of the screening process and the final article results.

5.2 Limitations of the evidence base

Due to the scope of this project, the literature search strategy had to be designed with certain limitations in order to keep the project feasible. Such limitations have

of course led to a rather biased sample of articles. The fact that only two databases were searched and that the search string was limited to include only peer reviewed journal and review articles written in English (language bias), completely excluding grey literature, means that this research has looked at and mapped out only a limited part of the literature/evidence available. Moreover, there exists geographical bias, since only studies conducted in Western countries were included as part of the evidence base. Availability bias is worth mentioning as well, since thirteen articles were found to be unretrievable during the full text screening stage.

5.3 Knowledge gaps, clusters and implications for further research

5.3.1 Sustainability

After a close look at the results depicting Sustainability focus among the analysed 34 articles, one can notice that Social Sustainability aims were defined in a quite limited way – all the authors have aimed solely for the improvement of human health and nutrition. Other social sustainability concerns, like, for example, promotion of fair labour practices, diversity, and another human rights' related topics, were not at all mentioned in the 17 articles that were attributed to the social domain of Food Sustainability. In other words, the authors have concentrated their attention on the end-consumer-related part of the problem while leaving out social sustainability issues connected with the rest of the actors/stakeholders involved in the global food system.

Future nudging experiments, therefore, can be conducted with the aim to promote meals/food products made with, for example, fair trade or/and locally produced ingredients (in addition to their high nutritional quality). Nudging at dining establishments can potentially be used to promote small local food producers and research investigating such possibilities is needed.

When it comes to the Environmental sustainability, its food system related problems were covered in a rather limited way as well. As it is previously described in the Results section, the Environmental sustainability aims were connected either to the decrease of GHG emissions, or to the decrease of food waste. Only one article – by Rosi et al. (2022), has defined Environmental sustainability in broader terms (see Environmental Sustainability: Wider Objectives). Moreover, in those cases where authors aimed to decrease food-consumption- related GHG emissions, it has always been executed through nudging consumers to choose vegetarian or vegan meal options. In the vast majority of such cases, authors did not calculate the actual carbon footprint of their nudged meals.

Given the above-mentioned knowledge gap, future food nudging experiments at dining establishments should be designed with a much broader array of environmental sustainability measurements in mind (for example, water usage,

biodiversity etc.). Methods for environmental impact assessment used by Rosi et al. (2022) are a great example and starting point of such. Moreover, to increase the overall credibility of the research, carbon footprint, or any other type of relevant ecological footprint of foods to be used during the experiment should be calculated. Nudging possibilities of sustainable non-vegetarian meal options within the context of dining establishments should be investigated as well.

Last but not the least, only five articles have combined social and environmental sustainability concerns, with majority of the examined research being dedicated to only one strand of (un)sustainability related to human food consumption. Given the above-mentioned shortcomings of the evidence base, there is a need for future research on food nudging experiments within the dining industry dedicated to a solution of a broader spectrum of food unsustainability issues. Ideally, a combination of environmental and social sustainability targets should be incorporated into the design of food nudging experiments executed at dining establishments.

5.3.2 Context (X Sustainability)

The mapping of the articles based on their study context (setting) has revealed one big cluster of experiments conducted at Educational Institutions (19 out of the total 34 studied articles belong to such category). There is, therefore, a potential for a more detailed evidence synthesis when it comes to use of food nudging within the broader “educational” dining setting. In addition, as the pivot table analysis has shown, social sustainability concerns were dominant amongst studies within this context/setting (see Table 10). On one side, this highlights an additional cluster of studies - food nudging experiments conducted at educational institutions with an aim to improve consumer diet and nutrition quality, with a possibility for a more detailed systematic evidence synthesis. On the other side, it highlights an existing gap in the primary research belonging to the educational context aimed at a wider spectrum of sustainability targets, rather than improvements in human health.

The “Educational” cluster further divides itself into four smaller subclusters (see Table 9), with articles depicting studies conducted at University canteens being the most “visible” of them (total such article n=9). Studies conducted at Primary/Elementary schools, private restaurants and workplaces each constitute a similar size of a knowledge cluster, with a total number of seven, eight and six articles correspondingly. Each of these four categories represent a relatively well visible knowledge cluster given the total number of studied articles. However, six to nine articles are questionably enough for a fully-fledged systematized literature review, and therefore there is a potential need in more studies conducted at such locations.

