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Literature review on means of food information provision other than packaging labels

Werle, C. O. C

Nohlen, H. U.

Pantazi, M.

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Joint Research Centre

EUR 31206 EN

Contact information
Name: Hannah Nohlen
Address: Joint Research Centre, Directorate I, Unit I.2: Competence Center on Behavioural Insights
CDMA, 04/13, Brussels, 1050, Belgium
Email: Hannah.NOHLEN@ec.europa.eu

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Contents

Abstract

This report presents the results of a literature review investigating alternative sources of food information available in the marketplace apart from packaging labels, and investigating how consumers use, understand, and are influenced by these means. Searches were conducted in EBSCO, PubMed, Proquest, Science Direct, and Web of Science for articles from 2004 until May 2021 to identify means of food information provision other than packaging labels, with a particular focus on online means of information provision. The reference lists of selected articles were also searched. Ninety-seven articles were included: 40 on online means of information provision, 29 on information provided through menu labels, 16 on information provided through shelf-labels, 5 on other means of providing food information, and 7 on the availability of food information for visually impaired individuals. The qualitative analysis of the included articles was structured around three research questions: 1) what means of food information provision apart from packaging labels do consumers use, 2) what means of food information apart from packaging labels do consumers want, and 3) how does food information delivered through means other than packaging labels influence behavioral outcomes, such as food purchase intentions and behavior. Results suggest that means providing direct access to food information, such as menu labels, shelf labels, and point-of-sale (POS) signs, are better options to influence consumers towards healthier behaviors in comparison to online means that require external tools to access the information, such as QR codes or website links. Because consumers value food information that is easy to process and useful, information that is immediately and visually available at the marketplace can be more effective to facilitate the choice of healthy and sustainable diets in comparison to online means of food information provision. The findings suggest that, if not provided on the food package, food information should be directly visible in the marketplace to be able to influence consumers. Adoption of an exclusive display of food information using digital means seems inappropriate due to lack of scientific evidence on how these means are used by consumers in the marketplace or on their behavioral effects. Online means seem to be an interesting tool to provide food information that goes beyond elements presented on packaging labels, such as complete list of ingredients or traceability information. Digital means, however, do not seem to be the best option to improve accessibility of food information that enables consumers to make informed food choices. This report also revised literature on the accessibility of food information for visually impaired individuals. A very limited number of scientific articles investigating this issue were identified. Improving accessibility of food information to visually impaired individuals may be done online through information that can be processed with automatic screen readers and by providing food information in Braille in the marketplace.

1. Introduction

Since 2014, the Food Information to Consumers (FIC) Regulation ((EU) No 1169/2011) made it mandatory to provide consumers with specific food information, such as allergens, nutritional information, or expiration dates. This mandatory food information should be available in a conspicuous place, should be highly visible and easily legible, and it should be indelible (Article 13, paragraph 1). According to the FIC Regulation, in the case of pre-packaged foods, this mandatory information shall appear directly on the package or on a label attached to it (Article 12, paragraph 1).

On 20 May 2020, the European Commission adopted the Farm to Fork (F2F) Strategy for a fair, healthy, and environmentally friendly food system. This strategy states that providing clear information that facilitates consumers' choice of healthy and sustainable diets will benefit their health and quality of life, reducing health-related costs. In this context, the European Commission will propose harmonized mandatory front-of-packaging (FOP) nutrition labelling and predicts the creation of a sustainable labelling framework to convey critical nutritional, climate, environmental, and social aspects of food products. Besides mandatory information appearing on labels, in the context of the F2F Strategy, the Commission will also explore new ways of providing food information to consumers through other means, such as digital means. The ultimate goal of the strategy is to improve the accessibility of food information and render it more available to specific subpopulations, such as visually impaired individuals.

The EU has established a comprehensive legal framework to provide food information to consumers. To prevent misleading actions and omissions of information, mandatory information is required, which can be supplemented by voluntary information. As a rule, mandatory food information has to be provided on the package or on a label attached thereto, as this information needs to be available and easily accessible to enable consumers to identify and make food choices that suit their individual dietary needs and make appropriate use of those foods. Supplementary information for consumers could be either placed on the label if space permits, or be supplied, for example, digitally via a website. The current food labelling framework therefore does not prevent such evolution towards further use of digital means.

This literature review was designed to provide a better understanding of how Food Business Operators (FBO) may provide information to consumers through means other than on the packaging label. This literature review is part of an exploratory work of consumers' demand, understanding, and use of food information.

The industry is aware that consumers want healthier food that also meets environmental and ethical standards (Spirits Summit, 2020) and that some consumers demand more information about food production methods and origin. A recent survey with a large sample of consumers (n= 18,980) from diverse countries showed that 73% of participants indicate that products' traceability is important to them (IBM Institute for Business Value, 2020). Consumers value transparency across the supply chain, something that is being implemented by some food companies through Blockchain traceability systems (e.g., Carrefour, 2018; Metro - Gallus, 2021). Furthermore, digital solutions are being developed to provide access to food information through digital means. For example, the Smart Tags project developed by the EIT Food from the European Institute of Innovation and Technology aims to increase trust towards food products by using smart tags or electronic markers that indicate products' properties and functions. Smart tags can be barcodes providing more information about the food product or indicators using functional ink allowing color variation depending on environmental factors (e.g., temperature, lighting, humidity). The idea is to provide information about the value chain directly to consumers through these tags.

Companies can also use QR codes, barcodes, or applications to share food information with consumers. Metro AG, a company specializing in wholesale food, adopted a seafood, fish, and meat traceability approach through an application allowing consumers to find food information from origin until the market shelf. This application provides information about the type of fish/meat, origin of the animals (region), method of slaughtering, related certifications, and recipes (Gallus, 2021).

Other sectors are already providing consumers with product information using both labels and digital means. According to the spirits sector association in Europe, at the end of 2020, 25% of the 700ml bottles of spirit drinks released in the European market already included energy information on the label (e.g., calories by 100 ml and serving size), while some of them also provided a link to websites with information about alcohol consumption in general (e.g., www.drinkiq.com, www.wise-drinking.com; Spirits of Europe, 2021; see Figure 1). They also committed to provide ingredient listing and nutritional values to consumers digitally, using QR codes or barcodes. In Spain, some companies are providing this additional detailed product information (e.g., nutritional facts panel) through barcode scanning (e.g., Diageo for the Cacique Añejo rum brand in Spain, El Clavel - Alquitaras de Cazalla, or Diego Zamora) (Spirit Summit, 2020).

Figure 1. Example of alcohol labels placed on spirits' bottles in Europe (Spirits of Europe, 2021).

Consumer associations, however, have a different view regarding online means of providing food information to consumers. A recent report from the European Consumer Organisation (BEUC, 2021) highlights that digital labels cannot be seen as an alternative to on-pack labels because they will prevent consumers from having immediate access to information about food products. Digital means of food information provision, such as smartphone applications, QR codes, and website links should thus only be seen as complementary means of information provision. If digital tools are used to provide essential information to consumers there is an important risk of excluding several groups, such as those that do not have internet connection or connected devices, or who lack digital skills (BEUC, 2021). More importantly, providing food information exclusively through digital means will represent a barrier to informed consumer choice because this will prevent most consumers from having access to food information directly in the marketplace. Having to scan QR codes, bar codes, or access weblinks requires time and effort, something that shoppers normally do not have, since most decisions in the marketplace are taken in a matter of seconds. In this sense, past work on packaging labels show that the most influential formats are those that are simple and easy to process by consumers (e.g., Dubois et al., 2020; Newman et al., 2016), showing that easiness to process food information is a determinant of information use. According to the European Consumer Organisation (BEUC, 2021), labels placed on the packaging of food products are therefore an important tool to ensure convenience and safety during shopping, but also when using products. Digital labelling is seen to have a complementary role, providing access to food information for visually impaired consumers, but also providing more detailed, relevant information to all consumers.

The general purpose of this report is to provide an overview of the various sources of mandatory and non-mandatory food information available to consumers, excluding information provided on packaging labels, and to understand how the information available through these alternative sources is processed by consumers. Specific attention was given to consumers' demand, understanding, and use of food information provided through means other than packaging labels, with a focus on how this information affects their attitudes, purchases, and consumption choices. The report also adopted a forward-looking perspective to identify emerging trends in the provision of mandatory and non-mandatory food information to consumers through new means, such as digital means.

A literature review with a systematic approach was conducted to identify scientific articles documenting the use of other means to provide mandatory and non-mandatory food information in the European market and globally (e.g., information on food shelves, menu labels, point of sales signage, etc.) with a particular focus on digital means to provide food information, such as mobile phone applications, blockchain, QR codes, and barcodes. The aim of this literature review is to address three main questions regarding consumers' reactions to other means of food information provision identifying: **1) the type of means of food information provision that consumers use apart from packaging labels, 2) the type of means of food information provision apart from packaging labels that consumers want, and 3) the impact of different means of food information provision on consumers' attitudes and behaviors.** The literature review also assesses if there are any consumers' characteristics that predict reactions to other means of food information provision. Finally, this literature review briefly addresses the question of the accessibility of food information to visually impaired persons, as this population can be particularly deprived of food information that is visually presented.

2. Methodology

This report presents a literature review of published articles about how alternative means of providing food information in the marketplace apart from packaging labels influence consumers' reactions (attitudes, intentions, behavior). The search strategy was developed in consultation with the Joint Research Center (JRC). The following electronic databases were searched for articles published between 2004 and May 2021: EBSCO, PubMed, Proquest, Science Direct, and Web of Science. The search terms were chosen to take into account several possible alternative means of food information provision available in the marketplace other than packaging labels. The search strategy included the following terms: food, drink, beverage, alcohol, consumer, information, verbal, oral, shelves, shelf, display, retail shelf, supermarket, grocery store, food market, convenience store, magazine, newspaper, restaurant, fast-food, menu, digital, smartphone application, smartphone app, mobile phone app, mobile phone application, mobile nutrition, nutrition application, blockchain, QR code, barcode, website, online, internet, visually impaired, visual impairment. In each of the databases, searches were done separately per type of means using separate search threads for leaflets, newspapers, online means, oral information, restaurant menus, retail shelf, and supermarket. Appendix 1 presents the complete search threads used in each database with the corresponding fields and Boolean operators.

The search strategy for online means included additional searches in Web of Science to maximize the chances of identifying studies on online means of food information provision. The search strategy for menu labels was restricted to recent articles given the existence of twelve published systematic reviews or meta-analyses in this area (Bleich et al., 2017; Crockett et al., 2018; Fernandes et al., 2016; Kiszko et al., 2014; Harnack & French, 2008; Long et al., 2015; Roberto et al., 2009; Sarink et al., 2016; Sinclair et al., 2014; Swartz, 2011; VanEpps et al., 2016; Zlatevska et al., 2018). It was thus decided to include articles on menu labels published after the systematic review by Long and colleagues (2015), which were not included in the systematic review from Bleich and colleagues (2017). We chose these two reviews as reference points because the most recent reviews (Crockett et al., 2018; Zlatevska et al., 2018) did not focus exclusively on consumers' reactions to menu labels.

Eligibility criteria. Inclusion criteria were: (1) an original, peer-reviewed published article (2) written in English, (3) published between 2004 and 2021, (4) with a study population of adults above 18 years old, (5) and using quantitative methodologies (e.g., surveys, cross sectional studies, experiments). Qualitative studies were excluded (except for articles on online means and visually impaired consumers, which are areas that received less attention in past empirical research), and so were review articles and meta-analyses (the reference lists of meta-analyses were however used as sources of additional references). Studies on weight loss interventions, FOP label interventions, educational interventions, advergames, and advertising were outside the scope of this review. To identify and include unpublished articles on digital means, searches in Web of Science included unpublished manuscripts, and the EFSA (European Food Safety Authority) website was consulted as well. Additionally, following the approach adopted by past meta-analyses and systematic reviews in similar topics (e.g., Ikonen et al., 2019; Sinclair et al., 2014) researchers working in this area were contacted by email and invited to share unpublished work on the topic. We have also screened the reference list of articles included in this literature review to identify additional articles. Importantly, we adopted an inclusive approach and no assessment of studies' quality was used to exclude studies; quality assessment was only discussed when presenting the articles. This choice was made to maximize the inclusion of articles, but this means that results should be interpreted with caution.

Study selection and data extraction. A template was developed to extract relevant data from the original papers with the extracted data organized in a database. A process of identification, screening, and eligibility assessment was applied to ensure that all relevant studies were included. We first screened the titles and abstracts, and the full text then was read if it was deemed relevant after title and abstract screening. Full text publications that were screened but not included appear in Appendix 2 and 3, along with the reasons for exclusion.

3. Results

The study selection process is illustrated in Figure 2. The database search yielded 3,808 records. Additional records identified through other sources were also included. After removing the duplicates, titles were screened for 2,537 records and abstracts were screened for 305 records. After abstract screening, 174 articles were initially included in the database for full text evaluation. Finally, the assessment of articles' full text led to the selection of 97 articles included in the qualitative review.

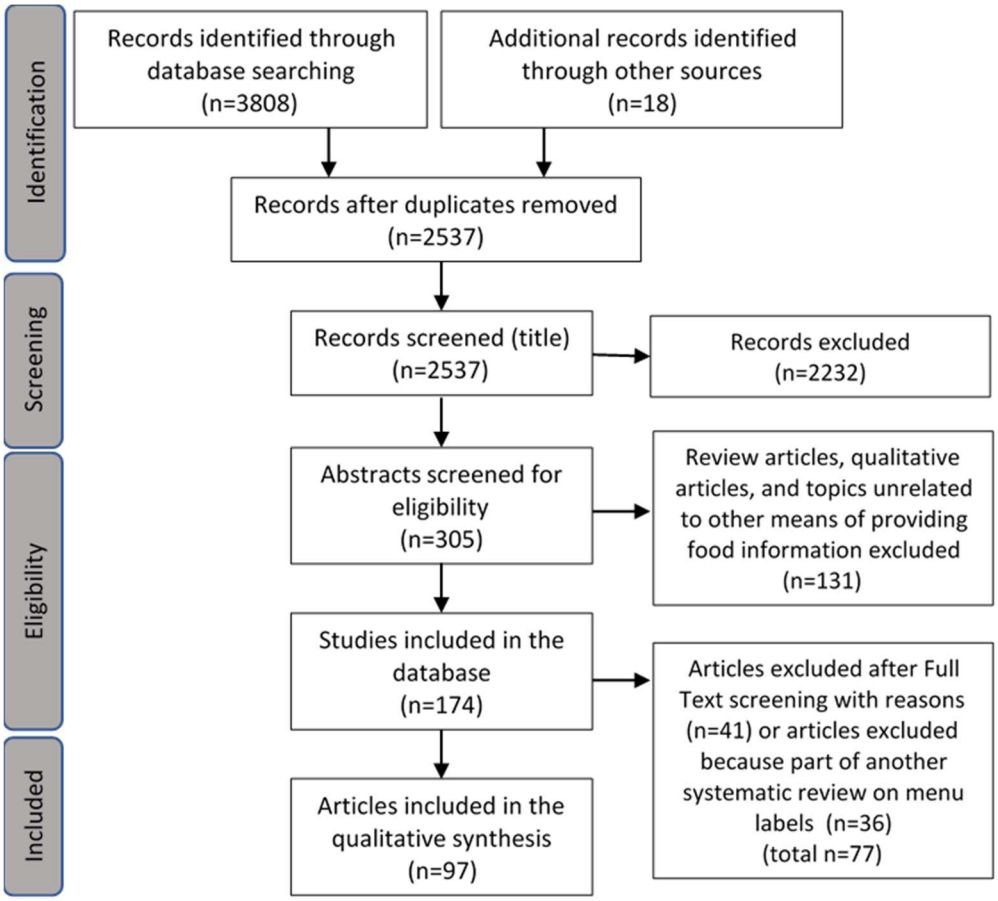

Figure 2. Study Selection Flow Diagram

For each article identified, we extracted information using a database developed for this study with the following elements: reference, mean of providing information (menu labels, shelf labels, online means, other means), geographic region, independent variable, outcome variables, theory (if specified), methodology, sample size, individual differences that may affect food information use, and main results. The structure of the database appears in Appendix 4.

The final set of articles includes 97 articles published between 2006 and 2021 (see Appendix 5 for the complete list). Given the large number of means to provide food information included in this literature review, the analysis of results was conducted separately for each mean of information. The articles focus on the effects of the following means of providing food information to consumers: online means (n=40), menu labels (n=29 articles), shelf labels (n=16), and other means (n=5). Articles focusing on the provision of food information to visually impaired consumers (n=7) were also included. Table 1 presents the number of articles included in the literature review per type of means of food information provision.

Studies in the articles included in the literature review were conducted in member states of the European Union (n=20) and in other countries (n=77), while most studies were conducted in the U.S. (n=42). Study designs included experiments (n=46), surveys (n=25), empirical models (n=19), pre-post studies (n=3), qualitative research (n=2, one on digital means and one on visually impaired individuals), content analysis

(n=1), and one article did not present empirics (n=1, this article presented only the number of downloads of a digital food application).

Table 1. Number of articles included in the literature review per type of means.

Category	# of records	%
Online means	40	41.24%
Menu labels	29	29.90%
Shelf labels	16	16.47%
Visually impaired	7	7.22%
Other means	5	5.15%
TOTAL	97	100.00%

The remainder of this report is structured in two parts. First, we describe articles on Online means, Menu labels, Shelf labels, and Other means, organized in separate sections, and articles related to how visually impaired consumers use food information. In each section we present the general findings of the respective articles and then an overview of the main results organized around the three research questions of this report, namely: 1) what type of means of food information provision apart from packaging labels do consumers use, 2) what type of means of food information apart from packaging labels do consumers want, and 3) how does food information delivered through means other than packaging labels influence behavioral outcomes including attitudes towards food, food purchase intentions, and behavior. Finally, a general discussion of findings across all means of providing food information to consumers is presented.

Within the sections of the various types of food information means, articles were grouped according to methodological and/or thematic similarities. Whether individual differences affect use of and interest in information presented through the various means was not studied in most of the articles. When they were studied, individual differences are presented along with each article description. An overview of key findings per type of mean is presented in a table at the end of each section. For the section on means of food information for visually impaired individuals, the key findings are discussed in the narrative because there are very few articles in this section.

4. Online means

Online means of food information provision include different tools that consumers can use to access food information through internet. Food information can be provided online through different means including mobile food applications, grocery stores' webpages, blogs and social media, website links, QR codes and barcodes, and augmented reality tools. We have also decided to include blockchain technology providing traceability information (see p. 17) as an online means of food information provision because this type of technology relies on the internet.

It is noteworthy that the type of food information provided through digital means is also very diverse. Articles included in this review deal with applications that aim to improve consumers' health but also with applications developed and used by companies to provide food information to consumers. Food companies are notably using digital means to provide consumers more detailed product information using augmented reality, a tool that is mainly used to promote products or services. QR codes and barcodes may also be used by companies to provide more comprehensive product information. Companies use blockchain technology to reassure consumers about the origin of food products, while information provided through grocery stores' webpages may also respond to public policy objectives (e.g., when food retailers provide nutrition information for food products, see Zou & Li, 2019). Similarly, website links, QR codes or barcodes are sometimes added to packaging labels to respond to public policy demands (see p. 3 and 25). Given the different types of online means of food information provision and the different types of information that can be communicated through these means, forty articles were included in this part of the literature review. Table 2 presents an overview of the type of online means studied in the included articles.

Table 2. Online means studied in the identified articles.

Online means	# of records	%
Apps	12	30.00%
General use of online means	4	10.00%
Blogs and social media	5	12.50%
Blockchain	5	12.50%
Online grocery stores interventions	3	7.50%
QR codes	5	12.50%
Augmented Reality	4	10.00%
Website link in alcohol labels	2	5.00%
TOTAL	40	100,00%

1.
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4.1 General use of online means of food information provision

Four articles discussed the general use of online means of food information provision by consumers (Table 3). Three of these articles specifically concerned information on alcoholic beverages. A survey with a representative sample of six EU countries (Denmark, Germany, Netherlands, Poland, Spain, and United Kingdom; n=5,395) showed first that consumers have a high level of interest in receiving the same nutritional

and ingredients' information for all food and drink products, regardless of whether they contain alcohol or not (GfK Belgium, 2014). Furthermore, results showed that, while consumers report low use of alcohol information provided through online means (specifically, through websites and applications), they declare to be highly interested in finding alcohol information such as the list of ingredients on websites and in-store if this information was not available on the label. Specifically, participants were asked the following question "In case the information would not be available on the label, where would you prefer to find this information from the following information sources?" and had to indicate their preference for seven information sources using a 5-point scale anchored 1 = not preferred at all and 5 = very much preferred. The preferred sources were health and nutrition websites, followed by in-store communication, public health authorities' websites, and product/brand-related websites. The least preferred sources were advertising, online applications, and offline applications. It is noteworthy that the aforementioned sources are presented by order of preference, but these findings should be analyzed with caution because the report does not present statistical tests. Participants were also asked to indicate their level of trust for the same information sources in the situation of accessing ingredient and nutrition information. Public health authorities' websites and health and nutrition websites were considered very trustworthy by the majority of respondents, while the other sources of information were considered less trustworthy. Trust in the information provided on websites seems to be high, in particular for websites provided by public health authorities' and health/nutrition websites (Gfk Report, 2014). This survey asked consumers to indicate preference and use of online sources of food information while considering that the information was not available in the label. They were not asked whether they preferred information online or on labels. These findings should thus be interpreted with caution.

An academic article used this same data to investigate a somewhat different research question (Grunert et al., 2018). Similarly to the GfK Belgium report (2014), they investigated to what extent consumers want and use ingredients and nutritional information for alcoholic beverages from information sources other than the label. But they also explored how wants and usage are influenced by product involvement, health interest, and previous knowledge on ingredients and nutritional characteristics of alcoholic drinks. Product involvement was assessed by five items, such as interest in reading information about how the product is made, knowledge and preference for brands in this product category. Health interest was measured with multiple items, such as "I always follow a healthy and balanced diet" and "It is important for me that my diet is low in fat". For product knowledge, measures of ingredient knowledge for beer, wine, gin, vodka, whiskey, and rum were used. To assess nutrition-related knowledge, an index of correct and incorrect answers to questions about the content of calories, fat and carbohydrates of 100 ml of alcohol-free beer, regular beer, white wine, red wine, and whiskey was computed. Results of a structural equation model using Partial Least Squares (PLS) showed that information wants and use are mainly determined by product involvement, and less so by health interest. Consumers with high knowledge of alcoholic beverages' ingredients have lower information wants and uses, while those with high knowledge of the calorie content of alcoholic beverages have higher information wants and uses for all sources of information. While use of off-label alcohol information sources (including online information sources) was low in general, interest in and use of information were significantly higher in Spain and lower in Denmark and the Netherlands (Grunert et al., 2018).

Another article investigated the online availability of calorie information for alcoholic beverages provided by retailers in the U.K. (Petticrew et al., 2017) using a content analysis of online grocers' websites. Results of the content analysis of 55 online grocers showed that calorie information for alcohol products was not provided at that time on any Facebook page or online shopping sections on the retailers' websites (Petticrew et al., 2017).

Finally, one article focused on the general use of food information by consumers when shopping online (Gumirakiza & VanZee, 2018). A survey with online shoppers (n=1,205) in the U.S. showed an 86% likelihood to consider food information (other than price) when shopping for fresh produce online. The relative probability for "locally grown" labels to be the most important attribute influencing purchase decisions online is 46%, 7% for "organically grown", 24% for both local and organic, and 23% for other kinds of labels (nutrition content and country of origin)(Gumirakiza & VanZee, 2018).

Table 3. Summary of articles on general use of online food information included in the literature review.

Authors (year) ***Journal*** ***Country***	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Key take-away**

GfK Belgium (2014) *Market Research Report* *Denmark, Germany, Netherlands, Poland, Spain, U.K.*	Survey	Interest, trust, and use of online alcohol information	n= 5,395	A survey with a representative sample of six EU countries showed low use of online means of alcohol information (websites and apps) and high interest for websites and in-store information. Trust in websites is high, in particular for public health authorities' and health/nutrition websites	- Low use of online means of alcohol information - High interest in websites and in-store information - High trust in public health authorities' websites and health/nutrition websites
Grunert et al. (2018) *Food Quality and Preference* *Denmark, Germany, Netherlands, Poland, Spain, U.K.*	Survey	Interest and use of online alcohol information	n= 5,395 (same database as GfK Belgium, 2014)	An online survey in six European countries showed that consumers have stronger interest for neutral sources of alcohol information, like public and health-related websites, but also have strong interest in getting the information in-store. Information desire and information use are mainly determined by product involvement and, to a lesser extent, by health interest. Use of sources of information about ingredients' and nutritional information for alcohol products is generally low (including online sources). Average levels of information wants and use differ between the six countries, with the highest levels in Spain and the lowest in Denmark and the Netherlands.	- High interest in institutional websites and in-store alcohol information - Low use of online means of alcohol information
Gumirakiza & VanZee (2018) *Journal of Agricultural Science* *U.S.*	Survey	Likelihood to consider food information when shopping online	n= 1,205	A survey with online shoppers in the U.S. showed that the likelihood for online shoppers to consider food information (other than price) in their purchase decision-making when shopping for fresh produce is 86%. The relative probability for "locally grown" labels to be the most important attribute influencing purchase decision is 46%, 7% for "organically grown", 24% for both local and organic, and 23% for other kinds of labels (nutrition content and country of origin). Those who give significant consideration to food labels are older, Caucasian, and primarily female.	High likelihood to use food information when buying fresh produce
Petticrew et al. (2017) *Public Health* *U.K.*	Content analysis	Availability of alcohol calorie information online	n=55 stores	A content analysis of online groceries websites in the U.K. revealed that no calorie information for alcohol products was present on any Facebook page or online shopping sections of any of the grocery stores under review.	Low availability of alcohol calorie information online

Findings of these four articles indicate that consumers are interested in having information about alcohol and food online, but this information is not always available or used. It is noteworthy, however, that two studies on wants and usages of alcohol information online (GfK Belgium, 2014; Grunert et al., 2018), although treating slightly different research questions, use the same database. These studies report low use but high interest for alcohol information delivered through websites and mobile applications only when there is no information available on labels. They do not, however, explore the mechanisms that could explain the difference between low use but high interest regarding online alcohol information. Importantly, trust in public health authorities and health and nutrition websites providing alcohol information is high. Furthermore, because these two articles analyze survey data using self-reported measures and do not present behavioral data, results should be interpreted carefully.

4.2 Mobile Food Applications

A total of 12 articles included in this literature review assessed the effect of mobile food applications on use of food information and on behavioral outcomes (Table 4). Three articles described general use of mobile applications by consumers to support their eating or drinking behavior. A survey with a representative sample of the U.S. population (n=615) assessed consumers' attitudes and behaviors related to food and technology, as well as to the use of mobile phone applications in food contexts (Doub et al., 2015). The results were analyzed using cluster analysis to provide a segmentation of the sample population. Specifically, they showed that while 66% of participants have positive attitudes towards digital technology as a tool to access food information, only 22% use mobile food applications frequently (Doub et al., 2015). Regarding individual characteristics, young adults and parents report being more engaged in using mobile technology to assess food-related content. A limitation of this article is that it uses self-reported measures of attitudes and use of mobile applications in general.

Another article presents the launch of a mobile application providing consumers with easy-to-understand nutrition information and supporting the selection of healthier choices when shopping for food in Australia (Dunford et al., 2014). The application uses barcode scanning technology to provide consumers with nutritional information through traffic light labels and helps to identify healthier products. The article reports an important number of downloads (400,000) 18 months after the launch of the application (Dunford et al., 2014). The authors consider that the number of downloads reflects the acceptance of the mobile application among consumers and imply that this app helps consumers make healthier choices. These findings seem to suggest that mobile phone applications are useful, facilitate access to nutrition information for consumers and may be used in the marketplace. It is noteworthy that this article did not present any empirical data and only use number of downloads as an indication of the mobile food application acceptance.

A third article in the U.K. focused specifically on a representative sample of high-risk drinkers (n=2,998) (Perski et al., 2019). The objective of this article was to assess adoption rates of digital alcohol reduction aids, such as websites and mobile phone applications, when trying to reduce alcohol consumption. Data of 2,998 high-risk drinkers revealed first that only 15.3% of high-risk drinkers made a quit/reduction attempt the year before. Among these drinkers who made a quit/reduction attempt, only 3.6% declared to have used a digital aid to help them quit or reduce alcohol consumption. There is therefore, very low self-reported use of mobile applications and websites among high-risk drinkers when trying to reduce alcohol consumption. However, among drinkers, having a high motivation to reduce alcohol consumption and higher levels of alcohol consumption were positively associated with the use of apps and websites in a recent attempt to reduce/quit drinking, suggesting that these tools may be useful for those in search of a change. This article only focuses on high-risk drinkers and addresses the use of online means in attempts to reduce consumption. It does not address the general use of mobile phone applications among the general population neither their use in other types of consumption situations.

Table 4. Summary of articles on mobile phone applications included in the literature review.

Authors (year) ***Journal*** ***Country***	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Key take-away**
Articles on general app use					
Doub et al. (2015) *Journal of Direct, Data and Digital Marketing Practice* *U.S.*	Survey	Attitude towards App	n=615	A survey investigated the use of mobile food apps among a representative sample of the U.S. population. This study used a cluster analysis to analyze data and has identified four consumer segments among the sample: two of these segments (66% of participants) were generally in favor of using the internet and mobile devices for food-related tasks. Only 22% use mobile food applications frequently (Doub et al., 2015). Regarding individual characteristics, young adults and parents report being more engaged in using mobile technology to assess food-related content.	- Positive attitudes towards internet for food information seeking and mobile food devices - Low use of mobile food applications frequently
Dunford et al. (2014) *Journal of Medical Internet Research*	Not presented	App use	-	The article reports the development of an app providing consumers with easy-to-understand nutrition information and supporting the selection of healthier choices when shopping for food in Australia. The only empirical data	High use of food-related app (assessed by number of downloads)

Australia				presented are the number of downloads (400,000) in 18 months.	
Perski et al. (2019) *Drug and Alcohol Dependence* *U.K.*	Survey	App use	n=2,998	A survey with a representative sample of high-risk drinkers in the U.K. showed that only 3.6 % of drinkers who had made a quit/reduction attempt in the past year used a digital aid—website or mobile app. Only 15.3 % of all drinkers made a quit/reduction attempt.	Low use of apps and websites among drinkers who made an attempt to quit/reduce drinking.
Immediate effects of food apps					
Abao et al. (2018) *Procedia Computer Science* *Philippines*	Experiment (within-subjects design)	Identification of healthy options	n=30	Participants of a within-subjects experiment conducted in the Philippines were better able to identify the healthiest product when using an app that provided augmented information when scanning the barcode of a food product, in comparison to the control condition (manual assessment).	Improvement in capacity to identify healthy options when using app
Ahmed et al. (2020) *The International Journal of Behavioral Nutrition and Physical Activity* *Canada*	Experiment (RCT)	Attitude towards App	n=1,997	An experiment with a representative sample of Canadians compared a mobile phone application displaying traffic light labels, health star ratings, and "high-in" warning labels, with no label (display of the Nutrition Facts Panel with no other functionality, control condition) in a between-subjects design. Participants had to scan 20 products with a food application that displayed information in different formats. Results show that the display of the health star rating was considered less useful, believable and understandable than all the other conditions, suggesting that this type of display of nutrition information in a food application is less effective. The display of "High in" and of traffic light labels in the application increased participants ability to compare products' healthfulness in comparison to both control and health star ratings conditions.	- Positive attitudes towards the display of "High in" and traffic light labels on app - Increase in the ability to compare products' healthfulness - Display of health star ratings on app was not different than control and less positive than other labels
Gauthier et al. (2021) *Working paper* *France*	Qualitative research	Attitudes towards App	n=1,500 consumer reviews and 117 press articles	A qualitative analysis of online consumer reviews and press articles in France showed that the Yuka food app facilitates consumers' access to food information, enabling knowledge acquisition, and increased control of food decisions. The app helps consumers to interpret food labels and is considered easy to use, useful, providing a positive experience	Improvement in access to food information, food knowledge and control. Positive attitudes towards the app.
Juan et al. (2019) *Frontiers in Computer Science* *Spain*	Pretest–posttest with app use once between the two surveys	Food knowledge Attitude towards App	n=40	Using an app with augmented reality to help consumers interpret the nutritional information about carbohydrates in packaged foods improved participants' objective knowledge about carbohydrate choices contained in packaged foods. Participants were also satisfied with the app and believed that it was very useful for learning.	Improvement in food knowledge and attitudes towards the app.
Minnens et al. (2020) *Food and Chemical Toxicology* *Belgium, Spain, Portugal, Norway, and Ireland*	Web-based cross-sectional survey	Attitude towards App Intention to use App	n=504	A survey in five European countries (n=504; Belgium, Spain, Portugal, Norway, and Ireland) measured the acceptance of an online tool to facilitate fish choice. This article specifically evaluated the *FishChoice* tool, developed and launched in 2016, and providing risk-benefit information online about several seafood species. Participants were asked to test the online tool for as long as they wanted and were then asked to complete the survey. Results showed that participants had positive attitudes towards FishChoice, perceived it as useful and easy to use. 68% of participants agreed they would use the information provided by the tool when choosing seafood species. Heavy users of the seafood category had higher intentions to reuse the tool.	- Positive effects on attitudes towards the app. - High intentions to use app provided information.
Long-term effects of food apps					

Appleton et al. (2019) *Journal of Medical Internet Research* *U.K.*	Experiment (RCT) 4 weeks of app use	Food knowledge Self-reported intake Food choice App use Attitude towards App	n=94	The use of an app designed to improve fruit and vegetable (FV) knowledge and choice for four weeks did not influence FV knowledge. Self-reported FV intake was higher for those using the app. Behavioral choice was measured in weeks 2 and 4: the choice of a fruit product was higher only in week 2, while no significant differences emerged in week 4. Self-reported use of the app was high and qualitative evaluations were positive.	No effect on food knowledge; Positive effect on attitudes towards the app, app use and high self-reported fruit intake.
Eyles et al. (2017) *European Journal of Preventive Cardiology* *New Zealand*	Experiment (RCT) 4 weeks of app use	Purchases of salt from packaged goods App use Attitude towards App	n=66	A smartphone application that enables shoppers to scan the barcode of a packaged food and receive an immediate, interpretive, traffic light nutrition label on the screen, along with suggestions for lower salt alternatives (SaltSwitch App) had a significant impact on reducing household purchases of salt from packaged foods after four weeks. The app was thus effective to reduce salt purchases. There were no effects of app use on other nutrient outcomes assessed (energy density, total fat, saturated fat, protein, or total sugar). The SaltSwitch App was well used and accepted by the intervention group.	Reduction on purchase of salt , Positive effect on app use and acceptance
Palacios et al. (2018) *Nutrients* *Puerto Rico*	Experiment (pilot RCT) 8 weeks of app use	Purchases of fruits and vegetables Weight	n=51	Exposure to an app that generates healthy grocery lists for eight weeks did not change purchases of fruits and vegetables compared to the control group. There were no changes in weight.	No effect of app on purchases of fruits and vegetables
Samoggia & Riedel (2020) *Food Research International* *Italy*	Two-step approach: baseline and follow-up surveys 12 weeks of app use	Self-efficacy to eat healthily Food Knowledge	n=143	The use of a nutrition-information app (app that reads product labels, assesses quality of ingredients and nutritional values based on users' personal data, and recommends healthier food alternatives) for 12 weeks decreases the perception of the barriers to healthy food eating and increases the perceived personal strength in approaching healthy food. For app users in charge of food purchases in the household, the app allows for the gaining of additional knowledge about healthy food.	Positive effect of app on self-efficacy towards healthy food and food knowledge.

The remaining articles on online food applications either focused on immediate or long-term effects of app usage. We have decided to analyze separately articles focusing on immediate (n=5) and long-term effects (n=4) of mobile food applications due to substantial differences in the way app use was operationalized. We considered immediate effects one single use or evaluation of a mobile food application, while long-term effects were those measured after several weeks of use of a mobile food application that was either controlled or measured.

Immediate effects of mobile food applications. Five articles focused on the immediate effects of mobile food applications, suggesting positive effects on different outcomes including attitudes towards the application, healthy food identification, food knowledge, and intentions to use the app. Two studies showed that the use of food applications improves the capacity to identify healthy options (Abao et al., 2018) and specific food knowledge (Juan et al., 2019). Abao and colleagues (2018) asked 30 university students in the Philippines to select the healthiest of two items of 10 different product categories twice in a within-subject design: first manually without any further information and then using a food application. Participants were better able to identify the healthiest product when using an app that provided augmented information when scanning the barcode of a food product, in comparison to when they did it without any support. Using a similar design, Juan and colleagues (2019) tested an application providing information about carbohydrates in packaged foods in Spain. A sample of 40 adults answered a questionnaire before and after using the app. Use of the application improved knowledge about carbohydrates' choices. These findings should, however, be considered with caution because these two studies involve very small sample sizes and within-subjects designs.

One controlled experiment with a representative sample of Canadians (n=1,997) tested different nutritional information presentation formats in a food application (Ahmed et al., 2020). The objective of this paper was to compare traffic light labels, health star ratings, and "high-in" warning labels, with no label (display of the Nutrition Facts Panel with no other functionality, treated in this article as the control condition) in a between-subjects design. Participants had to scan 20 products with a food application that displayed information in different formats. Results show that the display of "high-in" warning labels and of traffic light labels increased participants' ability to compare products' healthfulness in comparison to both control and health star ratings conditions. The health star rating was considered less useful, believable and understandable than all the other conditions, suggesting that this type of display of nutrition information in a food application is less effective.

A survey in five European countries (n=504; Belgium, Spain, Portugal, Norway, and Ireland) measured the acceptance of an online tool to facilitate fish choice (Minnens et al., 2020). This article specifically evaluated the FishChoice tool that was developed and launched in 2016 and that provides risk-benefit information online about several seafood species. Participants were asked to test the online tool for as long as they wanted and were then asked to complete the survey. Results showed that participants had positive attitudes towards FishChoice, perceived it as useful and easy to use. 68% of participants agreed they would use the information provided by the tool when choosing seafood species. Heavy users of the seafood category had higher intentions to reuse the tool.

Finally, a qualitative analysis of 1,500 online consumer reviews and 117 press articles in France investigated reactions towards the Yuka food app (a mobile application designed to provide consumers with detailed information about individual food products when scanning the product's bar code). The application appears to facilitate consumers' access to food information, enabling knowledge acquisition, and increased perceived control over food decisions. The app also seemed to help consumers interpret food labels and was considered easy to use and useful, providing a positive experience (Gauthier et al., 2021). Although this paper did not measure one single use of the Yuka application, it analyzes individual evaluations of it. It is noteworthy, however, that individuals who completed online evaluations of the application might have used it more often. This article thus presents only the view of those who used the application.

Overall, these articles suggest short-term positive effects of the use of mobile food applications on food knowledge, capacity to identify healthy options, and intentions to use food applications. Experience with the tested food applications is described by consumers as positive, although this might reflect the behavior of only a small subset of consumers who are exposed to the mobile food applications. Further research is definitely needed to assess the level of use of mobile phone applications in the marketplace among larger and more representative samples. These findings should, however, be interpreted with caution due to the quality of the evidence. Among five studies on short-term effects of mobile food applications, three of them present important methodological limitations due to small sample size (Abao et al., 2018; Juan et al., 2019) and qualitative methodology (Gauthier et al., 2021).

Long-term effects of mobile food applications. Four articles investigated long-term effects of the use of mobile food applications by consumers. An experiment in the U.K. (n=94) showed that the use of an app designed to improve fruit and vegetable knowledge and choice for four weeks did not improve knowledge about fruits and vegetables, but increased self-reported fruit and vegetable intake. The study also measured behavioral choices (i.e., choice of a fruit product) on weeks 2 and 4, and fruit choice was higher for the intervention group than the control group in week 2, but not in week 4. This means that the app improved behavioral choice after two weeks of use, but that this effect was not sustained after four weeks. Self-reported use of the app was high and qualitative evaluations were positive (Appleton et al., 2019).

An experiment in New Zealand (n=66) showed that a 4-week use of a smartphone application enabling shoppers to scan the barcode of a packaged food and receive a nutrition information and suggestions for lower salt alternatives (SaltSwitch App) reduced household purchases of salt from packaged foods, the main desirable outcome for this application. However, there were no effects for other nutrient outcomes assessed (energy density, fat, saturated fat, protein, or sugar). The app was highly used and accepted by the intervention group (Eyles et al., 2017).

Another experiment in Puerto Rico (n=51) showed that exposure to an app that generates healthy grocery lists for eight weeks did not improve purchases of fruits and vegetables in comparison to a control group that did not use the application. There were also no changes in participants' body weight after the intervention (Palacios et al., 2018). A limitation of this study is that it relies on a very small sample size.

Finally, a study using a two-step approach in Italy (n=143) showed that the use of a nutrition information app for 12 weeks decreased perceived barriers to healthy food eating and increased the capacity to adopt healthy eating habits among consumers that spontaneously downloaded the app. For app users in charge of household food purchasing, the app allowed for the gaining of additional knowledge about healthy food (Samoggia & Riedel, 2020). This study also revealed the existence of individual differences in reactions towards the app. Most of the app users that experienced an improvement in the capability of changing and maintaining their healthy dietary habits did not have an academic degree. App users who were employed did not perceive an improvement in their capability of improving and maintaining a healthy dietary habit. App users who were above 38 years old had more benefits from using the app when they had no initial interest in changing food behavior (i.e., they were in the pre-contemplation stage of change), compared to younger users.

The long-term effects of mobile food applications are positive concerning attitudes towards the apps, but mixed regarding changes in actual food knowledge. Results on behavioral effects of mobile food applications are also mixed: among three studies measuring behavioral effects, two showed improvement on food purchase or eating behavior, while one study showed no effect. It is noteworthy that the four articles on long-term effects of mobile phone applications report field studies using controlled designs.

The articles on mobile food applications included in this literature review suggest that consumers are interested in these applications, have positive attitudes towards them when exposed for a limited time in the context of a study, but there is limited evidence about their effectiveness to improve eating behavior.

4.3 QR codes

A QR code (Quick response code) consists in a square with a white background and black boxes in a specific pattern that is used to encrypt a text, a URL or other data (Oonk, 2013). Consumers can scan QR codes with their electronic devices to find more information about products (Li & Messer, 2019). Companies may use QR codes to provide information to consumers in the marketplace. Five articles investigated consumers' reactions to QR codes providing food information: two experiments and three surveys (see Table 5).

In an experiment conducted in the Netherlands, 214 smartphone owners were exposed to the packaging of four food products: tomato paste, ready-to-eat meal, bread and chocolate truffles. The packages contained either a 'QR code and an URL', a 'QR code', an 'URL' or 'no QR code and no URL'. Results showed that the presence of a QR code on the packaging did not influence purchase intention or intention to seek information (Oonk, 2013). It is worth noting, however, that in this experiment, the QR codes were presented on the back of the products' packaging that were visualized online (and not manipulated in a store).

A field experiment in an artefactual marketplace selling oysters at a Ferry terminal on the Atlantic coast of the U.S. (n=417) provides a more realistic test of QR code as an online mean in a real market setting (Li & Messer, 2019). This study compared four formats of food information provision for oysters: no information (control), additional information in print next to the basic label displaying the name of the product, additional information provided by a tablet displaying a clickable link, additional information provided by a QR code displayed on a tablet, and additional information provided by a QR code on a tablet and an accompanying electronic device (smartphone) on which the QR scanner software was already installed. Results show that 20.2% of participants clicked on the link to obtain additional information when it was available on a tablet in front of the products, while only 1.2% of participants scanned the QR code spontaneously using their own devices when it was only displayed on the tablet. Importantly, 52.6% of participants scanned the QR code when a smartphone on which the QR scanner software was already installed was provided for them at the marketplace besides the tablet presenting the QR code. This means that when a device was available, only half of consumers were exposed to the food information. There were, however, no effects of the form of nutritional information provision on consumers' overall preference for oysters (Li & Messer, 2019).

These two experiments suggest that the spontaneous use of QR codes by consumers is very low, unless a device containing the appropriate scanning software is available in the marketplace. These findings should be interpreted with caution because the presence of a smartphone to scan QR codes in the marketplace may have caused demand effects. Because consumers are not used to have smartphones available to scan products, the simple availability of this tool may have increased usage beyond the effect of the QR code alone.

Table 5. Summary of articles on QR codes included in the literature review.

Authors (year) *Journal* *Country*	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Key take-away**
Albăstroiu & Felea (2015) *Amfiteatru Economic Journal* *Romania*	Survey	QR codes Awareness, use, attitudes	n=365	The majority of respondents know what QR codes are and 40.8% have scanned them. 70.5% of the latter scanned QR codes to receive more information about a product. The majority of the respondents were interested in using a QR code.	- High awareness of QR codes. - High use to access food information. - High interest.
Bray et al. (2019) *British Food Journal* *Denmark, France, Greece, U.K.*	Survey	Preference for QR codes	n=452	A survey was conducted to assess preferences for food information displayed in a workplace dining setting in four countries (Denmark, France, Greece, and U.K.). Six types of food information were compared: traffic light labelling, information box (with ingredients or nutrition), quality assurance, brand, interactive information with QR code, footnotes (on the menu). Preference for information sources was assessed using a best-worst scaling method (respondents selected their most and least preferred option in each set). Results show that traffic light labelling, information box, and quality assurance are ranked in the top three for all four countries. Results revealed a very low preference for interactive information, provided through a QR code in France, Denmark, and U.K. This preference was higher in Greece.	Low preference for QR codes in comparison to labels.
Li & Messer (2019) *Journal of Agricultural and Resource Economics* *U.S.*	Experiment (field)	Use of QR codes and food preference	n=417	A field experiment compared four formats of food information provision: no info, printed, computer link, QR code alone, QR code + smartphone. 20.2% of participants clicked on the link to obtain additional information when the computer link was available, while only 1.2% of participants scanned the QR code. 52.6% scanned the QR code when a smartphone was available. There were however no effects of form of nutritional information provision on overall preference for oysters.	- Low spontaneous use of QR codes, - Average use of QR codes only when smartphone was available to access information.
Oonk (2013) *Master's Thesis University of Twente* *Netherlands*	Experiment	Purchase intention and intention to use QR codes	n=214	An experiment with smartphone owners in the Netherlands showed no effect of the presence of a QR code displayed on the package of foods on the purchase intention or intention to use QR codes to seek food information.	No effect on purchase intention or intention to use QR codes
Ryu & Murdock (2013) *Journal of Direct, Data and Digital Marketing Practice* *U.S.*	Survey	Attitudes towards QR codes and intentions to use	n=340	When consumers perceived the QR code to be easy to use, they rated the code as useful and favorable. Similarly, when consumers perceived the QR code to be highly useful, they formed a more favorable attitude and were more inclined to use the QR code. Consumers recognized the QR code as easy to use, useful, and favorable when they thought using the code was fun and entertaining.	Attitudes towards QR code are determined by easiness to use and usefulness.

The three remaining articles on QR codes reported survey studies. A survey in Romania (n=365) indicated good awareness of QR codes among consumers. The majority of respondents know what QR codes are and 40.8% have scanned them. The main reason to scan a QR code was, for 70.5% of participants, to receive more information about a product, followed by "to buy a product" (32.9%) and "to access contact information" (24.2%). The majority of respondents declared being interested in using QR codes (Albăstroiu & Felea, 2015). Similarly, a survey conducted in the U.S. (n=340) showed that, when consumers perceived QR codes in general to be easy to use, they rated it as useful and favorable. Similarly, when consumers perceived the QR code to be highly useful, they formed a more favorable attitude and were more inclined to adopt the QR code. Consumers' attitudes were positive when using QR codes was perceived as fun and entertaining (Ryu &

Murdock, 2013). This last finding suggests that easiness to use is an important feature to ensure QR codes' use.

Finally, a survey with workplace canteen users (n=456) in four European countries (Greece, Denmark, France, and U.K.) compared six types of food information offered in this type of restaurant: traffic light labelling, information box (with ingredients or nutrition), quality assurance (e.g., Red Tractor logos), brand, QR code, or footnotes that give further information about dishes (on the menu). Results showed that traffic light labelling, nutrition information box, and quality assurance were ranked top three in all four countries. Results revealed, however, a very low preference for QR codes in France, Denmark, and U.K. Preference for QR codes was slightly higher in Greece (Bray et al., 2019).

Taken together, these results show that the actual use of QR codes to obtain information about food products is low. Increasing accessibility (for example by providing a device to scan the QR code) and rendering the use of QR codes easier to use and fun may be potential ways to enhance the use of this tool. Further research in this area is definitely needed.

4.4 Blockchain

Blockchain is defined as "a digital, decentralized, and distributed ledger in which transactions are logged and added in chronological order with the goal of creating permanent and tamper-proof records" (Treiblmaier, 2018, p. 547). The main goal of using blockchain for food companies is to track food from its origins to the shelves of the stores (Nott, 2019). Blockchain has important consequences for different actors along the supply chain, but it can also be potentially interesting for consumers. Carrefour, for example, used blockchain to track farmyard fattened chicken from Auvergne, a region in France particularly known for producing high quality poultry. In this case, blockchain technology allows consumers to have access to information retracing the product's whole life with details of where it was reared and even information about the farmer in charge (Carrefour, 2018). Scanning a QR code, any consumer in the grocery store can check various information like the farm where the chicken grew or the feed they ate. By increasing transparency, the hope is to increase the trust consumers have in their food (Redmayne, 2019; Jarvis, 2020; Nott, 2019). Traceability is becoming important to consumers (Jarvis, 2020) and the information provided by blockchain could help them to make better consumption choices, through the identification of products that fit with their values (Redmayne, 2019). Another example is OpenSC, an Australian project led by the WWF and BCG Digital Ventures that tracks fish. Consumers can thus check whether the fish come from a sustainable and ethical catch by using their smartphone camera to scan a QR code (Redmayne, 2019).

Five articles identified in this review investigated how consumers react to information about the use of blockchain by retailers (see Table 6). Academic articles about blockchain use scenario manipulations or vignettes to introduce the concept of blockchain to consumers. A choice experiment used a representative sample of the U.S. population based on age, gender, income and education (n=1,096) to assess preferences for types of meat information displayed on labels: price, blockchain certified, USDA certified, QR code for product information, grass-fed, and reduced carbon. Results showed higher preference and willingness to pay for the governmental agency label (USDA), followed by the blockchain certified label (Shew et al., 2021). This experiment reveals low preference for blockchain label in comparison to a label issued by a governmental agency (USDA).

Three experiments (S1: n=180; S2: n=150; S3: n=439) in Austria assessed consumers' reactions towards blockchain traceability systems. Results show that being informed about a blockchain-based traceability system increases consumers' retailer preferences and that this effect is mediated by trust in the retailer. Especially unfamiliar retailers benefit more from the implementation of a blockchain-based traceability system, compared to familiar retailers (Garaus & Treiblmaier, 2021).

In the same vein, a survey in Taiwan (n=264) showed that blockchain information positively impacts trust towards the food provider and purchase intention of food products in general (Yeh et al., 2019). Another survey with 300 organic food product consumers in China showed that attitude toward traceable food and perceived behavioral control influence intention to use information about organic food's blockchain traceability system (Lin et al., 2021). Finally, a survey with 141 consumers in Europe (Germany, the Netherlands, Belgium, U.K.) and 12 qualitative interviews with different stakeholders (retailers, government officials, and one blockchain service provider) showed that consumers are overwhelmed by the amount and complexity of certification labels. Results show that blockchain implementation for meat traceability is

positively associated with consumers' self-reported purchasing decisions, mediated by food quality perceptions (Sander et al., 2018).

Table 6. Summary of articles on Blockchain included in the literature review.