When it comes to restaurants in particular, most of the studies conducted within such setting had environmental sustainability focus and none exhibited a

combination of social and environmental sustainability aims. Therefore, there is a heightened need for future research on food nudging at restaurants dedicated to social sustainability objectives or trying to achieve improvements across both of the sustainability domains.

Simultaneously there exist some clearly underrepresented types of contexts where food nudging experiments rarely took place. For example: high schools, restaurants located at hotels, cafeterias and other types of dining establishments located within hospital and other healthcare institutions' territories, and finally sports clubs and sports centres. Additionally, there exist completely unrepresented context types, such as for example canteens at elderly houses and prisons. All of which constitute a clear knowledge gap and are in need for academic research.

5.3.3 Intervention

The mapping of nudging techniques according to TIPPME categories has clearly revealed a large cluster of studies conducted with use of the Information type of nudges (total of 30 articles employing such nudging techniques). Instances, when Information nudges were employed at a Related Object level represent a strongly dominant subcluster of articles (see “Information X Related Objects” in Table 11). Both the cluster and the subcluster in its own, represent a potential for further studies, including systematic reviews.

Coming back to the TIPPME classification (Table 11), one can observe a general tendency of nudging techniques used at the related objects and wider environment levels to be of Information type. While the rest of the TIPPME intervention types are almost never used at these focus levels. Quite the opposite can be observed with nudges focused at the food product itself.

Instances when a variety of nudging techniques were employed at a food product level can be attributed to a separate cluster of knowledge as well. Such cluster equals to a relatively small number of articles – thirteen. However, represents 22 instances of different food nudging techniques, rather evenly spread out amongst all the TIPPME intervention types (with the exception of the Functionality type nudges).

Simultaneously, there exist huge knowledge gaps in the studied evidence base when it comes to the rest of the TIPPME food nudging categories. For example, nudges of Functionality type, involving changes in the design and functionality of food products or objects, were found to be completely unrepresented among the studied articles. Same can be said about nudges involving changes in the size or shape of related objects and wider environment, as well as nudges involving alternations in the position of objects comprising the wider dining environment. There is therefore a strong need for primary research encompassing experiments with nudges of other than Information type, especially at the Related Objects and Wider Environment focus levels.

6. Conclusions

This research project was conducted with the goal to produce a systematic literature map of academic journal articles describing sustainability-oriented food nudging experiments conducted at different dining establishments. To achieve this goal, two databases (Scopus and Web of Science) were systematically searched in February 2024, which, after the screening process has been completed, resulted in 34 articles that were used for the narrative evidence synthesis. The above-mentioned process resulted in the current systematized literature map, which can be further used by academics as a guidance and inspiration for future research.

Some of the most important further research recommendations include: a much wider spectrum of food-system-related environmental and social sustainability issues should be addressed. Ideally, future food nudging experiments at dining establishments should be aiming for improvements in both social and environmental aspects simultaneously.

Two big knowledge clusters: studies depicting food nudging experiments conducted at dining establishments of educational institutions and the cluster of studies involving Information type of nudging techniques – both represent a potential for a more detailed evidence synthesis (systematic review).

Additionally, the literature review process has identified major gaps in usage of other than Information type of nudging techniques, especially at the related objects and wider environment focus levels. There is, therefore, a need for future studies employing a much broader array of food nudging techniques when it comes to experiments at dining establishments aimed at sustainable outcomes.

Finally, due to the limitations of this literature map, future research recommendations include broadening of the scope of the current systematized map and execution of a more extensive literature search and mapping.

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Popular science summary

Today, out-of-home food consumption – aka dining out, accounts for a significant and growing proportion of food intake in many Western countries and substantially contributes to the unsustainability of the global food system. Food nudging – subtly influencing consumers to choose a healthier or more sustainable meal option, is increasingly being seen as the new panacea for these sustainability challenges.

The current study has found and analysed 34 previously published research articles which describe food nudging experiments at restaurants, canteens etc. The analysis resulted in a map, where each of the 34 articles have been attributed to different categories, based on what type of nudging technique they used, where did the experiment take place and what sustainability issues did authors try to resolve.

It turned out, that approximately half of these articles were describing studies conducted at University and school canteens. In most of these cases researchers were aiming to improve the overall health and diet quality of university and school canteen customers. Articles, which described food nudging experiments at restaurants, were mostly trying to improve environmental sustainability: decrease GHG emissions and/or food waste. When it comes to the nudging techniques that have been used, Information type of nudges strongly dominated the scene. Information nudges are, for example: visual food labels, posters with specific text, fun and attractive dish names.