Authors (year) *Journal* Country	Methodology	Main outcomes	Sample size	Main results	Key take-away
Garaus & Treiblmaier (2021) *Food Control* Austria	Experiment	Retailer preferences and trust	S1: n=180; S2: n=150; S3: n=439	Three experiments show that being informed about a blockchain-based traceability system increases consumers' retailer preferences and that this effect is mediated by trust in the retailer. Consumers experience higher levels of trust in retailers who implement a blockchain-based traceability system compared to a traditional traceability system. Unfamiliar retailers benefit more from the implementation of a blockchain-based traceability system compared to familiar retailers.	Blockchain traceability systems for food products increase preferences for retailer due to trust
Lin et al. (2021) International Journal of Environmental Research and Public Health China	Survey	Attitude and intention to use blockchain	n=300	A survey in China (n=300) showed that attitude towards blockchain and perceived behavioral control significantly and positively affect the usage intention for information about a blockchain food traceability system (BFTS).	- Positive attitudes for blockchain for organic food - High intention to use blockchain for organic foods
Sander et al. (2018) British Food Journal Belgium, Germany, Netherlands, U.K.	Survey & qualitative research	Self-reported purchases and quality perceptions	Survey: n=141, Qualitative research: n=12	Blockchain implementation appears to increase consumers' self-reported purchasing decisions for meat products, mediated by consumers' quality perceptions.	Increase in self-reported meat purchase decisions due to better quality perceptions
Shew et al. (2021) Applied Economic Perspectives and Policy U.S.	Experiment	Preference for information source		A choice experiment about meat traceability with a representative sample of the U.S. population (n=1,096) showed higher preference and willingness to pay for meat with labels ensuring its traceability issued by the governmental agency label (USDA), followed by the government-issued blockchain label. Regarding blockchain, no difference appeared in terms of terminology (Distributed Ledger or Blockchain) or in terms of blockchain governance system.	- Low preference for blockchain label in comparison to USDA label for meat traceability. - Blockchain was preferred only when government-certified.
Yeh et al. (2019) *IEEE*	Survey	Food purchase intention and	n=264	Blockchain positively impacts trust towards the food provider and purchase intention of food products in general.	Blockchain increases trust towards food provider and

Taiwan		blockchain trust			purchase intention for food products

Overall, consumers' attitudes towards blockchain traceability information are positive and this type of information enhances preferences towards food providers. These effects are likely mediated by trust or by quality perceptions. It is worth noting, however, that only one study measured purchase intentions and none of them measured behavioral effects of blockchain labeled products. Furthermore, no study investigated the effects of blockchain information on consumers' eating behavior or health-related choices. Most of these studies look at blockchain traceability systems from the retailer perspective. Further research is needed to see if the provision of blockchain information for food products actually affects consumers' behavior. There is need for research exploring how exposure to this type of information influences consumers' food choice quality from a health perspective.

4.5 Blogs and social media

Five articles—two experiments and three surveys—explore consumers' reactions to food information provided through blogs and social media platforms (Table 7). Two experiments with similar designs showed contradictory findings on the effect of healthy eating blogs on fruit and vegetable consumption. An experiment with 76 women in Canada showed that a group exposed to a healthy eating blog with a weekly post increased fruit and vegetable consumption after six months in comparison to the control group (no exposure) (Caplette et al., 2017*).* Another experiment with 84 women in Canada, however, showed that 6-month exposure to a healthy eating blog with a weekly post had no effect on dietary intakes, self- perceived meal planning, cooking skills, and body weight when compared with a control group with no access to the study blog (Dumas et al., 2020*).* The behavioral effects of blog posts to promote healthy eating on healthy food intake are thus mixed, although the designs of both studies were similar.

One article also investigated consumers' reactions to blogs, but focused on "vlogs", that is video blogs that provided food information in a video format often portraying food preparation, consumption, and food reviews. A survey with 330 users of the YouTube app and subscribers of food vlogger channels in Indonesia showed that, when consumers perceive the video blogs to be useful and beneficial, they have a higher intention to use them for purchase decisions. Perceived benefit of online food vlogger reviews also influenced general attitudes towards YouTube (usefulness) and perceived enjoyment (Briliana et al., 2020).

Table 7. Summary of articles on blogs and social media included in the literature review.

Authors (year) *Journal* *Country*	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Key take-away**
Briliana et al. (2020) *Journal of Management & Marketing Review (JMMR)* *Indonesia*	Survey	Attitudes towards blogs and intention to use information	n=330	A correlational study showed that the higher the perceived benefit of online food vlogger reviews, the higher the intention to use food vlogger reviews for purchase decisions. Perceived benefit of online food vlogger reviews also influenced perceptions of YouTube, including perceived usefulness and enjoyment.	- Positive attitudes towards vlogger reviews when the reviews were useful - High intentions to use vloggers' information
Caplette et al. (2017) *JMIR Research Protocols* *Canada*	Experiment	Food consumption	n=78	In comparison to the control group, the healthy eating blog group significantly increased their fruit and vegetable consumption at the 6-month visit.	Increase in fruit and vegetables' consumption due to blog exposure
Dumas et al (2020) *Journal of the Academy of Nutrition and Dietetics* *Canada*	Experiment	Food consumption, self-efficacy, and body weight	n=84	An evidence-informed healthy eating blog written by a registered dietitian, at a rate of 1 blog entry/week, had no effect on dietary intakes, including vegetables, fruit, milk, and alternatives consumption, self- perceived meal planning and cooking skills, as well as the body weights of French-speaking mothers of preschool- and school-aged children after 6 months, when compared with a	No effect of blog exposure on food intake, self-efficacy or weight

				control group with no access to the study blog.	
Tsai et al. (2020) *Frontiers in Psychology* *Taiwan*	Survey	Intention to use social media information, attitudes towards social media	n=298	Perceived ease-of-use, satisfaction, and usefulness indirectly affected social media continuance or the intention to continue to use social media to obtain food safety information.	- Positive attitudes when easy to use. - High intentions to use social media for food safety information.
You & Wiangin (2020) *Frontiers in Psychology* *Southern Asia (no country specified)*	Survey	Intention to use social media information, attitudes towards social media	n=235	A survey with participants of organic food promotion Facebook communities investigated how social media influences consumers' self-reported selection of organic food. Results showed that consumers' intention to gather organic food information through a social media forum is influenced by satisfaction with the platform. And satisfaction with the social media platform on organic food is determined by its functionality and its capacity to provide information about organic food (You et al., 2020).	- Attitudes towards social media organic food information are influenced by satisfaction with the platform. - Increase in intentions to use social media for organic food information.

The remaining two articles focus on social media platforms. A survey with 298 users of social media pages and groups promoting food safety information in Taiwan showed that perceived ease-of-use, usefulness, and satisfaction influenced users' social media continuance intention (Tsai et al., 2020). A survey with 235 participants of organic food promotion Facebook communities investigated how social media influences consumers' self-reported selection of organic food. Results showed that consumers' intention to gather organic food information through a social media forum is influenced by satisfaction with the platform. And satisfaction with the social media platform on organic food is determined by the functionality of the platform and its capacity to provide information about organic food (You et al., 2020). It is important to notice that these two studies are correlational, based on self-reported measures, and do not present any behavioral evidence of social media effects.

Very few articles looked into how food information provided through blogs and social media influences consumers' reactions. Two controlled experiment measured the effects of 6-month exposure to a food blog on actual eating behavior and showed mixed results. While using similar methodologies, one study found an increase in fruit and vegetable consumption while the other documented no behavioral effects. There is definitely need for more controlled studies to further explore the influence of food blog exposure on eating behavior.

Three articles explored consumers' reactions to different types of food information (food reviews and recipes, organic food, food safety information) provided through social media platforms. These articles used survey methodology with self-reported measures. This correlational evidence suggests that perceived usefulness and enjoyment while watching video food blogs determine intentions to use this type of information for purchase decisions. For social media platforms, perceived usefulness is also a determinant of satisfaction with online forums and peoples' intentions to use them. Again, future research is warranted to further investigate how consumers react to food information provided through social media platforms.

4.6 Augmented reality

Augmented reality (AR) systems combine real and virtual objects by aligning them in 3D and therefore allowing real-time interactions between consumers and virtual objects (Azuma et al., 2001). This technology allows for the visual placement of digital information in the actual shopping environment. The digitalized objects or images become visible through an AR device with a camera and a screen, such as mobile phones or tablets (Joerß et al., 2021). It creates an interface that enhances the physical environment from a visual standpoint (see Figure 3 for an example). The articles about AR included in this literature review deal with food-related AR information provided to consumers through tablets or smartphones in the marketplace (grocery stores or restaurants).

Figure 3. Example of an augmented reality tool providing food information in the marketplace (Joerß et al., 2021)

Four articles present studies on the effects of using augmented reality technology to deliver food information to consumers (Table 8). Most of these studies test features of information delivered through AR, rather than the effects of AR overall. They investigate how amount and level of detail of the provided information, level of consumers' interactivity with the information, or information content influence consumers' responses.

Heller and colleagues (2019) conducted three experiments (S1 n=304; S2 n=238; S3 n=214) in the U.S. to investigate how AR information on menus influences restaurant's word-of-mouth (WOM; e.g., willingness to say positive things about the restaurant to other people) and product choice. In comparison to a traditional menu and to an AR application showing only augmented information (ingredients and price), AR virtual tools placing 3D digitized replicas of desserts on the table (alongside information on ingredients and price) increases information processing fluency, decision comfort, and WOM intentions (Heller et al., 2019). Thus, in the context of restaurants, augmented reality with advanced features seems to be an interesting tool to reach consumers, in comparison to AR without advanced features or to a traditional menu without AR. This study only tested the effect of AR on dessert and not on other menu items. Future research is needed to investigate if AR technology can also be used to promote healthy food options in restaurants.

Table 8. Summary of articles on Augmented Reality (AR) included in the literature review.

Authors (year) ***Journal*** ***Country***	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Key take-away**
Heller et al. (2019) *Journal of Retailing* *U.S.*	Experiment	Restaurant WOM intentions Processing fluency of food information	S1 n=304; S2 n=238; S3 n=214	Information delivered through AR on menus positively influences WOM intentions and product choice. The effect is mediated by processing fluency and decision comfort, and is moderated by consumers' processing-type. In comparison to a traditional menu an AR application that shows only augmented information (ingredients and price), an AR application that virtually places 3D digitized replicas of desserts alongside ingredients and price information on the table increases processing fluency, decision comfort, and WOM intentions	Positive effects of AR food information on WOM intentions (mediated through processing fluency).
Hoffmann et al. (2021) *under review at JAMS*	Experiment (field)	Food purchase intentions, brand image, and behavior	S1 n=403; S2 n=51	A field study in a supermarket showed that, when exposed to detailed AR for breakfast cereal with a high controllability, consumers fear that they are less comprehensively informed and have reduced purchase intentions, negative brand image, and make	Reduction in purchase intentions, brand image and actual purchases when AR presents too

Germany				fewer purchases. S2 shows that AR providing extra product information increases the variety of beer types purchased only during relaxed shopping times. Information delivered through AR influences consumer decisions at the point of sale. Effectiveness depends on the controllability and details of the product information presented, yet a high level of both creates a backfire effect. The effect is mediated by perceived comprehensiveness and moderated by the medium, consumer stress, and shopping times.	much information (mediator: perceived comprehensiveness)
Joerß et al. (2021) *Journal of Business Research* *Germany*	Experiment	Food choice	n=120 (main study)	An experiment conducted in a grocery shopping laboratory showed that tablets providing positive sustainability information through AR lead users to choose more sustainable products. On average, subjects more often picked products rated as sustainable, notably for coffee, cereals, and milk (but not for jam).	Increase in product choice for sustainable products when sustainable information is presented through AR.
van Esch et al. (2019) *Journal of Retailing and Consumer Services* *Australia*	Survey	Food brand attitudes and Consumer experience	n=319	Exposure to anthropomorphized product information for eggs through an AR shopping device (tablet, smartphone) positively influences consumers' experience (confidence, convenience of the transaction, perceived innovativeness, number of perceived usage barriers, diminished perception that AR will cause unintended health effects or side effects in general), which in turn influences attitude towards the brand.	Positive effect of anthropomorphized AR information on consumers' experience and brand attitudes.

Food information delivered through AR also influences consumer decisions at the point of sale in grocery stores. A field study in a supermarket in Germany (n=403) showed that, when exposed to detailed AR for breakfast cereal with high controllability (i.e., the possibility to choose what information will be shown), consumers fear that they are less comprehensively informed and this negatively influences purchase intentions, brand image, and purchases (Hoffmann et al., 2021). A second study (n=51) shows that AR providing more product-related information increased the variety of beer types purchased only during relaxed shopping times, and not during rush shopping hours. This finding suggests that consumers need time to process AR-delivered product information. The effect is mediated by perceived comprehensiveness or how detailed the information provided by AR is perceived to be (Hoffmann et al., 2021). This article suggests a negative effect of AR if too much information is delivered to consumers in a retail setting, or if they do their groceries in busy shopping times. This article only observed the effect of AR on two product categories: breakfast cereal and beer. There was no specific analysis of products' healthiness level. More research is needed to investigate how AR influences reactions of products from different categories and healthfulness levels.

Augmented reality can also have positive effects on consumers. An experiment conducted in a grocery shopping laboratory in Germany (n=120) showed that tablets providing positive sustainability information through AR led users to choose more sustainable products. On average, subjects more often selected products rated as sustainable, notably for coffee, cereals, and milk (but not for jam) (Joerß et al., 2021). AR-technology was particularly effective in stimulating more sustainable consumption decisions for those consumers who have the habit of buying sustainably and consider the technology as a solution to current problems. This finding is interesting because it suggests that this type of technology can be used to promote sustainable products in the marketplace.

Finally, a survey (n=319) in Australia (van Esch et al., 2019) assessed consumers reactions to anthropomorphized product information for eggs provided through an AR device (tablet, smartphone) during a retail shopping experience. Results show that AR positively influences consumers' experience increasing confidence in using augmented reality technology, convenience of the transaction, and innovativeness. AR also diminished product usage barriers and perception that AR will cause unintended health effects or side effects in general, which in turn influences attitude towards the brand (van Esch et al., 2019).

Providing food information through Augmented Reality in the marketplace improves consumers' experiences and brand attitudes, except when AR presents too much information. Information delivered to consumers through AR has the potential to improve attitudes towards restaurants, increase choices of sustainable products in grocery stores when consumers are informed about products' level of sustainability, and improve attitudes towards the brand when anthropomorphized product information is provided. It is worth noting, however, that none of these studies looked into the use of AR to deliver food information to consumers from a public policy standpoint (although the study on products' sustainability has direct implications for policy). Future research is needed to address the question if AR is a viable strategy to deliver food information with important public policy consequences, notably nutritional information. Another important point to notice is that the specific objective of these studies was often to test AR features, and not to measure spontaneous use of augmented reality tools in comparison to other means of food information provision. Augmented reality tools provide information beyond what is presented in a packaging label, but providing food information only through AR does not seem possible. Information provided through AR does not seem to be a viable alternative to completely replace information displayed on labels. It can be used, however, to provide extra information, beyond the one displayed on the label.

4.7 Online grocery stores' interventions

Three articles investigate online grocery store interventions or specific information presented to consumers while grocery shopping online (see Table 9). Two studies focused on the provision of nutrition information in online grocery stores showed mixed findings, while a third study investigated the effect of personalized advice offering low-fat product switches to consumers in their online grocery shopping.

An experiment in Australia compared 10-week sales data for 53 products in an online grocery store presenting nutritional information and a control online store (without nutritional information). Nutrition information was displayed using traffic-light labels using four color-coded indicators to portray products' levels of fat, saturated fat, sugar, and sodium content. Results showed no effect of nutritional information on sales, nor changes in sales by the relative healthiness of the products (Sacks et al., 2011).

Another study investigated a similar question with a different empirical approach and a larger dataset. Zou and Liu (2019) conducted a field experiment to examine how nutrition information displayed online influences food shopping, whether there is an interaction between provision of nutrition information and seller reputation, and the effects of nutrition information display on healthy and unhealthy food sales. The analysis of data from 1,474 online food sellers in China through an empirical model ("empirical model" is a methodological term used to refer to different types of statistical models using econometrics to analyze big data sets) showed that nutrition information provision increases food sales in general. This effect was stronger for sellers with a high reputation. Healthy food with nutrition information tends to attract more purchases than unhealthy food. An eye-tracking study (n=60) complemented these findings and showed that consumers pay attention to nutrition information when shopping for groceries online and that the mere availability of such information increases food sales (Zou & Liu, 2019). These findings are interesting from a public policy perspective because they suggest that displaying nutrition information in online grocery stores is an effective way to improve sales of healthy products.

Lastly, one article investigated the effect of product switches proposed to consumers while shopping online. An experiment (n=456) in Australia showed that fully automated, personalized dietary advice recommending low fat product switches during Internet shopping diminishes the amount of saturated fat purchased in comparison to general, non-specific advice about a low saturated fat diet (Huang et al., 2006).

Table 9. Summary of articles on online grocery stores' interventions included in the literature review.

Authors (year) ***Journal*** ***Country***	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Key take-away**
Huang et al. (2006) *Plos Clinical Trials*	Experiment	Food purchases	n=456	Fully automated, personalized dietary advice recommending product switches during Internet shopping diminishes the amount of saturated fat purchased in comparison to general, non-specific	Reduction on purchases of foods high in saturated fat.

Australia				advice for low saturated fat diet.	
Sacks et al (2011) *Australian & New Zealand Journal of Public Health* *Australia*	Experiment	Food purchases	Sales data for 53 products	A 10-week trial presenting nutritional information for products in an online grocery store did not influence sales in comparison to a control online store. There were no changes in sales by the relative healthiness of the products.	No effect of nutritional information on online sales or product choices.
Zou & Li (2019) *Journal of the Academy of Marketing Science* *China*	Empirical Model and experiment	Food purchases, attention towards nutrition information (NI)	Sales data of 1,474 online food sellers; Experiment: n=60	Analysis of data from 1,474 online food sellers in China and an eye-tracking study (n=60) show that consumers pay attention to nutrition information when grocery shopping online and that such information increases food sales. The effect of nutrition information on product sales is stronger for sellers with high reputation. Healthy food with nutrition information tends to attract more purchases than unhealthy food. The eye-tracking experiment shows that attention on nutrition information increases for healthy foods but not for unhealthy foods.	- Increase in healthy food purchases. - Decrease in unhealthy food purchases. - Stronger effect for high reputation sellers and for healthy foods. - Attention to NI is increased for healthy foods.

Taken together these results show that food information delivered through online grocery stores influences consumers' purchase behavior. Experimental findings regarding the provision of nutritional information in online grocery stores are mixed, but the results of the work of Zou & Liu (2019) relying on data of almost 1,500 online grocery retailers, suggest that the display of nutrition information in online grocery stores significantly increase product sales, for healthy foods in particular. Online proposed switches to healthier options also influence purchase behavior improving the nutritional quality of food choices, similarly to the results of the SaltSwitch mobile application (Eyles et al., 2017), that also reduced purchase of salt (see p. 12).

4.8 Website link on alcohol labels

Two studies investigated the awareness and use of website links provided in alcoholic beverages' labels (Table 10). As discussed in the introduction the alcohol industry is implementing packaging labels with links to websites providing further information about products and alcohol consumption (see p. 3). In Australia, an alcohol industry organization implemented voluntary messages in alcohol bottles with a link to the association website (Coomber et al., 2015). The articles presented below assess the effects of these type of initiatives.

Results from the two articles indicate low use of website links provided on labels displayed on alcoholic beverages (Coomber et al., 2015; Vecchio et al., 2018). A survey with a representative sample of the Australian population (n=501) measured awareness of a voluntary alcohol warning label ("Get the facts") that directs consumers to a website (www.drinkwise.org.au) providing more information about safer alcohol consumption (see Figure 4; Coomber et al., 2015). The objective of this survey was to assess awareness of these voluntary warning labels and use of the link to an industry-designed informational website displayed on these labels. Results show that few participants (25.3%) were aware of the label on alcohol products, while even fewer (7.3%) visited the website recommended on the label (Coomber et al., 2015). Visitors of the website were more likely males, wine or spirits drinkers (vs. beer), more frequent binge drinkers, consumed alcohol directly from a can or a bottle, and supported the use of health-focused warning labels. This finding suggests that displaying a website link in a product label is not an effective way to improve accessibility of product information in the marketplace.

Figure 4. Example of labels placed in alcohol products in Australia displaying a link to the Drinkwise website (Coomber et al., 2015)

Vecchio and colleagues (2018) conducted a controlled experiment with 103 Italian wine consumers to compare labels providing different type of information (calories per glass, nutritional panel for 100ml, link to website, and key nutrients per glass) on wine bottles. The study showed that 74% of participants rarely or never looked for wine nutritional information. However, participants reported, in general, a high interest in additional information on wine nutritional values (mean=4.12/5) and in wine nutritional information on the label (mean=4.23/5). The main outcome measured in this study was preference, assessed through willingness-to-pay for the bottle of wine. Results show that preference was the lowest for the website link label, and higher for more descriptive labels (nutritional panel or key nutrients). These findings, while limited in terms of sample representativeness, suggest strong support of consumers for wine nutritional labels. Specifically, wine consumers least preferred format was the one providing less information, that is to say, no information available directly on the label besides the website link. Consumers prefer more informative formats such as nutritional panel or key nutrients' labels.

Table 10. Summary of articles on Website links on alcohol labels included in the literature review.

Authors (year) *Journal* *Country*	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Key take-away**
Coomber et al. (2015) *BMC Public Health* *Australia*	Survey	Awareness of labels with link Website use	n=501	An online survey with a representative sample of the Australian population measured awareness of a voluntary alcohol warning label ("Get the facts") that directs consumers to a website (Drinkwise.org) providing information about safer alcohol consumption. Results revealed that 25.3% of participants were aware of the label in alcohol products, while only 7.3% visited the website recommended in the label.	- Low awareness and use of website provided on alcohol labels - 25% of consumers are aware of the labels, 7.3% visited the website on the label
Vecchio et al. (2018) *Nutrients* *Italy*	Experiment (field)	Attitude towards website link label Interest for QR codes and apps with alcohol information	n=103	A controlled experiment with 103 Italian wine consumers compared wine labels (calories per glass, nutritional panel for 100ml, link to website, key nutrients per glass). Preference (assessed through WTP for wine) was the lowest for the website link label, and higher for more descriptive labels (nutritional panel or key nutrients). Use and interest to obtain wine information from other sources is very low.	- Low preference for wine with no information, only website link label - High interest for nutritional panel or key nutrients display.

These results suggest that website links or QR codes displayed on labels of alcoholic beverages are not used by consumers (Coomber et al., 2015; Vecchio et al., 2018). Consumers have higher interest to obtain information about alcoholic beverages through descriptive labels presenting nutritional information. It is noteworthy that future research in this area is needed because the two studies reported here also have limitations. The first study (Coomber et al., 2015) is a survey, so the evidence is descriptive and correlational and does not necessarily reflect actual behavior. And while the second study (Vecchio et al., 2018) uses a controlled design to test the different types of labels, the sample size is relatively small. Experimental studies with larger sample sizes are needed to assess the effect of website links placed on alcoholic beverages' labels in controlled settings but also in the field.

4.9 Overview of main results on online means

Table 11 presents an overview of the main findings of the 40 articles on online means organized around the main research questions of this report. The first two columns present the publication identification information followed by the type of online mean and product category that were the object of the article. A separate column documents the effects on the availability of food information through different means because some studies measured whether the means of information was available to consumers or not. Then, a first set of columns presents results related to RQ1 and RQ2 ("What means of food information apart from labels do consumers use and want?"). The awareness column refers to whether consumers noticed the information/means. The use column refers to whether consumers actually used the information and/or the means of information provision and includes self-declared and observed measures of use. The attitudes column refers to affective reactions towards the means of providing food information and/or the information itself. The intentions column shows results related to individuals' intentions to use of information/means. The next set of columns presents results related to RQ3 ("How does information delivered through means other than food labels influence behavioral outcomes?"). Columns in this set present effects on food knowledge, attitudes towards food and perceived self-efficacy to handle food decisions, attitudes towards food providers (e.g., food retailers, restaurants), food purchase intentions, and behavior (e.g., food purchase or choice). Finally, a last column in this part documents effects on body weight.

The first question this report investigates is what type of means of food information provision apart from labels consumers use. Regarding this question, there are only nine studies measuring use of online means of food information (another article by Dunford and colleagues (2014) only reported the number of downloads of a food application, but did not measure use directly). Six studies reported low use of online means, in particular to search for information about alcohol products (Coomber et al., 2015; GfK Belgium, 2014; Grunert et al., 2018; Perski et al., 2019; Vecchio et al., 2018). The use of links provided in alcohol labels is particularly low (Coomber et al., 2015; Vecchio et al., 2018). The spontaneous use of QR codes to access information about food products is also low (Oonk, 2013), but QR codes use increases when a specific device is available to scan them in the marketplace (Li & Messer, 2019). ***The overview of articles on online means suggests that use of information delivered through online means is low except for mobile food applications where participants were asked to use the app in the setting of the study*** (Appleton et al., 2019; Eyles et al., 2017. In the latter case, high use may be considered an artifact of the study's design because participants were asked to use the applications.

The second question investigated in this report concerns the type of means of food information other than labels that consumers want. Twenty-four articles measured attitudes and/or intention to use online means of food information provision. ***They show that consumers generally report positive attitudes towards online means of food information provision, in particular when they are considered easy to use, useful, or when they increase processing fluency (i.e., the ease with which individuals can process information and generate related thoughts; Schwartz, 2004). In the context of information provided on food traceability, trust towards the source of information is also an important attribute. These results suggest that attitudes towards the analyzed online means are generally positive, and in some cases influence intentions to use these means. An exception is the case of QR codes that are not always appreciated by consumers (Bray et al., 2019) and intentions to use them (Oonk, 2013) and actual use (Li & Messer, 2019) are low in***

certain contexts. QR codes' use is notably low when consumers are required to scan them using their own devices (Oonk, 2013; Li & Messer, 2019). Regarding augmented reality, the use of this tool in the setting of the studies included in this review was appreciated by consumers. It is worth noticing, however, that food information delivered using augmented reality can also have a negative effect on attitudes when it provides too much information to consumers (Hoffmann et al., 2021). In line with results about the use of online means, labels providing a website link for alcohol products are not particularly appreciated by consumers (Vecchio et al., 2018). The two studies in this domain show that consumers want to have access to alcohol nutrition information directly on the label.