The paper later concludes with suggestions for future research. One of the main concluding messages is that there is a need for a much wider array of food nudging techniques to be employed and tested within the dining out setting. Such nudges should as well be designed to address both social and environmental sustainability concerns. Specifically, more experimental research is needed on nudges addressing the food waste issue, as well as possibilities of using food nudging for promotion of locally grown and fair-trade foods at restaurants and similar settings can be investigated.

Appendix 1

Table 14. List of unretrieved articles during the full text screening stage and reasons behind.

| Article | Reason |
|---|-------------------------|
| Karolyova, D., Haider, I., Ratilla, M., Dohnalova, Z., Horak, M. & Buckova, M. (2023). The impact of a nudge intervention on healthy complementary food purchasing: An experiment from a Czech university canteen. <i>TRANSFORMATIONS IN BUSINESS & ECONOMICS</i> , 22 (1), 260–279 | Fulltext not accessible |
| Lindstrom, K.N., Tucker, J.A. & McVay, M. (2023). Nudges and Choice Architecture to Promote Healthy Food Purchases in Adults: A Systematized Review. <i>PSYCHOLOGY OF ADDICTIVE BEHAVIORS</i> , 37 (1), 87–103. https://doi.org/10.1037/adb0000892 | Fulltext not accessible |
| Cadario, R. & Chandon, P. (2020). Which healthy eating nudges work best? A meta-analysis of field experiments. <i>Marketing Science</i> , 39 (3), 465–486. https://doi.org/10.1287/mksc.2018.1128 | Fulltext not accessible |
| Buscemi, J., Withington, M.H.C., Loiacono, B., Cory, M., Mansfield, D., Herman, A., Jagpal, A., Hamm, A., Tussing-Humphreys, L., Soto, D. & Estrada, M. (2021). EXPLORING THE EFFICACY OF AN ENVIRONMENTAL SCHOOL LUNCHROOM INTERVENTION ON DIET IN A PREDOMINATELY LATINX SAMPLE. <i>ANNALS OF BEHAVIORAL MEDICINE</i> , 55, S212–S212 | Fulltext not available |
| Ratilla, M., Karolyova, D., Haider, I., Dohnalova, Z. & Horak, M. (2022). NUDGING HEALTHY RESTAURANT SELECTION IN AN ONLINE FOOD DELIVERY PLATFORM: THE EFFECT OF AVAILABILITY AND PRIMING. <i>Transformations in Business and Economics</i> , 21 (3), 395–411 | Fulltext not accessible |
| Trewern, J., Chenoweth, J. & Christie, I. (2022). Evaluating the impact of a retailer-led pilot at changing consumer behaviour. <i>PROCEEDINGS OF THE NUTRITION SOCIETY</i> , 81 (OCE2). https://doi.org/10.1017/S0029665122000933 | Fulltext not available |
| Montagni, I., Prevot, F., Castro, Z., Goubel, B., Perrin, L., Oppert, J.-M. & Fontvieille, A.-M. (2020). Using Positive Nudge to Promote Healthy Eating at Worksite: A Food Labeling Intervention. <i>Journal of Occupational and Environmental Medicine</i> , 62 (6), E260–E266. https://doi.org/10.1097/JOM.0000000000001861 | Fulltext not accessible |
| Schulz, F., Bitsch, L. & Hanf, J. (2021). Old wine in new skins - Nudging in the wine industry. <i>MITTEILUNGEN KLOSTERNEUBURG</i> , 71 (2), 187–195 | Fulltext not accessible |
| Vecchio, R., Cavallo, C.C., Giudice, T. del, Caso, G. & Cicia, G. (2023). Healthier food choices made easy: a nudging experiment in a restaurant targeting millennials. <i>International Journal on Food System Dynamics</i> , 14 (3), 251–266. https://doi.org/10.18461/ijfsd.v14i3.G1 | Fulltext not accessible |
| Gillespie, R., DeWitt, E. & Gustafson, A.A. (2021). BEHAVIORAL ECONOMIC APPROACHES CAN IMPROVE FOOD CHOICES IN RURAL FOOD ENVIRONMENTS WITH LIMITED FOOD ACCESS. <i>ANNALS OF BEHAVIORAL MEDICINE</i> , 55, S78–S78 | Fulltext not available |