Results show thus low level of use of online means but favorable attitudes. This discrepancy may be due to the design of the studies assessing attitudes towards online means. In several studies participants were asked to test online means and report their attitudes. In such situations use is a forced condition at the outset of the study. Therefore we do not know if consumers will enjoy using online means when deciding to use them in the marketplace. Future research is definitely needed to address this question.

This analysis also revealed that online means may influence food knowledge. Some mobile phone applications had positive effects on food knowledge increasing people's capacity to identify healthy food options or increasing their specific knowledge on a food category (Abao et al., 2018; Ahmed et al., 2020; Gauthier et al., 2021; Juan et al., 2019). One study, however, presented contradicting evidence: the use of a mobile food application designed to improve fruit and vegetable knowledge did not improve this variable after four weeks (Appleton et al., 2019).

The third research question studied in this review is how food information delivered through online means influences behavioral outcomes including attitudes toward food, food purchase intentions, and behavior. Out of the 40 articles on online means included in the literature review, 13 articles report effects on intentions and behavior. ***The effects of online means on behavioral variables are mixed.*** Hoffmann and colleagues (2021) showed that food information delivered using augmented reality diminished purchases of breakfast cereal in general when too much information was provided to consumers (in comparison when less information was available), suggesting that information delivered online should be easy to process. Four articles measured behavior but did not document any effects of online food information, notably for an application providing healthy shopping lists (Palacios et al., 2018), for QR codes (Li & Messer, 2019), for blog posts promoting healthy eating (Dumas et al., 2020), and for nutrition information provided in online grocery stores (Sacks et al., 2011).

Importantly, eight of the 13 articles reported significant effects of online food information on behavior. A mobile food application designed to diminish salt intake was able to reduce salt consumption after four weeks of use (Eyles et al., 2017). Sander and colleagues (2018) showed that blockchain traceability information increases self-reported meat purchase decisions. Exposure to a healthy eating blog for six months had a positive effect on fruit and vegetable consumption (Caplette et al., 2017), a finding that was however not replicated in similar research published more recently (Dumas et al., 2020). Food information delivered using augmented reality also had behavioral effects: AR providing sustainable information increased the choice of sustainable products (Joerß et al., 2021), while AR displaying replicas of dessert alongside price and product information in menus increased dessert choice (in comparison to the same information provided without AR)(Heller et al., 2019). It is noteworthy that this last behavioral effect—increase in dessert choice—while beneficial for restaurant owners, may not be beneficial from a public policy perspective, considering the general objective of promoting healthy eating. More research should assess effects of public policy food information delivered through online means.

Two online grocery shopping interventions also had a significant influence on consumers' behavior, increasing healthy food consumption and/or decreasing unhealthy food consumption. First, the offer of personalized switch options for foods low in saturated fat while grocery-shopping online reduces purchases of food products high in saturated fat (Huang et al., 2006). Finally, a recent study involving data from online retailers in China showed that the presentation of nutrition information in online grocery stores increased sales of healthy foods and decreased the sales of unhealthy ones (Zou & Li, 2019).

The analysis of included articles on online means showed a majority of significant effects on the different outcomes analyzed (use, attitudes towards online means, food knowledge, attitudes towards food, purchase intentions, and behavior). Only 6 of the 40 articles reported non-significant effects of online means on outcomes. The prevalence of positive results may be partially explained by publication bias: it is often easier to publish papers reporting positive effects of interventions.

Taken together, the analysis of 40 articles on online means of food information provision show that there is low spontaneous use of these means by consumers. Attitudes towards online means of food information provision are generally positive in particular when online means are easy to use, useful, and provide trustable information. Use of online means can improve consumers' food knowledge in some contexts. Regarding information on alcohol products, results suggest that consumers want to have access to alcohol nutrition information directly on the label and not through online links placed on labels. Although there are few articles studying behavioral effects of online means, there is a potential for online means to influence consumers' behavior, in particular when direct access to food information is warranted. Future research is needed to assess the impact of these means when consumers have to spontaneously use them in the marketplace (in comparison to when use is part of the study outset). Future work should also compare online means to more traditional ways to provide food information, such as labels.

Table 11. Summary of main results for online means

		RQ1: availability of food information	RQ1&2: What means of food information apart from labels do consumers use and want?				RQ3: How does food information delivered through means other than food labels influence behavioral outcomes?					
			Effects on online means or information-related outcomes				Effects on food-related outcomes					
Authors (year) *Journal*	**Food category / Mean**	**Availability**	**Awareness of information/ mean**	**Use of information delivered through the mean**	**Attitudes toward the mean/information**	**Intention to use online mean/information**	**Food knowledge**	**Attitudes towards food & perceived self-efficacy**	**Attitudes towards food provider (retailer/restaurant)**	**Food purchase intention**	**Behavior: food purchase or choice**	**Body weight**
General use of online food information												
GfK Belgium (2014) *Market Research Report*	Websites, apps for alcohol info			Low	High interest if info is not available on label High trust in public and health websites							
Gumirakiza & VanZee (2018) *Journal of Agricultural Science*	Online food labels					High likelihood to use food info						
Grunert et al. (2018) *Food Quality and Preference*	Websites, apps for alcohol info			Low	High interest if info is not available on label							
Petticrew et al. (2017) *Public Health*	Alcohol Calorie info in online stores	Low availability of food information in online stores										
Mobile applications												
Abao et al. (2018) *Procedia Computer Science*	Healthy food app						Short-term improvement of capacity to identify healthy options					

Ahmed et al. (2020) *The International Journal of Behavioral Nutrition and Physical Activity*	Food app with NI				Positive		Short-term improvement of capacity to identify healthy options					
Appleton et al. (2019) *Journal of Medical Internet Research*	Fruits & Veggies promotion app			High	Positive after 4 weeks						High self-reported fruit and vegetables' consumption	
Doub et al. (2015) *Journal of Direct, Data and Digital Marketing Practice*	Internet and app for food tasks				Positive							
Dunford et al. (2014) *Journal of Medical Internet Research*	Healthy choice app			High								
Eyles et al. (2017) *European Journal of Preventive Cardiology*	Low salt app			High	Positive						Reduction of salt purchases after 4 weeks No effect on other nutrients	
Gauthier et al. (2021) *Working paper*	App to scan foods when shopping	App provides access to food information			Positive: easy to use & useful		Improvement of food knowledge	Positive				
Juan et al. (2019) *Frontiers in Computer Science*	Carbohydrates info app				Positive: useful		Short-term improvement of carbohydrates' knowledge					
Minnens et al. (2020) *Food and Chemical Toxicology*	Fish info app				Positive: easy to use and useful	High						
Palacios et al. (2018) *Nutrients*	Healthy shopping list app										No effect on purchase of fruits and vegetables	No effect
Perski et al. (2019) *Drug and Alcohol Dependence*	Alcohol reduction app and website			Low								
Samoggia & Riedel (2020) *Food Research International*	Nutrition info app						Improvement of healthy food knowledge after 12 weeks	Positive after 12 weeks				
QR codes												

Albăstroiu & Felea (2015) *Amfiteatru Economic Journal*	QR codes in general	Participants are aware of what QR codes are		High	High							
Bray et al. (2019) *British Food Journal*	QR code in workplace canteens				Negative in comparison to labels							
Li & Messer (2019) *Journal of Agricultural and Resource Economics*	QR codes for oysters in the marketplace			Low spontaneous use Average if device available							No effect on food purchase behavior	
Oonk (2013) *Master's Thesis University of Twente*	QR codes in products' pack					No effect				No effect		
Ryu & Murdock (2013) *Journal of Direct, Data and Digital Marketing Practice*	QR codes in general				Positive: easy to use	High if useful, fun, entertaining						
Blockchain (BC)												
Garaus & Treiblmaier (2021) *Food Control*	Blockchain for food								Positive: retailers' preference and trust			
Lin et al. (2021) *International Journal of Environmental Research and Public Health*	Blockchain for organic foods				Positive for organic foods	High intention to use BC for organic foods						
Sander et al. (2018) *British Food Journal*	Blockchain for meat products										Positive	
Shew et al. (2021) *Applied Economic Perspectives and Policy*	Blockchain for beef products				Negative effect in comparison to public agency label							
Yeh et al. (2019) *IEEE*	Blockchain for food				Positive: trust					Positive		
Blogs and social media												

Briliana et al. (2020) *Journal of Management & Marketing Review (JMMR)*	Vloggers of street food				Positive: useful	High intention to use						
Caplette et al. (2017) *JMIR Research Protocols*	Healthy eating blog										Increase in fruit and vegetables consumption after 6-month	
Dumas et al (2020) *Journal of the Academy of Nutrition and Dietetics*	Healthy eating blog							No effect after 6-month			No effect after 6-month	No effect
Tsai et al. (2020) *Frontiers in Psychology*	Social media food safety groups				Positive: easiness to use	High						
You & Wiangin (2020) *Frontiers in psychology*	Social media organic food groups				Positive	Increase in intention to use						
Augmented reality (AR)												
Heller et al. (2019) *Journal of Retailing*	AR for desserts in restaurant menus				Positive: processing fluency				Positive: restaurant WOM		Increase in dessert choice when AR is available	
Hoffmann et al. (2021) *under review at JAMS*	AR for breakfast cereal and beer				Negative (when AR presents too much information)			Negative: brand attitudes		Negative	Negative effects of AR with high controllability	
Joerß et al. (2021) *Journal of Business Research*	AR for 4 grocery products										Increase in sustainable products 'purchases when AR info is displayed	
van Esch et al. (2019) *Journal of Retailing and Consumer Services*	AR for eggs							Positive: brand attitudes	Positive: consumer experience			
Online grocery store interventions												
Huang et al. (2006) *Plos Clinical Trials*	Online advice for low sat fat switches										Decrease in salt purchases	
Sacks et al (2011) *Australian & New Zealand Journal of Public Health*	NI in online grocery stores										No effect	

Zou & Li (2019) *Journal of the Academy of Marketing Science*	NI in online grocery stores				Positive: NI attention						Increase in healthy food purchases Decrease in unhealthy food purchases	
Website link in alcohol labels												
Coomber et al. (2015) *BMC Public Health*	Voluntary alcohol label w/ website link	Low		Low								
Vecchio et al. (2018) *Nutrients*	Alcohol label w/ website link			Low	Low							

5. Menu labels

The articles included in this literature review on menu labels consist in recent articles published after the systematic review of Long and colleagues (2015) that were not included in the systematic review by Bleich and colleagues (2017). The search strategy yielded 29 articles on menu labels. Only one article reported research conducted in Europe, and the majority of the articles included reported studies conducted in the U.S. (n=19). This is not surprising since mandates to post calorie information in restaurant and fast-foods have been progressively adopted at different levels in the U.S. for the past 15 years. New York City implemented this policy in 2006, and was followed by Philadelphia, several counties (e.g., King County, Washington; Chen et al., 2019) and also by states such as California, Massachusetts, and Oregon (Cawley et al., 2020). More recently, in May 2018, the requirement to display menu labels became a national requirement in the U.S. for chain restaurants with 20 or more locations and this law was included in the Affordable Care Act (ACA, Public Law 111–148; U.S. Food and Drug Administration, 2021). Four articles included in this literature review were conducted in Canada, where regulations of menu labels are also gradually being implemented. The province of Ontario implemented mandatory calorie-labeling regulations in 2017 for sit-down and fast-food restaurants with more than 20 locations. Voluntary programs of nutrition information display were launched in British Columbia in 2012, but with no formal requirement of calorie information display on menus (Goodman et al. 2018).

In terms of methodology, most of the articles on menu labels (n=20) use an experimental approach. The second most used methodology is empirical modelling (n=7), and in this group most articles analyzed a large survey on health conducted annually in the U.S. (the Behavioral Risk Factor Surveillance System-BRFSS) to estimate menu labelling effects on Body Mass Index (BMI). Finally, two articles report surveys' results. In the remainder of this section, we analyze articles on menu labels per type of methodology and type of setting discussing experimental studies conducted on fast-foods (n=5), experimental studies conducted in restaurants and cafeterias (n=10), experimental studies investigating features of menu labels (n=5), articles presenting empirical models (n=7), and surveys (n=2).

5.1 Articles on menu labels using an experimental approach and focusing on fast-foods

There were five experimental studies on the effects of menu labeling displaying calorie information for food products sold in fast-foods (Table 12). Only one of the articles provides direct insight on the use of menu labels (RQ1). Cantor and colleagues (2015) conducted a natural experiment involving receipt collection and survey responses in fast-food restaurants (n=7,699) in New York City (U.S.), and compared behavior of consumers exposed (or not) to calorie information on menu boards in 2008 and in 2013-14 (Cantor et al., 2015). Results showed an increase in nutritional information awareness, use (answer to the question whether calorie information influenced their purchase), and, in particular, use to reduce calorie consumption (answer to the questions whether calorie information influenced them to buy food that was lower/higher in calories). The percentage of participants noticing and using calorie information in fast food restaurants diminished through time but was higher than the baseline. There were no changes in the nutritional content of purchases or frequency of fast-food consumption. Importantly, no changes in calories ordered were observed.

Another experiment provides indirect information about the use of menu labels (RQ1) by assessing effects of calorie labels on nutrition knowledge. A quasi-experiment (n=220) conducted in Australia using exit surveys in fast-food stores displaying menu labels in Sydney and in control stores in Melbourne (without menu labels) showed that respondents estimated meal energy content more accurately when menu labels displaying energy content were available (Seenivasan & Thomas, 2016). This finding provides indirect evidence for the use of menu labels, while also showing an improvement in food knowledge (RQ3).

The other three experimental articles on the effects of menu labels on fast-foods assessed behavioral outcomes and provide insight into how food information delivered through other means influence food purchase behavior (RQ3). The findings suggest modest effects of menu labels on behavioral outcomes. A quasi-experiment using customer receipts at McDonald's and other equivalent control fast-foods in the U.S. assessed the effects of calorie nutrition labeling (implemented by McDonald's in 2012) on nutrition outcomes, such as calorie content, saturated fat, sugar, dietary fiber, and sodium. For adults, there was a small improvement in nutritional quality with a 4% reduction of calories from sugar, but a 1.8% increase in calories from saturated fat (Petimar et al., 2020).

Similarly, two controlled experiments conducted in an online virtual fast-food environment in the U.K. showed no effects of menu calorie labels on calories ordered. Marty and colleagues (2020) conducted two controlled

studies (total n=1,743) to test the effect of menu labels (calories displayed for each item vs. not) and menu structural changes varying the availability of lower energy labels (low vs. high) on hypothetical food ordering among lower and higher socioeconomic position (SEP) consumers. When the menu had a greater number of lower energy options (75% instead of 25%) participants ordered less caloric meals. The effect of menu calorie labels was, however, nonsignificant. Socioeconomic position of participants did not interact with any of the dependent variables. It is notable that the effect of menu calories labels was measured on hypothetical choices only, and not on real choices.

Finally, a within-subjects experiment with a small, convenience sample of university students in the U.S. (n=97) measured hypothetical food choices from a menu with and without calorie labels (Stran et al., 2016). Results show that participants ordered fewer calories when exposed to the menu calorie labels.

Taken together, articles using the experimental methodology and focusing on fast-foods provide evidence of an increase in nutrition information awareness and use (Cantor et al., 2015; Seenivasan & Thomas 2016) after the display of menu labels displaying calorie information. Effects on number of calories ordered were, however, either non-existent (Marty et al., 2020) or very small (Petimar et al., 2020; Stran et al., 2016).

Table 12. Summary of menu label articles using the experimental methodology and focusing on fast-foods.

Authors (year) *Journal* *Country*	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Key take-away**
Cantor et al. (2015) *Health Affairs* *U.S.*	Natural experiment	Awareness and use of NI, nutritional quality of purchases, calories purchased, frequency of fast-food consumption	n=7,699	A natural experiment including a comparison group involving receipt collection in fast-food restaurants in the U.S. compared behavior of consumers exposed to calorie information on menu boards (vs. not) in 2008 and in 2013-14. The presence of calorie information increased nutritional information awareness, use, and, in particular, use to reduce calorie consumption. Results showed an increase in nutritional information awareness, use (answer to the question whether calorie information influenced their purchase), and, in particular, use to reduce calorie consumption (answer to the questions whether calorie information influenced them to buy food that was lower (or higher—separate question) in calories). The percentage of participants noticing and using calorie information in fast food restaurants diminished but was higher than the baseline. There were no changes in the nutritional content of purchases or frequency of fast-food consumption.	- Increase in NI awareness and use - No change in nutritional quality of purchases, on calories purchased or on frequency of of fast-food consumption
Marty et al. (2020) *International Journal of Behavioral Nutrition and Physical Activity* *U.K.*	Experiment (RCT)	Calories ordered	n=1,743 (S1:n=868; S2:n=875)	In an online virtual fast-food environment, Marty et al. (2020) conducted two controlled studies (total n=1,743) to test the effect of menu labels (calories displayed for each item vs. not) and menu structural changes varying the availability of lower energy labels (low vs. high) on hypothetical food ordering among lower and higher socioeconomic position (SEP) consumers. When the menu had a greater number of lower energy options (75% instead of 25%) participants ordered less caloric meals. The effect of menu calorie labels was, however, nonsignificant. SEP did not interact with any of the dependent variables.	- No main effect of menu calorie labels display - Menu structural changes: labels with 75% (vs. 25%) lower energy options diminished calories ordered
Petimar et al. (2020) *Journal of the Academy of Nutrition*	Quasi experiment	Nutritional content of	n=2,883 adults (Adolescents:	A quasi-experiment used customer receipts from adults (n=2,883), adolescents	Small improvement in

and Dietetics *U.S.*		purchased fast-food meals	n=2,131, Children: n=433)	(n=2,131), and children (n=433) at McDonald's and other equivalent control fast-foods in the U.S. to assess the effects of calorie nutrition labeling (implemented by McDonald's in 2012). This study specifically focused on effects of calorie labeling on nutrition outcomes, such as saturated fat, sugar, dietary fiber, and sodium. For adults, there was a small improvement in nutritional quality with a 4% reduction of calories from sugar but a 1.8% increase in calories from saturated fat.	nutritional quality of meals ordered by adults
Seenivasan & Thomas (2016) *Journal of Economic Psychology* *Australia*	Quasi experiment	Nutrition knowledge, healthy choice, and choice	n=220	A quasi-experiment (n=220) using exit surveys in burger chain stores displaying menu labels in Sydney and in control stores in Melbourne, Australia (without menu labels) investigated effects on nutrition knowledge. When menu labels were available, respondents estimated meal energy content more precisely. Consumers overestimated the calorie content of meals and chose healthier meals when there were no menu labels.	- Increase in nutrition knowledge (accuracy of energy estimations) - No effect on choice: healthy meals' choice was higher without menu labels
Stran et al. (2016) *Journal of Nutrition Education and Behavior* *U.S.*	Quasi experiment	Calorie ordered hypothetically	n=97	In a within-subjects experiment, 97 university students in the U.S. made hypothetical food choices from a menu without labels and, after a filler task, made food selections again, this time from a menu displaying calorie labels. Results show that participants selected fewer calories when exposed to the menu calorie labels.	Reduction of calories ordered hypothetically

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5.2 Articles on menu labels using the experimental methodology and focusing on restaurants and cafeterias

Ten articles focused on the effects of menu labels inside restaurants and cafeterias (Table 13). Four of these articles addressed consumers' use and wants of this type of means to provide food information (cf. Research Questions 1 and 2; Goodman et al., 2018; Olstad et al., 2015; Vanderlee, 2016; Vasiljevic et al., 2019). A quasi-experiment and a survey conducted in a concession inside a recreation and sport facility in Canada evaluated how consumers react to nutrition information placed on menu boards or shelf labels (Olstad et al., 2015). A three-color system classifying food as green, yellow, or red was used to communicate nutritional quality. Sales data and surveys were collected one week before and one week after the implementation of the menu and shelf labels. Results of the survey after the implementation of the labels (n=312) show 38% of awareness of nutritional labels, 84.8% self-reported understanding, and 39.3% self-reported use of the labels.

Similarly, a quasi-experiment in two cafeterias in Canada (n=3061) assessed the effect of the display of nutritional information on digital menu boards on consumers' awareness and use of nutrition information, ability to estimate meals' calorie content, and on the nutritional quality of purchases made (Vanderlee, 2016). The labels provided information for calories, sodium, saturated fat and total fat for meals or food items. Menu labels increased awareness of nutrition information (control: 31.8%; intervention: 75.1%) and self-reported use of nutrition information (control: 9%; intervention: 25.4%) in comparison to the control.

A quasi-experiment compared the use of nutrition information in restaurants in two Canadian provinces: one with mandatory calorie labelling (Ontario) and another with a voluntary policy (British Columbia; Goodman et al., 2018). The voluntary policy consisted in displaying the logo of the Informed Dining Program and the statement "see our nutrition brochure" on menus or menu bords, while making nutrition information (on calorie and sodium content) available under consumers' request. Three other provinces with no formal policy were included as controls. Results show that, when mandatory calorie menu labelling was adopted, there was an increase in awareness of nutrition information (NI) (+25.1% vs. +1.6% voluntary vs. +6.5% control) and self-reported influence of NI on orders (+12.9% vs. +2.2% vs. +2.0% control). Support for calorie menu labelling was higher in all groups at follow-up. Mandatory calorie menu labeling was more effective to increase nutrition information use than a voluntary policy (Goodman et al., 2018). It is noteworthy that the voluntary policy intervention where nutrition information was only available upon request had no observable effect on consumers' awareness or use of food information relative to control. Females and younger respondents were more likely to use nutrition information in menus.

A controlled experiment in three worksite cafeterias in the U.K. measured sales data six weeks before and between 8-12 weeks after the display of calorie information (Vasiljevic et al., 2019). Regarding sales data, menu calorie labelling had no effect on calories ordered. An exit survey was also conducted (n=250) to assess consumers' attitudes towards the intervention. Attitudes towards the intervention were positive among 83% of consumers and 87% of them wanted the menu labels to remain in place after the study.

One recent article focuses specifically on how the display of calorie information in restaurants' menus influence food knowledge (Cawley et al., 2021). In a randomized controlled field experiment conducted in one full-service, sit-down restaurant in the U.S. (n=1546), parties of individuals were randomly assigned to receive a menu with or without calorie information. At the end of the meal consumers completed a survey including a calorie estimation measure. Results showed that the display of calorie information on menus increases food knowledge, improving the level of accuracy about the number of calories ordered. Calorie disclosure in restaurants allows consumers to make more accurate calorie estimations. In the absence of calorie information (control group), consumers largely underestimate calories in restaurant food (average error of 37.7%). Importantly, this underestimation was translated in more calories ordered on average. These results are aligned with findings on menu labels in fast-food (see p. 33): Seenivasan and Thomas (2016) showed that calorie labels in fast-food menus improved accuracy in calorie estimation. It seems thus that displaying calorie menu labels improves consumers' knowledge both in sit-down and in fast-food restaurants.

These articles suggest that menu labels in cafeterias and restaurants increase awareness and use of nutritional information. Importantly, displaying calorie information on menus also improves consumers' knowledge, allowing more accurate calorie estimations of the foods ordered. Furthermore, there is evidence of support for this type of intervention among consumers.

Most of the articles on menu labels in restaurants and cafeterias measured behavioral outcomes and therefore provide insight into how food information delivered through menu labels influence food purchase behavior (RQ3). Three articles showed no significant effects of menu label information on food intake (Berry et al., 2019; Droms, 2016; Vasiljevic et al., 2019), while five articles showed positive behavioral effects for consumers with improvements in the nutritional quality of purchased and reduction in number of calories ordered (Cawley et al., 2018; Kresĭć et al., 2019; Olstad et al., 2015; Pratt et al., 2017, Vanderlee 2016).

Positive behavioral effects of menu labels for consumers were documented for the number of calories ordered and nutritional quality of purchases made. Menu labels significantly diminished the number of calories ordered (Cawley et al., 2018) and improved the nutritional quality of purchases (Pratt et al., 2017; Vanderlee 2016), by not only reducing the amount of calories, but also of sodium, fat, and saturated fat purchased (Vanderlee 2016). The results of a randomized controlled field experiment in two full-service, sit-down restaurants in the U.S. (n=5551) showed that the display of calorie information on menus reduces calories ordered by 3%, mainly in appetizers and entrees (Cawley et al., 2018). There were no changes in calories ordered in drinks or desserts. Exposure to calorie labels on menus also increased consumer support for this policy. In the same vein, Olstad and colleagues (2015) showed an increase in sales of healthy items and a reduction in sales of unhealthy items after the introduction of color-coded menu labels in a concession inside a sports recreation facility in Canada. In another experiment (Kresĭć et al., 2019), conducted in Croatia, 324 university students were asked to imagine they were ordering food in a restaurant and received a menu that was either unlabeled (control), or displayed either calorie information or a graphical label (with information on the percent of recommended daily intake of energy and four nutrients) for each item. Exposure to both the calorie and the graphical label diminished energy, fat, and salt content of the foods chosen (Kresĭć et al., 2019). The graphical label also reduced the amount of fatty acids and sugar content

chosen. We cannot tell, however, if the improvements in nutritional quality of food choices due to the graphical label are due to its graphic format or to the extra information provided in this label.

Pratt and colleagues (2017) also found improvement in nutritional quality of purchases made after graphical signposts were displayed in menus. The signposts included a graphic presenting food nutrient content per calorie relative to recommendations. An experiment (n=63) and a quasi-experiment (n=362) in a cafeteria in the U.S. assessed consumers' responses to nutrition information that was either absent (control), displayed in nutrition facts panels (NFP), or through a graphical signpost presenting food nutrient content per calorie. The quasi-experiment looked into the effects on food purchases. The NFP had no effects on purchases. The graphical signpost, however, improved the nutritional quality of purchases, notably for protein (increase) and saturated fat (decrease).

Three studies documented no main effect of menu labels on behavioral outcomes (Berry et al., 2019; Droms, 2016; Vasiljevic et al., 2019). Droms and colleagues conducted two studies in the U.S. (S1: n=72, S2: n=120) to test if nutrition information in the menu interacts with consumers' stage of change regarding health and eating habits. Menu labels (vs. no label) were a between-subjects condition in both studies while stages of change and other individual characteristics were measured. Menus displayed contained information about calories, fat grams, and carbohydrates for each dish. Menu label did not have a main effect on food choice in any of the studies. There were, however, effects for women in Study 1: women in the action or maintenance stage of change purchase less calories when exposed to menu labels. It is noteworthy that the sample sizes in these studies are very small for designs with so many conditions. Also, there were no main effects of the display of menu labels on attitudes towards menu labels or towards the restaurant.

Similarly, a controlled experiment in three worksite cafeterias in the U.K. also found no behavioral effects of calorie information display on menu labels. The study measured sales data six weeks before and between 8-12 weeks after the display of calorie information in the worksite cafeterias. An exit survey was also conducted (n=250) to assess consumers' attitudes towards the intervention. Attitudes towards the intervention were positive among 83% of consumers and 87% wanted the menu labels to remain in place after the study. However, regarding sales data, menu calorie labelling had no effect on calories ordered.

While three studies showed no main effects of menu labels' display on behavioral outcomes (Berry et al., 2019; Droms, 2016; Vasiljevic et al., 2019), one of these articles sheds light into a possible mechanism behind the lack of effect of menu labels on behavioral outcomes (Berry et al., 2019). Specifically, Berry and colleagues (2019) conducted an online study (n=271) and a field experiment in a restaurant (n=233) to test if the effect of menu labels displaying calorie content on calories ordered depends on the food value-orientation of consumers (Berry et al., 2019). Results show that consumers who are health-value oriented order less calories when exposed to calorie labels in restaurants. For consumers who value taste or quantity in food, however, the display of calories in the menu has the opposite effect: it increases the number of calories ordered. The authors propose that these findings are a potential explanation for past research showing nonsignificant effects of menu labels displaying calorie information. Specifically, menu labels diminish calories ordered for consumers who value food health mainly, while menu labels increase calories ordered for consumers who value taste or quantity. Because the two effects go in opposite directions, the sum of these two effects shows no effect of menu labels on calories ordered if consumers' food value orientation is not taken into account.

The articles measuring behavioral outcomes following menu labels' display in restaurant and cafeterias present mixed effects, suggesting that this type of means of food information provision has significant but small effects in reducing calories ordered or improving the nutritional quality of consumers' purchases. While five articles documented improved nutritional quality of choices made in restaurants and cafeterias after the introduction of food information on menus, these effects were small. Furthermore, three articles reported no effect on calories ordered or food choice. One article (Berry et al., 2019) proposed a potential explanation for these mixed findings: the effect of food information provided in menu labels on food choice depends on consumers' value orientation regarding food. For consumers who value health, menu labels diminish the number of calories ordered while for those who value taste or quantity, menu labels increase the number of calories ordered.

Table 13. Summary of menu label articles using the experimental methodology and focusing on restaurants and cafeterias.

Authors (year) *Journal* ***Country***	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Key take-away**
Berry et al. (2019) *Journal of Public Policy & Marketing* *U.S.*	Experiment	Calories ordered	S1: n=271 (MTurk); S2: n=233	An online study and a field experiment in a restaurant indicate that the effect of menu labels displaying calorie content depends on the food value-orientation of consumers. Consumers who are health-value oriented order less calories when exposed to calorie labels. For consumers who value taste or quantity in food, however, the display of calories in the menu has the opposite effect: it increases the number of calories ordered. The authors propose that these findings are a potential explanation for many studies reporting non-significant effects of menu labels displaying calorie information on consumer behavior.	- No main effect of menu label display but moderation by food-value orientation - Reduction of calories ordered for health-value oriented consumers - Increase of calories ordered for taste or quantity oriented consumers
Cawley et al. (2018) *NBER Working Paper* *U.S.*	Experiment (field)	Calories ordered	n=5,551 data points from receipts; Survey: n=3,923	Results of a randomized controlled field experiment in two full-service, sit-down restaurants in the U.S. (n=5551) showed that the display of calorie information on menus reduces calories ordered by 3%, mainly in appetizers and entrees. There were no changes in calories ordered in drinks or desserts. Exposure to calorie labels on menus increases consumer support for this policy.	Reduction of calories ordered
Cawley et al. (2021) *American Journal of Health Economics* *U.S.*	Experiment (field)	Food knowledge (calorie estimation accuracy)	n=1546	In a randomized controlled field experiment conducted in one full-service, sit-down restaurant in the U.S. (n=1546), parties of individuals were randomly assigned to receive a menu with or without calorie information. At the conclusion of the meal consumers completed a survey including a calorie estimation measure. Results showed that the display of calorie information on menus increases food knowledge in general, specifically improving knowledge about the number of calories they ordered. Calorie disclosure in restaurants allows consumers to make more accurate calorie estimations. In absence of calorie information (control group), consumers largely underestimate calories in restaurant food (average error of 37.7%). Importantly, consumers who underestimate calories in their meal order more calories on average.	Improvement on food knowledge (calorie estimation accuracy)
Droms (2016) *Journal of Food Products Marketing* *U.S.*	Quasi experiment	Hypothetical food choice, attitudes towards menu labels, attitudes towards the restaurant	S1 : n=72; S2: n=120 students	Two studies conducted in the U.S. (S1: n=72, S2: n=120) tested if nutrition information in the menu interacts with consumers' stage of change regarding health and eating habits. Menu labels (vs. no label) were a between-subjects condition in both studies while stages of change and other individual characteristics were measured. Menus displayed contained information about	- Menu label did not have a main effect on hypothetical food choice in any of the studies - No main effects on menu labels' or

				calories, fat grams, and carbohydrates for each dish. Menu label did not have a main effect on food choice in any of the studies. There were, however, effects for women in Study 1: women in the action or maintenance stage of change purchase less calories when exposed to menu labels. Effects in Study 2 were either non-significant or unrelated to menu labels. It is noteworthy that the sample sizes are very small for designs with so many conditions. Also, there were no main effects of menu labels on attitudes towards menu labels or the restaurant.	restaurant's attitudes
Goodman et al. (2018) *Preventive Medicine* *Canada*	Quasi experiment	Awareness of NI, self-report of influence of NI on choice, and policy support for NI display	Before: n=2,929; After: n=968	A quasi-experiment compared the use of nutrition in two Canadian provinces: one with mandatory calorie labelling and another with a voluntary policy. Three other provinces with no formal policy were included as controls. Results show that, when mandatory calorie menu labelling was adopted, there was an increase in awareness of nutrition information (+25.1% vs. +1.6% voluntary vs. +6.5% control) and self-reported influence of NI on orders (+12.9% vs. +2.2% vs. +2.0% control). Support for the policy was higher in all groups at follow-up.	- Increase in NI awareness - Increase in self-reported influence of NI on orders - High support for the policy
Krešić et al. (2019) *British Food Journal* *Croatia*	Experiment	Hypothetical food choices	n=324 students	In an experiment conducted in Croatia, 324 university students were asked to imagine they were ordering food in a restaurant and received a menu that was either unlabeled (control), or displaying calorie information for each item, or a graphical label for each item (with information per nutrient). Exposure to both the calorie and the graphical label diminished energy, fat, and salt content of the foods chosen. The graphical label also reduced the amount of fatty acids and sugar content chosen.	- Reduction in energy, fat, and salt content of food hypothetical choices - Graphical label also reduced fatty acids and sugar
Olstad et al. (2015) *Appetite* *Canada*	Quasi experiment and survey	Awareness of NI, self-reported NI understanding, self-reported NI use, sales of healthy and unhealthy items	Sales data: n=2,101; Survey Before: n=315, After: n=312	A quasi-experiment and a survey were conducted in a recreation and sport facility in Canada to evaluate how consumers react to nutrition information placed on menu board or shelf labels. A three-color system classifying food as green, yellow, or red was used to communicate nutritional quality. Sales data and surveys were collected one week before (n=315) and one week after (n=312) the implementation of the menu and shelf labels. Results show an increase in sales of green items and a reduction in sales of red items between the two periods. There were no differences in behavioral and attitudinal reactions to the labels according to any demographic factor. Results of the survey after the implementation of the labels show 38% of awareness, 84.8% self-reported understanding, and 39.3% self-reported use of the labels.	- Increase in NI awareness Increase in self-reported NI understanding - Increase in self-reported NI use - Increase in healthy items sales - Decrease in unhealthy items sales
Pratt et al. (2017) *Nutrition*	Experiment and	Food	Experiment: n=63,	An experiment (n=63) and a quasi-	- Increase in food

Research *U.S.*	Quasi experiment	knowledge, nutritional quality of purchases,	Quasi-experiment: n=362	experiment (n=362) conducted in a cafeteria in the U.S. assessed consumers' responses to nutrition information that was either absent (control), displayed in nutrition facts panels (NFP) or through a graphical signpost. The experiment showed that the graphical signpost increased food knowledge (assessed through recall of correct fiber and protein ratings) by 43%. The quasi-experiment looked into the effects on food purchases. There were no effects of NFP menu labels on purchases. The graphical signpost, however, improved the nutritional quality of purchases, notably for protein (increase) and saturated fat (decrease).	knowledge after exposure to graphic signpost - Improvement in nutritional quality of purchases after exposure to graphic signpost - Reduction of calories ordered with graphic signpost
Vanderlee (2016) *PhD Thesis* *Canada*	Quasi experiment	NI awareness and use, calories ordered, nutritional quality of food choices	n=3,061	A quasi-experiment in two cafeterias in Canada (n=3061) assessed the effect of the display of nutritional information on digital menu boards in consumers' awareness and use of nutrition information, ability to estimate meals' calorie content, and on the nutritional quality of purchases made. Menu labels provided information for calories, sodium, saturated fat and total fat for meals or food items. Data was collected before menu label display and three months after. Menu labels increased awareness (control: 31.8%; intervention: 75.1%) and use of nutrition information (control: 9% and intervention: 25.4. Menu labels also reduced calories, sodium, saturated fat, and total fat purchased. There were, however, no differences in estimation of calorie content of meals across conditions. Results suggest a modest positive effect of the menu labelling intervention.	- Increase in NI awareness and use - No change in accuracy of calorie estimations - Reduction in calories ordered and increase in nutritional quality of foods ordered
Vasiljevic et al. (2019) *Appetite* *U.K.*	Experiment	Attitudes towards menu labels, calories ordered	n=250	A controlled experiment in three worksite cafeterias in the U.K. measured sales data six weeks before and between 8-12 weeks after the display of calorie information. An exit survey was also conducted (n=250) to assess consumers' attitudes towards the intervention. Regarding sales data, menu calorie labelling had no effect on calories ordered. Attitudes towards the intervention were positive among 83% of consumers and 87% wanted the menu labels to remain in place after the study.	- No effect on calories ordered - Positive attitudes towards menu labels and support for the policy

5.3 Articles on menu labels using an experimental methodology and focusing on menu features

Five articles using an experimental approach analyzed the impact of specific menu features (Table 14). Different types of features were studied: graphic symbols identifying healthier alternatives in the menu (White et al., 2016; Kerins et al., 2017), food pictures and type of food name (ambiguous vs. unambiguous; Hou et al., 2017), visual or descriptive ways of providing local food information on menus (Lu & Chi, 2018), and position of calorie information in the menu (left vs. right; Dallas et al., 2019).

The two articles testing graphic symbols identifying healthy menu items showed either a modest or a nonsignificant effect on purchases. A quasi-experiment conducted in Canada assessed the display of an icon identifying menu items with high nutritional quality, the Health Check (White et al., 2016). The Health Check is

a graphic symbol that was part of a voluntary nutrition labeling program developed by the Heart and Stroke Foundation of Canada to allow consumers to easily identify menu items of higher nutritional quality. The study used an exit survey (n_{total} =1126) of consumers to compare eight restaurants' chains, half of them participating (n=589) and half not participating in the program (n=537). Results show higher awareness of nutrition information in restaurant chains using the Health Check symbol (34.2% vs. 28.1% for control), even if only 5% of customers exposed to the symbol spontaneously recall it and very few report that it influenced their choices. While there was an increase in awareness, spontaneous recall of the Health Check icon was very low. Regarding consumption data, exposure to the symbol reduced the amount of saturated fat and increased the amount of protein and fiber in the items purchased in comparison to control restaurants. However, the display (vs. absence) of the Health Check icon also increased the amount of carbohydrates purchased. In restaurants displaying the Health Check icon, 15% of consumers exposed to the symbol ordered labeled products, but no information for this variable on control restaurants is presented in the article. These findings seem to indicate that displaying a graphic symbol to identify healthy menu items improve some elements of nutritional quality of the items purchased, but not all.

Another field study also investigated the effect of graphic symbols identifying healthy items in menus. A quasi-experiment measured the effect of placing icon symbols on healthy menu items in eight foodservice establishments in Ireland (Kerins et al., 2017). Items that were low in fat, sugar, and salt while high in fiber received one icon-based menu label defined based on its nutritional value. Five types of icons were displayed in the menus: Cholesterol Friendly, Blood Pressure Friendly, Weight Friendly, Diabetes Friendly, and Healthiest Heart Award. A menu footer explaining the icon-based menu labels was also displayed. Sales data were collected before and four weeks after the implementation of the menu labelling icons. Results show that there were no differences in the sales of menu items in any of the restaurants. No other attitudinal measures were assessed in this study. This finding indicates no behavioral effects of graphic symbols identifying healthy items in menus.

Another type of menu feature investigated is a common practice in the restaurant industry: adding pictures of food items beside its description on the menu. Hou and colleagues (2017) assessed the effect of pictures added besides menu items on consumers' attitudes towards the item, willingness-to-pay and purchase intentions. Two controlled experiments conducted in the U.S. (S1: n= 261; S2: n= 360) using an online panel (MTurk) investigated the effects of food pictures inserted in the menu (vs. no pictures), food name (ambiguous vs. common) and consumers' information processing style. The presence of pictures was manipulated by displaying or not a picture of the food item besides its name in the menu. Food name was manipulated using common descriptive food names (e.g., "chicken and egg salad") or ambiguous names (e.g., "which came first"). Results show that adding pictures to the menu improves attitudes towards the food item, willingness to pay, and purchase intentions for food items displaying common descriptive names. For ambiguous food names, however, the effect of picture on the main outcomes depends on the information processing style of the consumer. For consumers who are verbalizers (i.e., who process information without forming mental images), pictures have a positive effect, while they have a negative effect for visualizers (those who build mental images when processing information). These results suggest that displaying pictures in the menu improves attitudes and purchase intentions for food items described with common names. This study did not test, however, the behavioral effects of this type of menu feature.

Another study explored the effect of pictures in the menu, but focusing on a local food restaurant. Lu and Chi (2018) conducted an online study with an online panel (MTurk) sample in the U.S. (n=830) to explore consumers' reactions to local food at casual dining restaurants while manipulating the type of information provided on hypothetical menus. Using a scenario-based design, the study compared three types of information about local producers: visual information (with picture), verbal information (with description of local producers), and control (no information about producers, just a list of local ingredients) provided in restaurant menus. Results show that the type of information about local food producers provided in the menu did not influence consumers' attitudes and purchases intentions. There was no main effect of local producer information display: providing information about local producers did not increase attitudes and purchase intentions compared to when such information was absent. In this study, however, the picture likely portrayed the local farmers and not the food items as it was the case in the previous article (Hou et al., 2017). It is thus difficult to compare both findings.

Finally, one article investigated another feature of menu labels: the side of the menu (left vs. right) where the calorie information is presented. One field study (n=150) and one online experiment (n=275) in the U.S. show that presenting information on the left side of the menu (vs. right side) reduces the amount of calories ordered as consumers may give more weight to this information earlier in their decision process (Dallas et al., 2019). The same group of authors conducted another online study in Israel (n=254) and showed that this

effect is reversed among Hebrew speaking Israelis, who read from right to left. This last study also showed that this main effect is mediated by the weight placed on calorie information in a choice: weight placed on calorie information when choosing is higher when this information appears earlier in the decision process**.** The findings from Dallas and colleagues (2019) suggest that the use of nutrition information depends on its place on menu labels. If calorie information appears on the left (vs. right) side of the menu it is likely to be processed earlier by consumers and thus have a higher impact in the decision process.

The analysis of articles on specific features of menu labels provides some insights about consumers' use and wants of this type of means to provide food information (cf. Research Questions 1 and 2). Findings on use and attitudes towards menu labels are mixed. White and colleagues (2016) showed that display of an icon identifying healthy menu items (i.e., the Health Check) increased nutritional information awareness, but spontaneous recall of the icon was very low. This finding suggests that the effect of this type of menu feature may influence consumers even when they do not process this information with full attention.

Research on features of menu labels also show that adding pictures to illustrate menu items is a practice that also improves consumers' attitudes towards food items (Hou et al., 2017). It is noteworthy that not all pictures have positive effects. The display of a picture of the local producers in the menu of a local restaurant did not influence consumers' attitudes towards the restaurant (Lu & Chi, 2018). Finally, Dallas and colleagues (2019) showed that the side of the menu where calorie information is displayed is important. When calorie information is displayed in the left side of the menu consumers are exposed to it earlier in the decision process and end up giving more weight to it.

All articles on specific features of menu labels measured either purchase intentions or purchase behavior and therefore provide elements to answer the question about how food information delivered through other means influences food purchase behavior (RQ3). Behavioral results are mixed. It is however, hard to compare results of articles in this section because the features tested vary greatly between articles. Icons designing healthy menu options were found to either improve some nutritional quality elements of items purchased but not all (White et al., 2016) or to have no effects on purchases made (Kerins et al., 2017). Providing information about local producers on the menu did not influence purchase intentions (Lu & Chi, 2018). Two types of features, however, had a positive effect on consumers' behavioral reactions. Adding food pictures to the menu increased purchase intentions for menu items with descriptive food names (Hou et al., 2017), and placing calorie information in the left side of the menu reduced calories ordered (Dallas et al., 2019). Taken together, these results show limited effects of menu labels' features on behavioral outcomes. Future research is thus needed to further explore how specific menu features influence behavioral reactions and to replicate the above mentioned findings.

Table 14. Summary of menu label articles using the experimental methodology and focusing on menu features.

Authors (year) *Journal* *Country*	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Key take-away**
Dallas et al. (2019) *Journal of Consumer Psychology* *U.S.*	Experiment	Calories ordered	S1 : n=150, S2: n=275, S3: n=254	One field (n=150) and one online experiment (n=275) in the U.S. show that presenting information on the left side of the menu (vs. right side) reduces the amount of calories ordered because consumers give more weight to this information earlier in their decision process. Another online study conducted in the U.S. and in Israel (n=254) showed that this effect is reversed among Hebrew-speaking Israelis, who read from right to left. This last study shows that this main effect is mediated by the weight placed on calorie information in a choice. Weight given to calorie information in a choice is higher when this information appears earlier in the	Reduction in calories ordered only when calories are placed at the left side of the menu (due to earlier integration in the decision process)

				decision process.	
Hou et al. (2017) *International Journal of Hospitality Management* *U.S.*	Experiment	Willingness to pay (WTP) and purchase intentions for food items	S1: n= 261 (MTurk) S2: n= 360 (MTurk)	Two controlled experiments conducted in the U.S. using an online panel (MTurk) assessed the effect of pictures added besides menu items on consumers' attitudes towards the item, willingness-to-pay and purchase intentions. The studies also investigated the effects of food name (ambiguous vs. common) and consumers' information processing style. Results show that adding pictures improves attitudes towards the menu item, willingness to pay, and purchase intentions for common descriptive food names. For ambiguous food names, however, the effect of picture on the main outcomes depends on the information processing style of the consumer. For verbalizers, those who process information without forming mental images, pictures have a positive effect, while they have a negative effect for visualizers (those who build mental images when processing information). There was no main effect of local producer information display: providing information about local producers did not increase attitudes and purchase intentions compared to when such information was absent.	Menu labels with pictures increase WTP and purchase intentions for foods with descriptive food names
Kerins et al. (2017) *Perspectives in Public Health* *Ireland*	Quasi experiment	Sales of menu items	n=4,407 labelled menu items (in 8 restaurants)	A quasi-experiment measured the effect of placing icon labelling on some healthy menu items in eight foodservice establishments in Ireland. Items that were low in fat, sugar, and salt while high in fiber received one icon-based menu label (e.g., Weight Friendly, Healthiest Heart Award) after nutritional analysis. Sales data were collected before and four weeks after the implementation of the menu labelling icons. Results show that there were no differences in the sales of menu items in any of the restaurants.	No effects of the display of icon-based labels beside healthy menu items
Lu & Chi (2018) *International Journal of Hospitality Management* *U.S.*	Experiment	Purchase intention	n=830	An online study conducted with MTurk in the U.S. (n=830) explored consumers' reactions to local food at restaurants while manipulating the type of information provided on menus. Using a hypothetical scenario, the study compared visual information (with picture), verbal information (with description of local producers), and control (no information about producers, just a list of local ingredients) provided in restaurant menus. The type of information about local food producers provided in the menu does not influence consumers' attitudes and purchases intentions.	No influence of type of local food information in menus on attitudes and purchase intentions
White et al. (2016) *Preventive Medicine Reports* *Canada*	Quasi experiment	Awareness of NI, menu symbol recall, menu items selected, and nutritional quality of foods purchased	n_{total}=1,126, exposed to menu labels (n=589) vs. not exposed (n=537)	A quasi-experiment was conducted in Canada to evaluate the effect of a voluntary measure of communicating nutrition information on menus, the Health Check. This is a single icon attributed to the healthiest food items, allowing consumers to easily identify items of higher nutritional quality through a graphic symbol. The study used an exit survey of consumers to compare eight restaurants' chains, half of them participating (n=589)	- Improvement in some nutritional quality elements of foods purchased - Higher NI awareness - Low menu icon

				and half not participating in the program (n=537). Results show higher awareness of nutrition information in restaurant chains using the Health Check symbol (34.2% vs. 28.1% for control), even if only 5% of customers exposed to the symbol spontaneously recall it and very few report that it influenced their choices. Regarding consumption data, exposure to the symbol reduced the amount of saturated fat and increased the amount of protein, fiber, and carbohydrates purchased. 15% of consumers exposed to the symbol ordered labeled products.	recall

5.4 Articles on menu labels using empirical models

Six studies used empirical models to analyze the effects of menu labels using existing data from national surveys conducted in the U.S., such as the Behavioral Risk Factor Surveillance System (BRFSS: a survey of health-related data conducted annually by the Centers for Disease Control and Prevention with a representative sample of adults in the U.S.) or the National Health and Nutrition Examination Survey (NHANES) (Table 15).

Two of the articles using empirical models provide insights about Research Questions 1 and 2 because they addressed consumers' use and wants of this type of means to provide food information (Chen et al., 2019; Lee-Kwan et al., 2016). Lee-Kwan and colleagues (2016) used data from the 2012 BRFSS to investigate the use of menu labels displaying calorie information among adults who noticed menu labels and its association with sociodemographic factors. Results show low levels of use among adults who noticed menu labels: 42.7% of respondents never used menu labelling to decide what to order, while 31.6% use it moderately, and 25.6% use it frequently. Frequent users of menu labels were mainly adults aged 30-49 years, women, non-Hispanic, college graduates, married, and with higher household income. The highest percentage of frequent menu-labeling users was among underweight/normal-weight adults, physically active, never-smokers, non-consumers of sugar-sweetened beverages, and adults living in states with menu-labeling legislations already enacted or proposed (Lee-Kwan et al., 2016). Because this study focused on adults who noticed menu labels, these levels of use should be interpreted with caution. The general population may have lower levels of menu labeling usage.

More recently, Chen and colleagues (2019) also investigated use and awareness of menu labels displaying calorie information. Using data from the BRFSS between 2008 and 2010 from residents of King County, Washington, a repeated cross-sectional study assessed consumers' awareness and use of calorie information before and after the implementation of calorie labeling in restaurants' menus. The study focused on participants who ate at regulated chains of sit-down or fast-food restaurants. Results show that both awareness and use of calorie information increased between 2008 and 2010. Specifically, awareness raised from 18.6% to 59.4% and use raised from 8.1% to 24.8%. Use and awareness of calorie information varied among subgroups of consumers. Awareness was higher among white, higher income, and obese individuals, while use was higher among women, higher income, and those visiting a fast-food (vs. a sit-down) restaurant (Chen et al., 2019). This last work shows an increase in awareness and use of calorie information after menu mandate implementation. These findings complement the work from Lee-Kwan and colleagues (2016) that only focuses on individuals who were aware of menu labels. ***The findings of two studies (Chen et al., 2019; Lee-Kwan et al., 2016) suggest increases in awareness after the display of calorie menu labels, while levels of use increased, but still remained low.***

One study using empirical models provides insight on behavioral outcomes of this type of means of food information provision and thus helps answer RQ3. The National Health and Nutrition Examination Survey (NHANES) dataset from 2003 until 2014 was used to estimate the effect of menu calorie labeling on the relationship between meals consumed away from home (e.g., in restaurants, cafeterias or fast-foods) and daily caloric intake (Todd et al., 2021). Geographic information about whether and when an area implemented a menu labeling law was linked to the NHANES survey data. There were non-significant effects of menu labeling on the number of meals consumed away from home for adults, adolescents, and children. The display of menu labels did not affect the propensity or frequency of eating out, but it reduced the marginal

effect that meals consumed away from home have on total calorie intake. ***This finding suggests a positive effect of menu labels on behavioral outcomes, with a reduction in calories consumed away from home.***

Finally, four articles using empirical models investigate effects of menu labels on more consequential outcomes, such as Body Mass Index (BMI) and obesity rates. ***They all show small but statistically significant reductions in BMI after the implementation of calorie mandates*** (Deb & Vargas, 2016; Courtemanche et al., 2020; Restrepo, 2017; Yelowitz, 2016).