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| Rajbhandari-Thapa, J., Vandellen, M., Just, D. & Panda, S. (2020). Fun facts about fruits and vegetables can improve consumption. <i>Journal of Child Nutrition and Management</i> , 44 (2). [2020-11-25] | Fulltext not available |
| Gravert, C. & Kurz, V. (2021). Nudging à la carte: a field experiment on climate-friendly food choice. <i>Behavioural Public Policy</i> , 5 (3), 378–395. https://doi.org/10.1017/bpp.2019.11 | Duplicate |
| Griesoph, A., Hoffmann, S., Merk, C., Rehdanz, K. & Schmidt, U. (2021). Guess What ...?—How Gussed Norms Nudge Climate-Friendly Food Choices in Real-Life Settings. <i>Sustainability</i> , 13 (15), 8669. https://doi.org/10.3390/su13158669 | Duplicate |

Appendix 2

Table 15. Details on study country and experimental design connected to each of the 34 analysed articles.

| <i>No.</i> | <i>Author(s)</i> | <i>Study country</i> | <i>Experiment design</i> |
|------------|------------------------------------|----------------------|--|
| 1 | Andersson and Nelander, 2021 | Sweden | Pretest – posttest field experiment |
| 2 | Bauer et al., 2021 | Germany | Pretest – posttest field experiment |
| 3 | Buratto and Lotti, 2024 | UK | Pretest – posttest field experiment |
| 4 | Buscemi et al., 2021 | USA | Pretest – posttest field experiment |
| 5 | Byker Shanks et al., 2023 | USA | Quasi-experiment |
| 6 | Cesareo et al., 2022 | Italy | Pretest – posttest field experiment |
| 7 | Cozzio et al., 2021 | Italy | Between-subject/group field experiment |
| 8 | Delaney et al., 2022 | Australia | Cluster randomized controlled trial |
| 9 | De Visser-Amundson, Anna, 2022 | Netherlands | Pretest – posttest field experiment |
| 10 | Erjavec et al., 2021 | UK | Pretest – posttest field experiment |
| 11 | Gavrieli et al., 2022 | USA & Australia | Quasi-experiment |
| 12 | Gravert and Kurz, 2021 | Sweden | Pretest – posttest field experiment |
| 13 | Griesoph et al., 2021 | Germany | Between-subject/group field experiment |
| 14 | Kawa et al., 2023 | Germany | Quasi-experiment |
| 15 | Kee et al., 2022 | USA | Pretest – posttest field experiment |
| 16 | Lohmann et al., 2022 | UK | Pretest – posttest field experiment |
| 17 | Meeusen et al., 2023 | Netherlands | Pretest – posttest field experiment |
| 18 | Migliavada et al., 2022 | Italy | Quasi-experiment |
| 19 | Palmer et al., 2021 | USA | Pretest – posttest field experiment |
| 20 | Radnitz et al., 2023 | USA | Pretest – posttest field experiment |
| 21 | Rantala et al., 2022 | Finland | Quasi-experiment |
| 22 | Reinholdsson et al., 2023 | Sweden | Pretest – posttest field experiment |
| 23 | Rosi et al., 2022 | Italy | Pretest – posttest field experiment |
| 24 | Schindler-Ruwisch and Gordon, 2021 | USA | Quasi-experiment |

| | | | |
|----|----------------------------------|-------------|--|
| 25 | Schneider et al., 2022 | Germany | Pretest – posttest field experiment |
| 26 | Spence et al., 2022 | UK | Pretest – posttest field experiment |
| 27 | Taufik et al., 2022 | Netherlands | Between subject/group field experiment |
| 28 | Van Rookhuijzen and De Vet, 2021 | Netherlands | Pretest – posttest field experiment |
| 29 | Venema and Jensen, 2023 | Denmark | Between-subject/group field experiment |
| 30 | Vidal-Mones et al., 2022 | Spain | Pretest – posttest field experiment |
| 31 | Wyse et al., 2021a | Australia | Cluster randomized controlled trial |
| 32 | Wyse et al., 2021b | Australia | Cluster randomized controlled trial |
| 33 | Wyse et al., 2022 | Australia | Cluster randomized controlled trial |
| 34 | Yi et al., 2022 | Canada | Pretest – posttest field experiment |

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