Using data from the BRFSS between 1994 and 2012 (n=594,364), Courtemanche and colleagues (2020) examined how laws requiring chain restaurants to post calorie counts on menus influence consumer BMI and measures of life satisfaction. Results show that menu calorie labeling reduced BMI (0.2kg/m^2, the equivalent of 1.5 pounds) but also reduced measures of life satisfaction. These reductions are mainly concentrated among individuals who have a healthy weight. Importantly, the authors highlight that these effects are smaller than what could be predicted extrapolating results from field experiments about the impact of menu calorie labels on choices made in restaurants. This last point is important because it suggests that empirical models using national surveys' data are an interesting way to access the impact of labelling policies in consequential outcomes, such as BMI. This type of approach complements field experiments because it captures reactions in less controlled environments, which closely correspond to consumers' reality. They are also aligned with recent work measuring the impact of FOP labeling in a large field experiment in several supermarkets in France that showed effects several times smaller than those reported in controlled laboratory experiments (Dubois et al., 2020).

Using data from the BRFSS from 2003 until 2012, Deb and Vargas (2016) analyzed the effects of menu calorie labeling implementation in a number of counties, cities, and states in the U.S. (and neighboring geographies that did not implement calorie labeling) on adults' BMI. States (and corresponding cities and counties) that have implemented calorie-labeling and were included in this study were: New York (Queens, Kings, Richmond, Bronx, New York City, Westchester, Ulters, Albany, Schenectady, and Suffolk), California (statewide), Washington (King), Oregon (statewide), Pennsylvania (Philadelphia), Maine (statewide), and Massachusetts (statewide). States with no calorie-labeling laws in 2012 that were included in the control group were: Connecticut, Delaware, New Hampshire, Maryland, New Jersey, Rhode Island, Vermont, Arizona, Idaho, and Nevada. Results revealed a decrease in individuals' BMI when menu labeling was implemented. For men there were effects for normal, overweight, and obese individuals whereas for women the effect was concentrated on overweight individuals only. Effects of menu labels on men's BMI were larger for overweight and obese individuals.

An empirical model using 2004 to 2012 data from the BRFSS assessed consumers' change in BMI after the implementation of menu calorie labelling in New York counties (Restrepo, 2017). The study used a differences-in-differences empirical strategy using within-county variation in the policy mandate and the differential timing of implementation across the counties to identify the effect of calorie labeling on body weight (Retrepo, 2017, p. 3). Results show that the policy caused reductions in BMI and in the probability of obesity. Specifically, calorie labeling reduced BMI by 1.5%, and decreased the risk of obesity by 12%. Results also suggest that calorie labeling has a larger impact on the body weight of lower-income individuals and minorities.

Complementing the findings from Restrepo (2017) with a larger sample from different cities across the U.S., Yelowitz (2016) further documents the effect of calorie labeling on BMI and obesity. The empirical approach was to compare individuals in locations where mandated calorie disclosure were implemented before and after menu mandates' enforcement (i.e., Boston, Los Angeles, New York, Philadelphia, Portland, San Diego, San Francisco, San Jose, and Seattle). Other large cities (i.e., Austin, Baltimore, Charlotte, Chicago, Columbus, Dallas, Denver, Detroit, El Paso, Fort Worth, Houston, Indianapolis, Jacksonville, Louisville, Memphis, Milwaukee, Nashville, Oklahoma City, Phoenix, San Antonio, Washington, D.C.; Yelowitz, 2016) were used as control group. An empirical analysis of data from the BRFSS between 2003 and 2012 for 30 large cities in the U.S compared individuals' BMI and obesity rates before and after menu calorie labeling mandates for restaurants were enforced (Yelowitz, 2016). Results show a reduction of obesity of about 1.25% at time of menu labels' implementation. This effect was, however, short-lived, obesity rates rose again and the initial benefit disappeared in four years after implementation. Effects on BMI indicate a reduction of 0.15 BMI points that is sustained over time, a finding aligned with the one reported by Restrepo (2017) in New York counties but suggesting a smaller effect. Effects of menu labels on BMI were stronger for older adults and those highly educated, but they fade out rapidly. There are, however, no effects on BMI for younger adults and the less educated individuals.

Results from four articles analyzing effects of menu labels on BMI suggest that menu labels' mandates have a small but significant effect on the BMI of individuals, while there are also small reductions in obesity rates. Effects on obesity rates are not sustained over time. One study also documents a reduction in one measure of life satisfaction, suggesting that the beneficial effects of menu labels on BMI reduction may come with a hedonic cost for consumers.

Table 15. Summary of menu label articles using empirical models.

Authors (year) ***Journal*** ***Country***	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Key take-away**
Chen et al. (2015) *American Journal of Public Health* *U.S.*	Empirical model	Awareness and use of calorie information	n=3,132 English-speaking King County residents aged 18 years and older who reported eating at a regulated chain	Using data from the Behavioral Risk Factor Surveillance System (BRFSS: a survey of health-related data conducted annually by the Centers for Disease Control and Prevention with a representative sample of adults in the U.S.) between 2008 and 2010 from residents of King County, Washington, a repeated cross-sectional study assessed consumers' awareness and use of calorie information before and after the implementation of calorie labeling in restaurants' menus. The study focused on participants who ate at regulated chains of sit-down or fast-food restaurants. Results show that both awareness and use of calorie information increased between 2008 and 2010. Specifically, awareness raised from 18.6% to 59.4% and use raised from 8.1% to 24.8%. Use and awareness of calorie information varied among subgroups of consumers. Awareness was higher among white, higher income, and obese individuals, while use was higher among women, higher income, and those visiting a fast-food (vs. a sit-down restaurant).	Increase in calorie information use and awareness
Courtemanche et al. (2020) *NBER Working Paper* *U.S.*	Empirical model	Body mass index (BMI) and life satisfaction	n=594,364	Using data from the BRFSS between 1994 and 2012, Courtemanche et al. (2020) examined how laws requiring chain restaurants to post calorie counts on menus influence BMI and measures of life satisfaction. Results show that menu calorie labeling reduced BMI (0.2kg/m^2, the equivalent of 1.5 pounds) but also reduced measures of life satisfaction. These reductions are mainly concentrated among individuals who have a healthy weight. Importantly, the authors highlight that these results are smaller than what could be predicted extrapolating results from field experiments about the impact of menu calorie labels on choices made in restaurants.	- Small reduction in BMI - Reduction in life satisfaction
Deb & Vargas (2016) *NBER Working paper* *U.S.*	Empirical model	Body mass index (BMI)	-	Using data from the BRFSS from 2003 until 2012, Deb and Vargas (2016) analyzed effects of menu calorie labelling implementation on adults' body mass. Analyses using empirical models show that the implementation of mandatory menu calorie labeling laws in certain states and counties decrease individuals' BMI. For men there were effects for normal, overweight, and obese individuals whereas for women the	Small reduction in BMI

				effect was concentrated on overweight individuals only. Effects of menu labels on men's BMI were larger for overweight and obese individuals.	
Lee-Kwan et al. (2016) *Journal of the Academy of Nutrition and Dietetics* *U.S.*	Empirical Model	Use of menu labels	n=100,141 adults who noticed menu labeling at fast-food or chain restaurants	A study using data from the 2012 BRFSS investigated the prevalence of menu-label use among adults and their association with sociodemographic factors. 42.7% of respondents never used menu labelling to help decide what to order, while 31.6% use it moderately, and 25.6% use it frequently. Frequent users of menu labels were mainly adults aged 30-49 years, women, non-Hispanic, college graduates, married, and with higher household income. The highest percentage of frequent use menu-labeling users was among underweight/normal-weight adults, physically active, never-smokers, non-consumers of sugar=sweetened beverages, and adults living in states with menu-labeling legislations already enacted or proposed.	Low use of menu labels to decide what to order
Restrepo (2017) *Health Economics* *U.S.*	Empirical model	Body mass index (BMI)	-	An empirical model using 2004 to 2012 data from the BRFSS assessed consumers' change in BMI after the implementation of menu calorie labelling in New York counties. Results show that the policy caused reductions in BMI and in the probability of obesity. Specifically, calorie labeling reduced BMI by 1.5%, and decreased the risk of obesity by 12%. Results also suggest that calorie labeling has a larger impact on body weight among lower income individuals and minorities.	Reductions in BMI and obesity
Todd et al. (2021) *Economic Inquiry* *U.S.*	Empirical model	Number of meals consumed away from home	-	The National Health and Nutrition Examination Survey (NHANES) dataset from 2003 until 2014 was used to estimate the effect of menu calorie labeling on the relationship between meals consumed away from home (e.g., in restaurants, cafeterias or fast-foods) and daily caloric intake (Todd et al., 2021). Geographic information about whether and when an area implemented a menu labeling law was linked to the NHANES survey data. There were non-significant effects of menu labeling on the number of meals consumed away from home for adults, adolescents, and children. The display of menu labels did not affect the propensity or frequency of eating out, but they reduced the marginal effect that meals consumed away from home have on total calorie intake.	- Reduction on the effect that away from home meals have on calorie intake
Yelowitz (2016) *Policy Analysis, Cato Institute* *U.S.*	Empirical Model	Body mass index (BMI) and obesity	-	An empirical analysis of data from the BRFSS between 2003 and 2012 for 30 cities in the U.S compared individuals' body mass index (BMI) and obesity rates before and after menu calorie labeling mandates for restaurants were enforced. Results show a reduction of obesity of about 1.25% when menu labels were implemented. This effect is, however, short-lived, obesity rates rise again and the initial benefit disappears in four years. Effects on BMI indicate a reduction of 0.15 BMI points that is sustained over time.	- Reduction in BMI and obesity in the short-run - Small reduction on BMI sustained over time

				Effects of menu labels on BMI are stronger for older adults and those highly educated, but they fade out rapidly. There are, however, no effects on BMI for younger adults and the less educated.	

5.5 Articles on menu labels using surveys

Finally, two articles investigated menu labels' effects using surveys (Table 16). Nianogo and colleagues (2016) conducted a survey with 639 low-income adults in the U.S. to examine the associations between individuals' weight self-perceptions and importance, frequency of use, and intentions to use calorie information when ordering food in grocery stores as well as fast-food and sit-down restaurants (Nianogo et al., 2016). Results suggest that adults who desired to weigh less than their current weight had higher intentions to use calorie information in restaurants and considered the display of calorie information important, but there were no associations with frequency of use of calorie information.

Montandon and Colli (2016) conducted three discrete choice experiments in South Africa to compare consumers' preference for fast-food menu labels displaying three formats of nutritional information (traffic lights signals, color-coded guided daily amounts (GDA), and health endorsement logo). Brand, price and format of nutritional information were randomized to form 18 product profiles. Participants had to choose between 15 pairs of hamburgers varying in price, brand, and nutritional quality. Although type of nutritional information was a between-subjects factor, participants were not randomly assigned to each of the three formats; rather three separate surveys were conducted. They analyzed the data through a choice-based conjoint analysis, revealing that the traffic light signal was the format receiving the highest importance (41.42%) in fast-food preference being more important than price and brand and outperforming color-coded guided daily amounts (GDA) and health endorsement logo. GDAs and the Health endorsement logo had lower importance (27.71% and 13.75% respectively). It is important to notice that there was no random assignment to conditions, therefore the comparison of the three labels is purely descriptive.

These two studies suggest that intentions to use menu labels displaying calorie information are determined by weight self-perception, so that individuals who desire to weigh less have higher intentions to use menu labels' information (Nianogo et al., 2016). In terms of format of menu labels, traffic light labels seem to be preferred in the context of fast-food restaurants (Mondandon & Colli, 2016).

Table 16. Summary of menu label articles using surveys.

Authors (year) *Journal* ***Country***	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Key take-away**
Nianogo et al. (2016) *BMC Public Health* *U.S.*	Survey	Intention to use NI	n=639 low-income adults	A survey with 639 low-income adults in the U.S. examined the associations between individuals' weight self-perceptions and importance, frequency of use, and intentions to use calorie information when ordering prepared food in grocery stores, as well as fast-food and sit-down restaurants. Results suggest that adults who desired to weigh less than their current weight had higher intentions to use calorie information in restaurants and considered the display of calorie information important, but there were no associations with frequency of use of calorie information.	Higher intentions to use NI information when weight self-perception is negative
Montandon & Colli (2016) *British Food Journal* *South Africa*	Survey	Preference for NI format	n=219	Montandon and Colli (2016) conducted three discrete choice experiments in South Africa to compare consumers' preference for fast-food menu labels displaying three formats of nutritional information (traffic lights signals, color-coded guided daily amounts (GDA), and health endorsement logo). Brand, price and format of nutritional information were randomized to form 18 product profiles. Participants had to choose between 15 pairs of	Higher preference for menu labels displaying traffic light symbols

				hamburgers varying in price, brand, and nutritional quality. Although type of nutritional information was a between-subjects factor, participants were not randomly assigned to each of the three formats; rather three separate surveys were conducted. They analyzed the data through a choice-based conjoint analysis, revealing that the traffic light signal was the format receiving the highest importance (41.42%) in fast-food preference being more important than price and brand and outperforming color-coded guided daily amounts (GDA) and health endorsement logo. GDAs and the Health endorsement logo had lower importance (27.71% and 13.75% respectively).	

5.6 Overview of main results on menu labels

Table 17 presents the main results of the 29 articles investigating the effects of menu labels. **The first question this report investigates is what type of means of food information provision apart from packaging labels consumers use.** Regarding this question, there are only eight articles measuring awareness or use of food information provided through menu labels (Cantor et al., 2015; Cawley et al., 2020; Chen et al., 2015; Goodman et al., 2018; Lee-Kwan et al., 2016; Olstad et al., 2015; Vanderlee, 2016; White et al., 2016. The majority of them show a positive effect of menu labels' display on both awareness and use of nutrition information. **The overview of articles on menu labels means suggests that awareness and use of food information increases with the display of menu labels**.

Three articles demonstrate improvements in food knowledge due to calorie content menu labels' display (Cawley et al., 2021; Pratt et al., 2017; Seenivasan & Thomas, 2016), suggesting that this measure is affecting accuracy of calorie estimations when ordering food. Another article, however, did not find improvements in accuracy of calorie estimations after menu label display (Vanderlee, 2016), but it looked into labels displaying multiple nutritional quality elements and not only calorie content as the other articles.

The second research question investigated in this report concerns the type of means of food information apart from packaging labels that consumers want. Seven articles measured attitudes and/or intention to use information provided through menu labels (Cawley et al., 2020; Droms, 2016; Goodman et al., 2018; Lu & Chi, 2019; Montandon & Colli, 2016; Nianogo et al., 2016; Vasiljevic et al., 2019). Three articles measuring effects of calorie labelling in menus show high support for the measure among consumers (Cawley et al., 2020; Goodman et al., 2018; Vasiljevic et al., 2019), while one article only documented high intentions to use information from calorie labels among consumers who have a negative perception of their weight (Nianogo et al., 2016). Three articles tested menu labels displaying different types of nutrition information (not only calories) showed mixed effects (Droms, 2016; Lu & Chi, 2019; Montandon & Colli, 2016). Two articles documented no effects on attitudes towards the labels (Droms, 2016; Lu & Chi, 2019), while one article revealed higher preference for menu labels displaying traffic light symbols. **Seven articles (out of 29) on menu labels investigated consumers' attitudes towards menu labels specifically; the majority show positive reactions towards menu labels in general and in particular for labels displaying calorie content.**

The third research question studied in this review is how food information delivered through menu labels influences behavioral outcomes including attitudes towards food, food purchase intentions, and behavior. Out of the 29 articles on menu labels included in the literature review, 18 articles report effects on behavior and four articles report effects on Body Mass Index (BMI). **The effects of menu labels on behavior-related variables are mixed. Nine articles do not document significant effects of menu labels' display on behavioral outcomes, but two of these articles identify important moderators of the effect of menu labels on behavior (consumers' food-value orientation and place where menu labels are displayed). These moderators provide potential explanations for the mixed effects of menu labels on behavior. Nine articles report significant effects, with menu**

labels either reducing the number of calories ordered or improving the nutritional quality of food ordered. These effects are modest. Importantly, four studies measuring effects of menu labels on BMI showed small but significant reductions in body mass after the implementation of menu labels: **The adoption of menu labels' mandates had a modest but significant effect in reducing the body mass of consumers, in comparison to places where this measure has not been implemented.**

Overall, menu labels seem to be an effective measure to influence consumers' behavior in the marketplace with small but significant effects on consequential outcomes such as food purchases with improvement in nutritional quality of products purchased and/or reduction in the number of calories purchased. The literature also documents a small reduction in Body Mass Index in places where calorie labeling mandates were implemented. Although these effects are small, they provide evidence of effectiveness of this measure in the field.

The methodological differences across articles included in this review make comparisons far from straightforward. This literature review adopted an inclusive approach, with no assessment of studies' bias prior to inclusion. Therefore, the conclusions presented here should be examined with caution and should not be disconnected from the qualitative analysis of the articles presented beforehand.

Table 17. Summary of main results for menu labels

	Main outcome assessed / category	RQ1: availability of food information	RQ1&2: What means of food information apart from labels do consumers use and want?				RQ3: How does food information delivered through means other than food labels influence behavioral outcomes?					
			Effects on online means or information-related outcomes				Effects on food-related outcomes					
Authors (year) *Journal*		**Availability**	**Awareness of information/mean**	**Use of information delivered through the mean**	**Attitudes toward the mean/information**	**Intention to use online mean/information**	**Food knowledge**	**Attitudes towards food & perceived self-efficacy**	**Attitudes towards food provider (retailer/restaurant)**	**Food purchase intention**	**Behavior: food purchase or choice**	**Body weight**
Menu label articles using the experimental methodology and focusing on fast-foods.												
Cantor et al. (2015) *Health Affairs*	Awareness and use of NI Food purchases		Increase	Increase							No change in nutritional quality of purchases, on calories purchased or on frequency of fast-food consumption	
Marty et al. (2020) *International Journal of Behavioral Nutrition and Physical Activity*	Calories ordered										No effects	
Petimar et al. (2020) *Journal of the Academy of Nutrition and Dietetics*	Nutritional content of purchased fast-food meals										Small improvement in nutritional content of meals	
Seenivasan & Thomas (2016) *Journal of*	Nutrition knowledge,						Increase: accuracy of				No effects	

Economic Psychology	healthy choice, and choice						energy estimations					
Stran et al. (2016) *Journal of Nutrition Education and Behavior*	Calorie ordered hypothetically										Reduction of calories ordered hypothetically	
Menu label articles using the experimental methodology and focusing on restaurants and cafeterias.												
Berry et al. (2019) *Journal of Public Policy & Marketing*	Calories ordered										No main effect on calories ordered Reduction in calories ordered for health-oriented consumers Increase in calories ordered for taste or quantity-oriented consumers	
Cawley et al. (2020) *NBER Working Paper*	Calories ordered in a full-service, sit-down restaurant				Increase in support for menu calorie labeling						Small effect on calories ordered	
Cawley et al. (2021) *American Journal of Health Economics*	Food knowledge (calorie estimation accuracy)						Increase in calorie estimation accuracy					
Droms (2016) *Journal of Food Products Marketing*	Hypothetical food choice, Menu label's attitudes, attitudes towards the restaurant				No main effects on menu labels' attitude				No main effect on restaurants' attitude		No main effect on hypothetical food choice	
Goodman et al. (2018) *Preventive Medicine*	Awareness of NI, self-report of		Increase	Increase in self-reported	High support for the policy							

	influence of NI on choice, and policy support for NI display			use								
Krešić et al. (2019) *British Food Journal*	Hypothetical food choices										Improvement in nutritional content of hypothetical choices for graphic label (Reduction in energy, fat, salt, fatty acids and sugar)	
Olstad et al. (2015) *Appetite*	Awareness of NI, self-reported NI understanding, self-reported NI use, sales of healthy and unhealthy items		Increase	Increase in self-reported understanding and use							Increase in healthy items sales Decrease in unhealthy items sales	
Pratt et al. (2017) *Nutrition Research*	Food knowledge, nutritional quality of purchases,						Increase in food knowledge for graphic signpost				Improvement in nutritional quality of purchases for graphic signpost Reduction of calories ordered with graphic signpost	
Vanderlee (2016) *PhD Thesis*	NI awareness and use, calories ordered, nutritional quality of food choices		Increase	Increase			No change in accuracy of calorie estimations				Reduction in calories order and increase in nutritional quality of foods ordered	
Vasiljevic et al. (2019) *Appetite*	Attitudes towards menu labels Calories ordered				High attitudes towards menu labels and support for the policy						No effect on calories ordered	

Menu label articles using the experimental methodology and focusing on menu features.												
Dallas et al. (2019) *Journal of Consumer Psychology*	Calories ordered										No main effect of menu labels Reduction in calories ordered only when calories are placed at the left side of the menu (due to earlier integration in the decision process)	
Hou et al. (2017) *International Journal of Hospitality Management*	WTP and purchase intentions for food items										Menu labels with pictures increase WTP and purchase intentions for foods with descriptive food names	
Kerins et al. (2017) *Perspectives in Public Health*	Sales of menu items										No effects of the display of icon-based labels beside healthy options	
Lu & Chi (2018) *International Journal of Hospitality Management*	Purchase intention				No influence of type of local food info on attitudes					No influence of type of local food info		
White et al. (2016) *Preventive Medicine Reports*	Awareness of NI, menu symbol recall selection, and nutritional quality of foods purchased		Higher NI awareness	Low menu symbol recall							Improvement in nutritional quality of foods purchased	
Menu label articles using empirical												

models.												
Chen et al. (2015) *American Journal of Public Health*	Awareness and use of calorie information		Increase	Increase								
Courtemanche et al. (2020) *NBER Working Papers*	Body mass index (BMI) and life satisfaction											BMI reduction
Deb & Vargas (2016) *NBER Working paper*	Body mass index (BMI)											BMI reduction
Lee-Kwan et al. (2016) *Journal of the Academy of Nutrition and Dietetics*	Use of menu labels			Low use to decide what to order								
Restrepo (2017) *Health Economics*	Body mass index (BMI)											BMI and obesity reduction
Todd et al. (2021) *Economic Inquiry*	Number of meals consumed away from home										No effects on number of meals consumed away from home	Reduction on the effect of food away from home on daily intake
Yelowitz (2016) *Policy Analysis, Cato Institute*	Body mass index (BMI) and obesity											BMI and obesity reduction Small reduction sustained over time
Menu label articles using surveys.												
Nianogo et al. (2016) *BMC Public Health*	Intention to use NI					High intentions to						

						use NI information when weight self-perception is negative						
Montandon & Colli (2016) *British Food Journal*	Preference for NI format				High preference for menu labels displaying traffic light symbols							

6. Shelf labels

Shelf labels are labelling systems that display food information on product shelf tags normally placed next to the price (Hobin et al., 2017). The information presented is often an indication of the product's nutritional quality using a nutrition rating system. The advantage of using shelf tags to display nutrition information is that it is easily accessible to consumers because they need to use them to know products' prices. Most of the shelf labeling systems discussed in this review have been developed at a voluntary basis by the grocery industry, in particular in the U.S. and Canada. The search strategy of this literature review yielded 16 articles on shelf labels as a means of food information provision. Table 18 presents a summary of the articles on shelf labels. Most of the articles (n=14) use empirical models to measure the effect of shelf labels on sales data of grocery stores, either through a before and after approach, or using control stores. The remaining two articles use experimental methodology.

Table 18. Summary of shelf label articles included in the literature review.

Authors (year) *Journal* *Country*	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Main take-away**
Berning et al. (2010) *Journal of Food Distribution Research* *U.S.*	Experiment	Food choice and attention to the labels	n=1,200 grocery shoppers	An experiment with 1,200 shoppers in the U.S. showed that, exposure to a hypothetical shopping list with pictures of products (salad dressing, mayonnaise, microwave popcorn, and peanut butter) and shelf labels presenting prominent (highlighted) nutrition information, increases attention to the label (in comparison to non-highlighted nutrition information or no information) and healthy choices.	Positive effect of highlighted nutrition information on attention to the labels and increase of healthy choices
Berning & Sprott (2011) *Food Policy* *U.S.*	Experiment	Food preference	n=403 grocery shoppers	An experiment with 403 grocery shoppers in the U.S. compared shelf labels for tomato soup with highlighted nutrition information, without information, or with non-highlighted nutritional information. Consumers who perform a greater percentage of household shopping prefer shelf labels with highlighted nutrition information.	Increased preference for highlighted nutrition information labels
Bollinger et al. (2021) *Journal of Marketing Research (JMR)* *Canada*	Empirical Model (sales data) and repeated cross-sectional design	Food purchase, shelf-labels awareness, understanding, and use	Data set of 39.7 million transactions; Exit survey: n= 883 before and n=836 after campaign	The analysis of transaction data of a grocery retailer in Canada revealed a small increase in the purchase of healthier foods during a national campaign to promote the use of shelf-labels using stars to indicate healthier options. This increase was driven by produce purchases, and 60% of the effect disappears after the campaign's conclusion. The campaign increased purchase of unhealthier items in the dairy, meat, and dessert categories. A cross-sectional survey conducted before (n=883) and after (n=836) the campaign, showed an increase in awareness and understanding of the Guiding Stars program, but no effect of self-reported use of shelf-labels.	- Small increase on purchase of healthier foods - Increase on purchase of unhealthier items (dairy, meat and dessert) - Positive effect on awareness and understanding of the labels - No effect on labels' use
Cawley et al. (2015) *Public Health Nutrition* *U.S.*	Empirical Model (sales data)	Food purchase	Sales data from 168 supermarkets	The analysis of sales data from 168 supermarkets in the U.S. showed that the introduction of shelf-labels (Guiding Stars) diminished sales of less healthy products by 8.3%, mainly for canned meat and fish, soda pop, bakery products, and canned vegetables. Sales of healthy food did not change.	- Reduced sales for unhealthier products - No effect on healthy products
Daunfeldt & Rudholm (2014) *Journal of Retailing and Consumer*	Empirical Model (sales data)	Food purchase	Sales data from one grocery store on 3	A natural experiment in a hypermarket in Sweden showed that display of organic shelf-labels increased sales of two organic products: olive oil (43%) and coffee	- Increase in sales of organic olive oil and

Services *Sweden*			product categories before and after shelf-labels display	(48%). Sales of organic flour decreased by 29%. All targeted products became less price-sensitive.	coffee - Decrease in sales of organic flour
Finkelstein et al. (2018) *American Journal of Clinical Nutrition* *U.S.*	Empirical Model (sales data) and survey	Food purchase, shelf-labels awareness, understanding, and use	Sales data for 191 yogurt products; Survey: n=665	The analysis of sales data for yogurt in regional grocery stores in the U.S. implementing shelf-labels (NuVal) suggested that a 1-point increase in the NuVal score (which varies between 1-100, higher scores indicating better nutritional quality) is associated with a 0.49% increase in sales. A survey with 655 shoppers in grocery stores implementing the shelf-labels showed that 44% of them were aware of shelf-labels, 32% understood the labels, 15% said labels influenced the foods they buy, and 8% said labels influenced their purchases of dairy products.	Increase in sales of healthy yogurt
Freedman & Connors (2010) *Journal of the American Dietetic Association* *U.S.*	Empirical Model (sales data)	Food purchase	Sales data of a convenience on-campus store	A quasi-experimental study in an on-campus convenience store in the U.S. showed that labelling healthy foods (soup, cereal, cracker, and bread) with a shelf-label for five weeks and the availability of brochures and a poster explaining the labels did not change sales of tagged items in comparison to the baseline (6-week period where products did not have a shelf-label). There was, however, an increase in the percentage of total sales for the product categories of cereal, soup, and crackers, but a decrease for the bread category.	No effect on sales
Gamburzew et al. (2016) *International Journal of Behavioral Nutrition and Physical Activity* *France*	Empirical Model (grocery sales data for loyalty-reward customers) and two surveys	Food purchase, shelf-labels' awareness and attitudes	Sales data: n = 6,625 customers with grocery store loyalty cards; Exit survey: n = 259; in-depth survey: n = 116	For six months, grocery stores in disadvantaged neighborhoods in France displayed shelf-labels and posters signaling healthy, inexpensive foods and also implemented in-store taste tests. The analysis of sales data (n=6,625) shows that the contribution of inexpensive foods with good nutritional quality to customers' total spending on food did not change due to the intervention. All product categories were analyzed, but there was an increase in purchases for only two product categories (fruits and vegetables and starches) in the intervention stores in comparison to control stores. Two surveys (n=259; n=116) revealed that 31% of consumers were aware of the intervention and 60% considered it useful. The in-depth survey results show that intervention awareness was higher among shoppers who visit the store frequently. No other individual characteristics played a significant role.	- No change in total sales of healthy inexpensive foods - Increase in purchases of fruits & vegetables and starches - 31% of awareness - Positive attitudes towards the intervention
Ghvanidze et al. (2017) *British Food Journal* *Germany, U.K., U.S.*	Experiment and Empirical model (supermarket data)	Food choice	n=1,872 from SSI panel in 3 countries (Germany: n=779; U.K.: n=549; U.S.: n=544)	A discrete choice experiment in three countries (Germany, U.K., and U.S.) tested the effect of visual shelf-labels simulations for wine and yogurt. For yogurt, price and nutritional information had more influence on consumers' choices than information about social responsibility of producers. For wine, nutritional information had more influence on consumers' choice in the U.S. and Germany, but not in the U.K. Specifically, for American and German consumers, wine nutritional information (lower alcohol content and less carbohydrates), had a positive value, but for British respondents the same information had a negative value. The authors suggest that U.K. respondents value higher alcohol content in wine. Ecological and social responsibility attributes are valued more by consumers who are highly environmentally conscious or concerned about goods' production. The presence of information about the ecological impact of production on nature, on the other hand, was valued positively in the U.K. and the	- Nutritional information on shelf labels influenced consumers' hypothetical choices of yogurt. - Nutritional information on shelf labels did not influence hypothetical choices of wine in the U.K.

				U.S. market, but not in Germany which was an unexpected finding. Information about social responsibility of wine producers had a positive effect only in the U.S.	
Hobin et al. (2017) *The Milbank Quarterly* *Canada*	Empirical Model (supermarket transaction data) and survey	Food purchase	Data from three supermarket chains; Survey: n=783	The analysis of supermarket transaction data of three supermarkets chains in Canada showed that the display of shelf-labels (Guiding Stars) for six months caused small increases in both the nutritional quality (+ 1.4% assessed by the mean star rating per product purchased) and the mean revenue (+4.2%) in intervention supermarkets in comparison to control supermarkets without shelf-labels. Products purchased had less trans-fat (-3.5%) and sugar (-1.5%), and more fiber (+0.6%) and omega-3 fatty acids (+4.5%). There were no differences in calorie content, sodium, fat, saturated fat, or protein per product purchased. The exit survey showed that levels of awareness, understanding, and trust of shelf-labels were small. Only 9.7% of shoppers in the intervention supermarkets noticed the shelf-labels after six months, and 2% reported using it.	- Increase on sales of healthier products - Increase in revenue in intervention supermarkets
Kiesel & Villas-Boas (2013) *International Journal of Industrial Organization* *U.S.*	Experiment and Empirical Model (supermarket transaction data)	Food purchase	Weekly store-level scanner data of five treatment stores and 27 control stores	For four weeks, five stores of a supermarket chain in the U.S. placed one out of five types of shelf-labels in popcorn products: low calorie, low fat label, low fat with FDA approval, low calorie and low fat label, or low calorie, low fat, and low trans-fat label. Results show that low calorie label increases sales, while low fat label decreases sales. Low trans-fat label also increased sales. Combined claims in one label do not have a significant effect on sales.	- Increase on sales for low calorie label - Reduction on sales for low fat label
Melo et al. (2019) *Economics & Human Biology* *U.S.*	Empirical Model (sales data) and survey	Food purchase	Household scanner data: n=883; survey: n=665	The analysis of household scanner data from a grocery store that adopted shelf-labels (NuVal) showed that shelf-labels influenced the likelihood of purchasing healthier products. The impact of shelf-labels varied depending on household profile and product category. Results of a survey (n=665) with shoppers of stores that adopt NuVal showed that awareness of shelf-labels was average (44%), but understanding was low (35%). Only 20% of respondents reported having been influenced by shelf-labels during shopping.	Increase in likelihood of purchasing healthy foods
Nikolova & Inman (2015) *Journal of Marketing Research (JMR)* *U.S.*	Empirical Model (panel data) and experiment	Food purchase	Supermarket transaction data from n=535,000 shoppers at a major supermarket chain	The data analysis of weekly purchases of 535,000 shoppers at a major supermarket chain in the U.S. revealed that exposure to the shelf-label NuVal for six months leads to a small increase in the nutritional quality of products purchased. The nutritional quality of purchases in eight product categories (frozen pizza, tomato products, soup, salad dressing, yogurt, spaghetti sauce, granola bars, and ice cream) was improved by 21.8% on average. This improvement is stronger for healthier product categories. Shelf-labels also diminishes sensitivity towards price and promotion.	Increase on purchase of healthier foods
Rahkovsky et al. (2013) *Food Policy* *U.S.*	Empirical Model (sales data)	Food purchase	Data from 134 intervention and 134 control grocery stores.	The analysis of sales data from 134 stores displaying shelf-labels (Guiding Stars) and of 134 control stores (with no labels) in the U.S. revealed that purchases of ready-to-eat cereal were influenced by the presence of shelf-labels. The presence of shelf-labels caused a switch to healthier cereals while holding price and non-price variables constant.	- Increase in purchase of healthy breakfast cereal. - Decrease in purchase of unhealthy breakfast cereal.

Sutherland et al. (2010) *The American Journal of Clinical Nutrition* *U.S.*	Empirical Model (sales data)	Food purchase	Transaction data from 168 grocery stores before and after the implementation of Guiding Stars	An analysis of transaction data from 168 grocery stores in the U.S. before and after the introduction of Guiding Stars Shelf-labels, showed that the implementation of Guiding Stars increased the proportion of healthy products purchased significantly and steadily over two years by 1.39%. Increases were most important for 1-star products, but also significant for 2-stars and 3-stars products.	Increase in sales of healthy products
Zhen & Zheng (2020) *Applied Economic Perspectives & Policy* *U.S.*	Empirical Model (sales data)	Food purchase	Data on 130 yogurt products sold in six grocery stores	This study presents a comparative analysis of retail scanner data for yogurt of one store that introduced NuVal shelf-labels in comparison to five stores that did not implement shelf labels. Results showed that exposure to shelf-labels for four months increased sales for both healthier and less healthy products due to a salience effect. The authors believe that the display of NuVal shelf labels increased products' salience in general and that this effect explains the improvement in sales for both healthy and unhealthy foods.	Increase in sales of healthy and unhealthy foods

Two types of shelf labels implemented in the U.S. received substantial attention from past work: Guiding Stars and NuVal. The Guiding Stars are a four-point system introduced in the U.S. in 2006 and also used in Canada, while the NuVal is a 1-100 numeric system introduced in 2008, but abandoned in 2017. Five articles in this literature review assess the effects of Guiding Stars, while four articles discuss effects of the NuVal system.

6.1 Shelf label articles focusing on the Guiding Stars' shelf labelling system

The Guiding Stars are an in-store food rating system that aims to make food choices simple. Guiding stars represent a summary indicator displayed in shelf labels that uses a metric from zero to three stars to communicate the nutritional quality of food products. More stars signify healthier products. This system is consistent with label design advice from the U.S. National Academies, except that products with a zero-star rating have no label and are thus equal to non-rated products (Bollinger et al., 2021). We discuss five articles on the Guiding Stars' shelf labels in chronological order of publication.

An analysis of transaction data from 168 grocery stores in the USA before and after the introduction of Guiding Stars Shelf-labels, showed that the implementation of Guiding Stars increased the proportion of healthy products purchased significantly steadily and over two years by 1.39%. Increases were most important for 1-star products, but also significant for 2-stars and 3-stars products (Sutherland et al., 2010).

Another article looked into the effects of Guiding Stars for one specific product category: breakfast cereal. The analysis of sales data from 134 stores displaying shelf-labels (Guiding Stars) and of 134 control stores (with no labels) in the U.S. revealed that purchases of the breakfast cereals product category were influenced by the presence of shelf-labels. The presence of shelf-labels caused a switch to healthier cereals while holding price and non-price variables constant (Rahkovsky et al., 2013). Results suggest that the increase of sales of more nutritious cereals was higher for high-income individuals but lower for Black or Hispanic population.

Finally, a study looked into the effects of Guiding Stars in the U.S. with a larger sample, involving multiple product categories and grocery stores. The analysis of sales data from 168 supermarkets in the U.S. showed that the introduction of shelf-labels (Guiding Stars) diminished sales of less healthy products by 8.3%, mainly for canned meat and fish, soda pop, bakery products, and canned vegetables. All product categories were analyzed but the aforementioned ones experienced the greatest decrease in sales after introduction of the Guiding Stars System. Sales of healthy food did not change (Cawley et al., 2014).

Two articles investigated the effects of Guiding Stars in Canada. The analysis of transaction data of four supermarkets in Canada showed that the display of shelf-labels (Guiding Stars) for six months caused small increases in both the nutritional quality (+1.4%, assessed by the mean star rating per product purchased) and the mean revenue (+4.2%) in intervention supermarkets, compared to control supermarkets without shelf-labels (Hobin et al., 2017). Products purchased had less trans-fat (-3.5%) and sugar (-1.5%), as well as more fiber (+0.6%) and omega-3 fatty acids (+4.5%). There were no differences in calorie content, sodium, fat, saturated fat, or protein per product purchased, indicating that the Guiding Stars improved some but not all

nutritional quality indicators. The authors also conducted exit surveys (n=783) in supermarkets displaying and not displaying Guiding Stars. Results showed that levels of awareness, understanding, and trust of shelf-labels were small. Only 9.7% of shoppers in the intervention supermarkets noticed the shelf-labels after six months, and 2% reported using it (Hobin et al., 2017). Younger shoppers (25-44 years) were more aware of shelf-labels and reported using them more often. A potential implication of these findings is that shelf labels influence consumers' behavior outside of awareness. The discrepancy between the effects on purchase behavior and the low levels of shelf-labels' awareness among consumers suggests that this type of means of providing food information does not require deliberate processing of information to influence behavior. Another interesting finding in this article is that the display of Guiding Stars' shelf labels increased the mean revenue in intervention supermarkets suggesting that consumers were willing to pay more for healthy products.

Recently, another analysis of transaction data of a grocery retailer in Canada was used to investigate if the effect of the Guiding Stars' system could be improved by a national promotion campaign (Bollinger et al., 2021). Results revealed a small increase in the purchase of healthier foods during a national campaign to promote the use of shelf-labels using stars to indicate healthier options. This increase was driven by agricultural products' purchases, and 60% of the effect disappears after the campaign's conclusion. The campaign increased purchase of unhealthier items in the dairy, meat, and dessert categories. Bollinger and colleagues (2021) also conducted a cross-sectional survey before (n=883) and after (n=836) the campaign. Results showed an increase in awareness and understanding of the Guiding Stars program, but no effect of self-reported use of shelf-labels. Importantly, younger consumers (aged 25–44 years) were more likely to report understanding the Guiding Stars system compared with those aged 45–64 years and those who reported using the Nutrition Facts panel.

The five articles assessing the effects of the Guiding Stars' system show improvements in the healthiness of purchases made after the display of the shelf labels. The display of the Guiding stars improved sales of healthy products when looking into all food categories (Hobin et al., 2017; Sutherland et al., 2010) or into specific ones (i.e., cereal; Rahkovsky et al., 2013). Importantly, the display of Guiding Stars also improved revenue in one study, suggesting that consumers chose more expensive products when shelf labels were displayed (Hobin et al., 2017). One article did not find an increase in sales of healthy foods when shelf labels were displayed, but it showed a reduction in sales of unhealthy food products, suggesting an overall improvement in nutritional quality (Cawley et al., 2014). Finally, a national campaign promoting the Guiding Stars' system improved healthy food purchases, although the campaign's effects were short lived and disappeared once the promotional campaign was over (Bollinger et al., 2021). Taken together, these results suggest Guiding Stars' shelf labels have a small, positive influence on consumers' behavior improving overall healthiness of purchases made.

6.2 Shelf label articles focusing on the NuVal Shelf labelling system

The next four papers report the effects of the NuVal Shelf labelling system. The NuVal shelf labeling system classifies healthier and less healthy products on a scale from one (least healthy) to 100 (healthiest). The system uses a particular algorithm, the Overall Nutritional Quality Index (ONQI) that takes into account 21 nutrients and the quality of four nutrition factors (Katz et al., 2009). The higher the NuVal score, the healthier the food.

The data analysis of weekly purchases of 535,000 shoppers at a major supermarket chain in the U.S. revealed that exposure to the shelf-label NuVal for six months leads to a small increase in the nutritional quality of products purchased (Nikolova & Inman, 2015). The nutritional quality of purchases in eight product categories was improved (frozen pizza, tomato products, soup, salad dressing, yogurt, spaghetti sauce, granola bars, and ice cream) by 21.8% on average. This improvement was stronger for healthier product categories. Shelf-labels also diminished consumers' sensitivity towards price and promotion (Nikolova & Inman, 2015).

The analysis of sales data for yogurt in regional grocery stores in the U.S. implementing shelf-labels (NuVal) suggested that a 1-point increase in the NuVal score is associated with a 0.49% increase in sales (Finkelstein et al., 2018). A survey with 655 shoppers in grocery stores implementing the shelf-labels showed that 44% of them were aware of shelf-labels, 32% understood the labels, 15% said labels influenced the foods they buy, and 8% said labels influenced their purchases of dairy products (Finkelstein et al., 2018).

The analysis of household purchase data from a grocery store that adopted the NuVal system showed that shelf-labels influenced the likelihood of purchasing healthier products. Results of a survey (n=665) with shoppers of stores that adopted NuVal showed that awareness of shelf-labels was 44%, but understanding was low (35%). Only 20% of respondents reported having been influenced by shelf-labels during shopping (Melo et al., 2019). The impact of shelf-labels varied depending on household profile and product category. For low-income households and families with children, the shelf-labels improved the quality of yogurt choices in comparison to high-income households and those without children. Nutritional quality of purchases of yogurt and frozen dinner product categories improved, but there was weak evidence of improvement for cold cereal and canned choices.

The analysis of retail scanner data for yogurt in six grocery stores in the U.S., one of them adopting shelf-labels (NuVal), showed that exposure to shelf-labels for four months increased sales for both healthier and less healthy products due to a salience effect (Zhen & Zheng, 2020). The authors believe that the display of NuVal shelf labels increased products' salience in general, independently of the level of the score, and that this effect explains the improvement in sales for both healthy and unhealthy foods.

The articles about NuVal shelf labels suggest significant effects on purchases, mainly for healthier product categories but also for less healthy products due to a salience effect. Because the display of NuVal shelf-labels increase attention towards the product, it improves sales regardless of products' quality (Zhen & Zheng, 2020). Importantly, label understanding is low, indicating that there is room for further communication about the system. Also, low understanding of labels and the existence of behavioral effects aligned with this policy (improvement in healthiness of purchases) suggest that shelf labels such as NuVal may be operating outside of consumers' awareness.

6.3 Shelf label articles studying other systems

Seven other studies tested diverse formats of shelf labels. The shelf labels studied displayed product features, such as: highlighted nutritional information, identification of healthy foods, inexpensive healthy foods, low calorie/low fat foods, organic foods, as well as nutrition and sustainable information.

A quasi-experimental study in an on-campus convenience store in the U.S. showed that labelling healthy foods (soup, cereal, cracker, and bread) with a shelf-label for five weeks, while providing brochures and posters explaining the labels in the store, did not change sales of tagged items in comparison to the baseline (6-week period where products did not have a shelf-label) (Freedman & Connors, 2010). There was however, an increase in the percentage of total sales for the product categories of cereal, soup, and crackers, but a decrease for the bread category.

A longer and more developed intervention study in France also found mixed results (Gamburzew et al., 2016). For six months, grocery stores in disadvantaged neighborhoods in France displayed shelf-labels and posters signaling healthy, inexpensive foods and also implemented in-store taste tests. The analysis of sales data (n=6,625) shows that the contribution of inexpensive foods with good nutritional quality to customers' total spending on food did not change due to the intervention. All product categories were analyzed, but there was an increase in purchases for only two product categories (fruits and vegetables and starches) in the intervention stores in comparison to control stores. Two surveys (n=259; n=116) revealed that 31% of consumers were aware of the intervention and 60% considered it useful (Gamburzew et al., 2016). The in-depth survey results show that intervention awareness was higher among shoppers who visit the store frequently. No significant differences were observed for other individual characteristics. In this case, the intervention had a high level of awareness but did not influence purchases in general.

Another article tested the effects of shelf labels for one product category (popcorn). For four weeks, five stores of a supermarket chain in the U.S. placed one out of five types of shelf-labels in popcorn products: 1) low calorie, 2) low fat, 3) low fat with FDA approval, 4) low calorie and low fat, or 5) low calorie, low fat, and low trans-fat label (Kiesel & Villas-Boas, 2013). Results show that a low calorie label increases sales, while low fat label decreases sales. The low trans-fat label also increased sales. Combined claims (e.g., low fat AND low calorie) in one label do not have significant effects on sales probably due to increases in information costs for consumers.

A natural experiment in a hypermarket in Sweden investigated the effect of displaying organic shelf-labels on three product categories. Results show increased sales for two of the organic products: olive oil (43%) and coffee (48%). Sales of organic flour, on the other hand, decreased by 29%. Choices of the targeted products became less price-sensitive (Daunfeldt & Rudholm, 2014). The different effect of organic shelf-labels for

flour in comparison to olive oil and coffee could be related to the hedonic-utilitarian aspect of the products. The authors highlight that flour is more utilitarian than coffee and olive oil, and therefore consumers may perceive smaller quality differences among organic and non-organic products. Future research is needed to further understand how organic shelf-labels influence different product categories.

A discrete choice experiment in three countries (Germany, U.K., and U.S.) tested the effect of visual shelf-labels simulations for wine and yogurt (Ghvanidze et al., 2017). For yogurt, price and nutritional information had more influence on consumers' choices than information about social responsibility of producers. For wine, nutritional information had more influence on consumers' choice in the U.S. and Germany, but not in the U.K. Specifically, for American and German consumers, wine nutritional information (lower alcohol content and less carbohydrates) had a positive value, while for British respondents the same information had a negative value. The authors suggest that U.K. respondents value higher alcohol content in wine. Ecological and social responsibility attributes are valued more by consumers who are highly environmentally conscious or concerned about goods' production. The presence of information about the ecological impact of production on nature, on the other hand, was valued positively in the U.K. and the U.S. market, but not in Germany which was an unexpected finding. Information about social responsibility of wine producers had a positive effect only in the U.S.

Two experiments using an experimental methodology and following similar procedures show that shelf labels with highlighted nutrition information have a positive effect on preference, compared to shelf labels that do not highlight nutrition information (Berning et al., 2010; Berning & Sprott, 2011). First, an experiment with 1,200 shoppers in the U.S. showed that, exposure to a hypothetical shopping list with pictures of products (salad dressing, mayonnaise, microwave popcorn, and peanut butter) and shelf-labels presenting prominent (highlighted) nutrition information, increases attention to the label and healthy choices in comparison to non-highlighted nutrition information or no information (Berning et al., 2010). This study also found individual differences explaining reactions to shelf-labels. Older, nutritionally conscious, and label-conscious shoppers gave more attention to highlighted nutrition information on shelf labels, while price-conscious shoppers gave less attention. The effect of highlighted nutrition information on healthy choices was stronger for shoppers with a high nutrition label consciousness score.

The second article using an experiment involved 403 grocery shoppers in the U.S. and compared shelf-labels for tomato soup that contained either highlighted nutritional information with price information highlighted, highlighted nutritional information with price non-highlighted, or non-highlighted nutritional information and non-highlighted price (Berning & Sprott, 2011). Results first show that there were no effects of the non-highlighted nutritional information. Consumers who perform a greater percentage of household shopping prefer shelf-labels with highlighted nutrition information. Similarly to the previous study, nutrition-conscious consumers prefer the high-prominence nutrition labels. There were no other individual differences.

6.4 Overview of main results on shelf labels

Table 19 presents the main results of the 16 articles investigating shelf labels. Regarding the use of shelf labels by consumers (Research Question 1) and their attitudes towards these labels (Research Question 2), there are only seven articles that assessed any of these variables. Interestingly, four articles documenting the effect of shelf labels on purchase behavior (increase in healthy products' purchases or decrease in unhealthy products purchases) showed no or low effects on self-reported use. This finding is interesting because shelf labels seem to influence behavior even when consumers do not report using them. It is therefore possible that the impact of shelf-labels on behavior operates outside of consumers' awareness. Three other articles showed positive effects of shelf labels on attention and favorable attitudes towards the labels. ***The overview of articles on shelf labels provides limited evidence on whether consumers use or want shelf labels providing food information. Four articles show low self-reported use of shelf-labels while three articles report positive attitudes towards the labels. One possible explanation for this contradictory effect relates to time or attentional constraints: because consumers are exposed to shelf labels in the marketplace where often they lack time and cognitive resources, they may be unable to use this information, even if they are interested on it.***

The literature on shelf labels focuses mainly on behavioral outcomes, measuring food purchases through grocery stores' sales data using empirical models. This literature analyses an important amount of data allowing the detection of effects that are, sometimes, very small. It, therefore, provides important information regarding the third question addressed in this report: ***how food information delivered through menu labels influences behavioral outcomes including attitudes towards food, food purchase intentions, and behavior. Overall, the majority of the articles (n=15) showed small but significant effects of***

shelf-labels on food purchase, with either an increase of healthy food purchases and/or a decrease of unhealthy food purchases. It is noteworthy, however, that one study also documented an increase in sales of unhealthy food items after shelf-labels display, probably due to enhanced products' salience (Zhen & Zheng, 2020). The main discrepancy across studies concerns whether these effects are due to an increase in the purchase of healthy foods (9 articles) or a decrease in purchase of unhealthy foods (2 articles). Findings are mixed regarding this point. Further research is definitely needed to understand the mechanism explaining why shelf labels differently affect healthy and unhealthy products' purchases.

Table 19. Summary of main results for shelf labels

	Food category/Mean	RQ1: availability of food information	RQ1&2: What means of food information apart from labels do consumers use and want?				RQ3: How does food information delivered through means other than food labels influence behavioral outcomes?					
			Effects on online means or information-related outcomes				Effects on food-related outcomes					
Authors (year) *Journal*		**Availability**	**Awareness of information/mean**	**Use of information delivered through the mean**	**Attitudes toward the mean/information**	**Intention to use online mean/information**	**Food knowledge**	**Attitudes towards food & perceived self-efficacy**	**Attitudes towards food provider (retailer/restaurant)**	**Food purchase intention**	**Behavior: food purchase or choice**	**Body weight**
Guiding Stars' shelf labels												
Bollinger et al. (2021) *Journal of Marketing Research (JMR*	Guiding Stars Groceries		Increase in awareness	No effect on self-reported use							Small increase in purchase of healthier foods Increase on purchase of unhealthier items (dairy, meat and dessert)	
Cawley et al. (2014) *Public Health Nutrition*	Guiding Stars Groceries										Decrease in sales of unhealthy products; No change in sales of healthy products	
Hobin et al. (2017) *The Milbank Quarterly*	Guiding Stars		Low	Low							Increase in sales of healthy products	
Rahkovsky et al. (2013) *Food Policy*	Guiding Stars Breakfast cereal										Increase in sales of healthy cereal Decrease in sales of unhealthy cereal	

Sutherland et al. (2010) *The American Journal of Clinical Nutrition*	Guiding Stars All groceries										Increase in sales of healthy products	
NuVal Shelf Labels												
Finkelstein et al. (2018) *American Journal of Clinical Nutrition*	NuVal Yogurt product category		Average (44% noticed labels)	Low (15% declare to use it when shopping)							Increase in sales of healthy yogurt	
Melo et al. (2019) *Economics & Human Biology*	NuVal 4 product categories		Average (44% noticed labels)	Low (20% declare it influenced purchases)							Increase in likelihood of purchasing healthy products	
Nikolova & Inman (2015) *Journal of Marketing Research (JMR)*	NuVal All groceries										Increase in sales of healthy products	
Zhen & Zheng (2020) *Applied Economic Perspectives & Policy*	NuVal Yogurt product category										Increase in sales of healthy and unhealthy products	
Other Shelf Labels												
Berning et al. (2010) *Journal of Food Distribution Research*	Highlighted NI on shelf labels for different products				Positive effect on attention to labels						Increase in choice of healthy products	
Berning & Sprott (2011) *Food policy*	Highlighted NI on shelf labels for tomato soup				Positive effect on preference for labels							
Daunfeldt & Rudholm (2014) *Journal of Retailing and Consumer Services*	Organic shelf labels for 3 product categories										Organic shelf-label increased sales of olive oil and coffee and decreased sales of flour	

Freedman & Connors (2010) *Journal of the American Dietetic Association*	Healthy shelf labels										No effect on sales of healthy foods	
Gamburzew et al. (2016) *International Journal of Behavioral Nutrition and Physical Activity*	Labels for healthy, inexpensive products		Average-low (31% noticed labels)		Positive (useful)		Increase in nutrition knowledge				No effect on total sales of healthy, unexpensive food Increase in purchases of fruits & vegetables and starches	
Ghvanidze et al. (2017) *British Food Journal*	NI on shelf labels										NI shelf labels increased choice of yogurt and wine (in U.S. and Germany) NI shelf labels did not influence wine choice in the U.K.	
Kiesel & Villas-Boas (2013) *International Journal of Industrial Organization*	Low calorie, Low fat labels for popcorn										Low calorie shelf labels increased popcorn sales Low fat decreased sales	

7. Other means

Five articles about other means than the ones discussed in the previous sections were also included in this literature review. Three articles concerned point-of-sale (POS) signs in grocery stores, while the two other articles were about a magazine article with food safety information and a comparison of in-store events versus brochures aimed at promoting fruit and vegetable consumption. Point-of-sales signage refers to posters or banners placed inside grocery stores to provide food information to consumers. They are similar to shelf-labels because they provide information directly in the marketplace, but they are more salient because they are often displayed in large, highly visual supports that cover not only one product, but sometimes a product category (e.g., sugary drinks; Donnelly et al., 2018).

Point-of-sales signs that display graphic warnings to reduce sugary drinks consumption seem to effectively change consumers' behavior, reducing purchases and also purchase intentions of sugary drinks (Donnelly et al., 2018; Scully et al., 2020). A field study conducted in a hospital cafeteria in Massachusetts (U.S.) over 14 weeks compared four types of point-of-sale (POS) signs: text warning, graphic warning, calorie, and no sign (Donnelly et al., 2018). The calorie condition presented calorie content and an indication of the general nutrition advice of daily calorie intake suggested by the U.S. Food & Drug Administration. The text warning was: "WARNING: Drinking beverages with added sugar(s) contributes to obesity, diabetes, and tooth decay." The graphic warning included the same text and one image portraying obesity, diabetes, and tooth decay. All bottled sugary drink were grouped in the cooler and a sign (20 cm X 7.6 cm) was displayed on the cooler shelves immediately below the sugary drinks. Signs were also placed on fountain drinks dispensers. The display of graphic warning POS signs reduced the purchases of sugary drinks from 21.4% to 18.2%, due to substitution of water for sugary drinks. This same article also reports an online study during which 200 participants, recruited through the Amazon Mechanical Turk panel, were asked to imagine they were in a cafeteria, had to decide what to drink, and reported the brand of soda they normally chose. They were then randomly exposed to a screen either presenting the chosen brand logo with no sign (control) or with one of the four types of signs used in the previous study. Results revealed that the graphic warning led to higher purchase intentions for water in comparison to sugary drinks (Donnelly et al., 2018). These results were mediated by experience of negative affect that enhanced health consideration: warning labels increased negative affect, which increases health consideration, reducing sugary drink choice. It is noteworthy that the signs used in this study are very close to packaging labels because they are visually accessible in front of the products and very salient in the marketplace. The difference is that they are not displayed on a product individually (as packaging labels) or on a product price tag (as shelf labels), but they refer to the product category of sugary beverages in general.

One experiment conducted online in Australia (n=3,034) also investigated how different types of POS signs influence choice of sugary beverages. This study tested five signage conditions: no signage (control), sugar content per beverage, Health Star Rating per beverage, health warning about sugary drinks, and graphic health warning about sugary drinks (Scully et al., 2020). Participants received this information while visualizing different options of non-alcoholic drinks and were then hypothetically asked to choose one drink. Results show that exposure to three of the four types of signage tested (sugar content, Health Star Rating, and graphic health warning) diminished the choice of a sugary beverage in comparison to the control. Similarly to the work of Donnelly and colleagues (2018), this study uses POS signs that may look similar to packaging labels. The difference with packaging labels, however, is that in this case the health warning signs used did not target any particular beverage, but the sugary drinks product category in general.

Finally, another article explores the effects of POS signs on the consumption of low-fat cheese. An experiment conducted in a Dutch grocery store (n=127) investigated the effect of a shelf banner (vs. no banner) promoting low-fat cheese consumption using a social proof (''Most sold in this supermarket'') on purchases among depleted (through a speech control task) and non-depleted consumers (Salmon et al., 2015). It is noteworthy that, although the shelf banners were used to promote a low fat product, they did not mention this specific attribute of the product. Results show that only participants who were depleted and thus had low self-control bought more low-fat cheese in the presence of the banner. The banner did not influence non-depleted consumers.

Taken together, articles on POS signage in grocery stores provide initial evidence that graphic health warning signs can reduce sugary drink consumption. One study also provides indication that POS signs can be used to promote healthy products: a social proof sign increased choice of low-fat cheese products when situational self-control is low, a situation that consumers may face when grocery shopping.

A pre-test/post-test controlled design survey with 17 grocery stores in Canada (baseline: n=688 shoppers; 3-month follow-up questionnaire: n=201 shoppers) showed that in-store events were more effective than the distribution of brochures to increase consumers' fruit and vegetable (FV) knowledge. Grocery stores either hold an event promoting FV consumption (n=11 stores) or distributed brochures promoting FV consumption (n=6 stores). Surveys were conducted at baseline and three months later. The events involved public health staff, a display, resources, and food samples. The control stores only distributed brochures. Results show that the events increased immediate knowledge of recommendations of fruit and vegetable serving size and of number of servings measured at baseline. There were, however, no differences in food knowledge between the two groups (event and brochure) three months later (Colapinto & Malaviarachchi, 2009).

An experiment conducted in an experimental laboratory with 110 participants in the U.S. investigated consumers' reactions to food safety information (Dillaway et al., 2011). Participants were randomly exposed to either no information (control) or to a media-based magazine article about a food safety issue concerning leading brands of chicken (contamination of harmful bacteria) and saying that another brand was not affected. The experiment used a modified version of the sealed-bid English auction mechanism to elicit willingness to pay estimates that are incentive-compatible. Results show that participants exposed to the food safety information had lower willingness-to-pay (WTP) for the brands concerned with food safety issues and higher WTP for the brand that was not affected.

Table 20. Summary of articles on other means.

Authors (year) *Journal* ***Country***	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Key take-away**
Articles on POS signs.					
Donnelly et al. (2018) *Psychological Science* *U.S.*	Field and online experiment	Purchase of sugary drinks and intentions	Study 2: n=200	A field study conducted in a hospital cafeteria in Massachusetts (U.S.) over 14 weeks compared four types of point-of-sale (POS) labels: text warning labels, graphic warning labels, calorie labels, and no label (Donnelly et al., 2018). The display of POS signs with graphic warning reduced the purchases of sugary drinks from 21.4% to 18.2%, due to substitution of water for sugary drinks. This same article also reports an online study during which 200 participants recruited through Amazon Mechanical Turk were asked to imagine they were in a cafeteria, had to decide what to drink, and reported the brand of soda they normally chose. They were then randomly exposed to a screen either presenting the chosen brand logo with no label (control) or with one of the four types of labels used in the previous study. Results revealed that the graphic warning lead to higher purchase intentions for water in comparison to no water. These results were mediated by experienced negative affect that enhanced health consideration.	Graphic warning POS signs diminished consumption and intentions to consume sugary drinks due to enhanced health consideration
Salmon et al. (2015) *Food Quality and Preference* *Netherlands*	Experiment	Purchase of cheese in a grocery store	n=127	An experiment conducted in a Dutch grocery store (n=127) investigated the effect of a shelf banner (vs. no banner) promoting low-fat cheese consumption using a social proof ("Most sold in this supermarket") on purchases among depleted (through a speech control task) and non-depleted consumers. Results show that only participants who were depleted and thus had low self-control bought more low-fat cheese in the presence of the banner. The banner did not influence non-depleted	Banner using social proof increased low-fat cheese purchases only among depleted consumers

				consumers.	
Scully et al. (2020) *Appetite* *Australia*	Experiment	Drink choice, healthiness perceptions for non-alcoholic drinks, and attitudes towards the messages	n=3,034	One experiment conducted online in Australia (n=3,034) tested five signage conditions: no signage (control), sugar content per beverage, Health Star Rating per beverage, health warning about sugary drinks, and graphic health warning about sugary drinks. Participants received this information while visualizing different options of non-alcoholic drinks and were then asked to choose one drink. Results show that exposure to three of the four types of signage tested (sugar content, Health Star Rating, and graphic health warning) diminished the choice of a sugary beverage in comparison to control.	Exposure to POS signs displaying sugar content, Health Star Rating, or graphic health warning diminished sugary drinks' choice
Articles about other means					
Colapinto & Malaviarachchi (2009) *Canadian Journal of Dietetic Practice and Research* *Canada*	Pretest-Posttest controlled design	NI Knowledge	Baseline: n=688; Three-month follow up: n=201	A pre-test/post-test controlled design survey with grocery shoppers in Canada showed that in-store events were more effective than the distribution of brochures to promote fruit and vegetable (FV) consumption. Events increased immediate knowledge of recommendations of FV serving size and number of servings, but there were no differences between event and brochure three months later.	- Events increased food knowledge immediately - No effects three months later
Dillaway et al. (2011) *Applied Economic Perspectives & Policy* *U.S.*	Experiment	WTP for safe food	n=110	An experiment with 110 participants in the U.S. investigated consumers' reactions to food safety information. Participants were randomly exposed either to no information (control) or to a magazine article about a food safety issue concerning leading brands of chicken (contamination of harmful bacteria) and saying that another brand was not affected. Participants exposed to the food safety information had lower willingness-to-pay (WTP) for the brands concerned with safety issues and higher WTP for the brand that was not.	Negative food safety information in a magazine article reduced WTP for safety-concerned chicken brands.

8. Accessibility of food information to visually impaired individuals

According to the European Blind Union, there are approximately 30 million visually impaired individuals in Europe. Past work suggests that visually impaired individuals suffer from a lack of social support (Bruce et al., 2007) and they have important difficulties when accessing the marketplace (Kaufman-Scarborough & Childers, 2009). Shopping is mentioned as one of the most stressful activities for visually impaired individuals (Matsunaka et al., 2002). This literature review aims to understand how to improve the accessibility of food information and render it more available to specific subpopulations, such as visually impaired individuals. It was therefore important to understand how visually impaired individuals access the marketplace in general and, specifically, how they access (or do not access) food information while shopping. The search strategy implemented yielded seven articles focusing on visually impaired consumers (Table 20).

Table 20. Summary of articles on visually impaired consumers included in the literature review.

Authors (year) *Journal* *Country*	**Methodology**	**Main outcomes**	**Sample size**	**Main results**	**Main take-away**
Balabanis et al. (2012) *The Journal of Consumer Affairs* *U.K.*	Survey	Characteristics associated with marketplace engagement	n=675	A survey with a nationally representative sample of visually impaired individuals in the U.K. (n=675) explored coping strategies for shopping and marketplace engagement. Findings reveal that engagement in shopping activities for the visually impaired is stronger for those who have social support. Visually impaired consumers that have children in their households also engage more in shopping activities.	Social support and presence of children is positively associated with shopping
Childers & Kaufman-Scarborough (2009) *Journal of Business Research* *U.S.*	Survey	Use and reasons for online shopping	n=1,053 (n=291 disabled and n=756 non-disabled)	A survey with 291 disabled and 756 non-disabled consumers in the U.S. examined online retail shopping experiences. While other disabled consumers are less likely to have used online shopping than non-disabled, visually impaired (n=77) individuals use online shopping as much as non-disabled people (69% of visually impaired respondents purchase online). Their main reasons for purchasing online are convenience (48%) and cheaper prices (41%). The article also mentioned that sometimes screen readers assisting the visually impaired cannot describe images or graphics that lack "alt tags" (text-based descriptions of pictures). Tools to translate visual information into alternative modalities, such as audio, are normally used by visually impaired individuals when navigating in online stores.	- High use of online shopping - Benefits of online shopping include convenience and cheap prices
Dias de Faria et al. (2012) *International Journal of Contemporary Hospitality Management* *Brazil*	Survey and Qualitative Research	Preference for restaurants' attributes	Survey: n=203; Focus groups: n=21	A survey (n=203) and a focus group (n=21) with visually impaired consumers were conducted in Brazil to identify the most important service attributes of restaurants. Focus groups' results suggest that menu information should be provided either in Braille, or with an audio system, or should be read aloud by the server. These elements, among others, were tested in the survey using conjoint analysis. Results mainly emphasized the importance of service and of design elements in the restaurant, such as having low lighting and sound, round and not rectangular tables. Customer service should be provided by empathetic servers that could be called using a button. Menu features (Braille, with audio or read by the server) were considered less important. Respondents preferred to have the menu read by the server in comparison to having a menu in Braille or with audio.	Preference for menu information in Braille or read aloud by the server
Kaufman-Scarborough & Childers (2009) *Journal of Public Policy &*	Qualitative research	Benefits and barriers of online shopping	n=45	A qualitative study with 45 visually impaired online shoppers in the U.S. revealed that commercial websites are seen as public spaces where they can shop, find product information and make purchases. Shopping	Benefits of online shopping include independence

Marketing *U.S.*				online allows visually impaired consumers to feel independent, being able to do things by themselves and avoiding contact with insensitive employees. Online shopping allowed the visually impaired to have access to the marketplace for making individual choices, without the help of others. There are however issues related to poor website design and lack of information. This study did not focus specifically on food shopping.	and access to the marketplace
Kostyra et al (2017) *Appetite* *Poland*	Survey	Attitudes and interest for online grocery shopping	n=250	A survey with 250 blind and visually impaired subjects in Poland showed high use of online grocery shopping among this group. Access to Internet shopping is perceived as a way to gain independence while shopping, whereas in-store scanners were considered less important. There is high interest in having product information in Braille. Information provision and product labelling in Braille was mentioned as a way of supporting independent food shopping. Visually impaired consumers consider electronic readers of labels to be a useful device for accessing information on food products.	- High use of online grocery shopping -Independence is perceived as a benefits of online shopping - High preference for product information in Braille
Nicholson et al (2009) *The Open Rehabilitation Journal* *U.S.*	Survey	Test of a system to help grocery shopping	n=11	This article tests a wearable system designed to assist visually impaired shoppers in grocery stores (ShopTalk). It includes an off-the-shelf barcode scanner. The system was tested by 11 participants in a real grocery store and resulted in 100% retrieval of products after one hour of training. Participants tried the wearable system five times, and time to find the products in the score decreased through runs. Participants proposed as main points for improvement the fact that the system cannot be accessed through a smartphone and that it limited participants to only shopping for products in aisles with shelves.	Positive returns for the test of an audio-based barcode scanner system
Sahingoz (2012) *British Journal of Humanities and Social Sciences* *Turkey*	Survey	Issues when food shopping, Food information needs	n=500	A survey with 500 visually impaired consumers in Turkey explored problems encountered when shopping for food. 71.4% of respondents go shopping for food, but most of them do it accompanied by other people (63.2%). Main problems when food shopping involved stores' physical design and access, but also service issues. It is noteworthy that problems related to the availability of food information were also mentioned: 54.4% of respondents mentioned the absence of the Braille alphabet on labels or scanners while 45% pointed out the lack of arrangements in food packaging for visually disabled. Regardless of educational level visually impaired respondents are interested in information about ingredients, storage conditions, and nutritional quality. The importance of nutritional information was higher for younger consumers (under 40 years old).	Main issues when food shopping: physical access, service, and lack of food information

Three papers describe how visually impaired individuals navigate through shopping experiences in general, while four articles focus specifically on food shopping experiences. It was considered important to include papers on shopping experiences in general because several elements may also apply to situations involving the purchase of food.

A survey with a nationally representative sample of visually impaired individuals in the U.K. (n=675) explored coping strategies for shopping and marketplace engagement (Balabanis et al., 2012). Engagement in shopping activities for the visually impaired is stronger for those who have social support from family members or friends. Visually impaired consumers that have children in their households also engage more in shopping activities. Online shopping seems to be an interesting option to compensate for this need for social support while shopping. The next two articles focused specifically on how disabled consumers and in particular, visually impaired consumers, use and perceive online shopping.

A survey with 291 disabled and 756 non-disabled consumers in the U.S. examined how disabled individuals navigate online retail shopping experiences (Childers & Kaufman-Scarborough, 2009). While disabled consumers are less likely to have used online shopping than non-disabled, the subset of visually impaired (n=77) individuals used online shopping as much as non-disabled people (69% of visually impaired respondents purchase online). Their main reasons for purchasing online were convenience (48%) and better or cheaper prices (41%). The same researchers conducted a qualitative study with 45 visually impaired online shoppers in the U.S. revealing that commercial websites are seen as public spaces where visually impaired people can search and find product information, and make purchases. Shopping online allows visually impaired consumers to feel independent, being able to do things by themselves, and avoiding contact with insensitive employees. Online shopping allowed the visually impaired to have access to the marketplace by making individual choices, without the help of others. There are however issues related to poor website design and lack of information (Kaufman-Scarborough & Childers, 2009).

The remaining four articles in this section relate to food shopping. A survey with 500 visually impaired consumers in Turkey explored problems encountered when shopping for food. 71.4% of respondents go shopping for food, but most of them do it accompanied by other people (63.2%), in line with the strong need for social support among visually impaired people documented by the work of Balabanis and colleagues (2012). Main problems in food-shopping involved stores' physical design and access, but also service issues. It is noteworthy that problems related to the availability of food information were also mentioned: 54.4% of respondents mentioned the absence of the Braille alphabet on labels or scanners, while 45% pointed out the lack of arrangements in food packaging for visually disabled. Visually impaired respondents are interested in information about ingredients, storage conditions, nutritional quality, regardless of educational level, while the importance of nutritional information was higher for younger consumers (under 40 years old)(Sahingoz, 2012).

A survey with 250 blind and visually impaired subjects in Poland (Kostyra et al., 2017) showed high use of online grocery shopping among this group, a finding aligned with the work of Childers and Kaufman-Scarborough (2009) cited above. Access to Internet shopping is perceived as a way to gain independence while shopping, but in-store scanners were considered less important. There is high interest in having product information in Braille. Information provision and product labelling in Braille was mentioned as a way of supporting independent food shopping. Visually impaired consumers consider electronic readers of labels to be a useful device for accessing information on food products (Kostyra et al., 2017).

Dia de Faria and colleagues (2012) focused on how visually impaired individuals experience restaurant visits. A survey (n=203) and a focus group (n=21) with visually impaired consumers in Brazil were conducted to identify the most important service attributes of restaurants. Focus groups' results suggest that menu information should be provided either in Braille, or with an audio system, or should be read aloud by the server. These elements, among others, were tested in the survey using conjoint analysis. Results mainly emphasized the importance of service and of design elements in the restaurant, such as having low lighting and sound, round and not rectangular tables. Customer service should be provided by empathetic servers that could be called using a button. Menu features (Braille, with audio or read by the server) were considered less important. Respondents preferred to have the menu read by the server in comparison to having a menu in Braille or with audio.

Finally, one article tested a wearable system (*ShopTalk*) designed to assist visually impaired shoppers in grocery stores. The system includes an off-the-shelf barcode scanner used to locate products on the shelves. The system was tested by 11 participants in a real grocery store and allowed participants to find 100% of the products in a shopping list after one hour of training. During the study, participants tried the wearable system five times (during each trial, they entered the store and purchased certain items from a list provided), and time to find the products in the store decreased through runs. Qualitative observations of participants revealed that the main points for improvement were the fact that the system cannot be accessed through a smartphone and that it limited participants to only shopping for products in aisles with shelves, but not for products displayed elsewhere in the supermarket (e.g., in fridges) (Nicholson et al., 2009).

Taken together, the literature focusing on visually impaired consumers show that their levels of internet use for shopping are generally equivalent to those of non-disabled individuals. They have, however, an important demand for adapted food-related information online. Online shopping seems to be a prevalent activity for visually impaired individuals and allows them to feel independent if access to product information is available. Results also show that visually impaired individuals have a hard time shopping in-store and that there is need to provide specific tools,

such as food information in Braille, to allow access to food information inside grocery stores and restaurants.

9. General Discussion

This literature review was designed to answer three main research questions regarding consumers' reactions to various alternative means of food information provision apart from information displayed on packaging labels, identifying: ***1) the type of means of food information provision apart from packaging labels that consumers use, 2) the type of means of food information provision apart from packaging labels that consumers want, and 3) the impact of different means of food information provision on consumers' attitudes and behaviors.*** By using a systematic approach and an inclusive strategy, a large number of articles (n=97) were included. These articles document a variety of means for providing food information to consumers using different methodologies. It is important to note that this review adopted an inclusive strategy responding to broad research questions, and articles were included independent of the quality of evidence and without formal assessment of risk of bias. The findings presented here should thus be interpreted with caution and attention should be paid to the quality assessment provided in the description of studies.

Use of information delivered through online means (RQ1) is low according to most of the articles studying this variable. However, when asked, consumers have positive attitudes towards online means of food information (RQ2), in particular when these are easy to use, useful, and do not present too much information. Also, consumers seem to trust online information provided by public policy websites as well as health and nutrition websites (GfK Belgium, 2014). It seems that processing fluency, or the easiness with which information is processed (Schwarz, 2004), is an important variable to take into account when studying online means of food information. For online means that provide access to food traceability information (e.g., blockchain), trust towards the information source (e.g., food provider) is also an important attribute. QR codes in the marketplace and website links on labels for alcohol products were not often used or appreciated by consumers, except for one study showing an increase in the use of QR codes when a scanning device was available. Even in this situation, only half of consumers were exposed to the food information in the marketplace when it was available through a QR code. The fact that online means such as QR codes or website links do not provide direct access to food information, as opposed to package labels or shelf labels and menu labels, may influence consumers' reactions. QR codes and website links require, presumably, effort to access food information, which may, in turn, lead to their reduced use (e.g., Li & Messer, 2019). In one study directly comparing online means to on-package label information for alcohol products, consumers preferred to have access to food information directly on the label (Vecchio et al., 2018). Some online means, notably mobile food applications, increase consumers' food knowledge, improving the identification of healthy food options or knowledge about specific food categories (Abao et al., 2018; Ahmed et al., 2020; Gauthier et al., 2021; Juan et al., 2019; Samoggia & Riedel, 2020).

Very few articles measured behavioral effects of online means (RQ3). The findings on the behavioral effects of online means are mixed. This can be due to considerable differences in design and heterogeneity in the online means and product categories studied. Thus, on the basis of the existing evidence included in the present review, it is difficult to draw a definite conclusion regarding the behavioral effects of online means of food information.

The findings of this literature review suggest that consumers' use of online means of food information provision is low, especially for means requiring effort to use, such as website links or QR codes. Consumers want food information that is easy to use, useful, relevant, and that they can trust. Food knowledge is increased when online means allow consumers to identify healthier food options, notably through the use of food applications that provide nutritional information about food products. Nevertheless, very few studies investigated how online means influence consumers' behavior, so there is need for more research in this area.

Regarding menu labels (n=29), the scientific evidence is more homogeneous from a methodological standpoint and investigates mainly behavioral effects (RQ3), but also effects on body mass index. Only eight articles evaluated menu-label use (RQ1) and they show that awareness and use of food information increases with the display of menu labels. An even smaller number of studies (n=6) investigated attitudes towards menu labels (RQ2); their results show that consumers are positively inclined towards menu labels and support this measure. The behavioral effects of menu labels, notably on calories ordered, are mixed but suggest a reduction of calories ordered after the display of menu labels. Four studies on the effects of menu labels on BMI suggest modest, but significant reduction in BMI after the implementation of menu label mandates.

There is a limited number of articles about consumers' use or attitudes towards menu labels, but there are several articles measuring their behavioral effects. Half of the studies measuring behavioral outcomes document small positive effects on consumers' choices (a small decrease in the calories purchased and/or an increase in nutritional quality of products purchased), and the other half show nonsignificant effects. Four studies assessing effects on BMI suggest a modest but significant reduction in BMI after the implementation of menu label mandates. Thus, while menu labels may not always have a direct observable effect on the quality of nutritional products purchased, they seem to have a small significant effect on body mass reduction.

The articles studying shelf labels (n=16) also focused mainly on behavioral outcomes (RQ3). Six articles assessed awareness, use (RQ1) or attitudes towards shelf labels (RQ2). It is noteworthy that in four studies the use of shelf labels appears to be low, though there are behavioral effects suggesting improvement in the nutritional quality of the products purchased owing to information provided through shelf labels. Thus, it seems that shelf labels influence behavior even when consumers do not report using them. Four studies report measures of attitudes towards shelf labels, and those were generally positive. Almost all studies included (n=15) show small but positive effects of shelf labels on food purchase, with either an increase in healthy food purchases or a decrease in unhealthy food purchases. One article also reported an increase in sales of unhealthy products after the display of NuVal shelf-labels, due to a salience effect. This is a boomerang effect of this type of means of information provision that definitely deserves more attention from future research.

Research on shelf-labels also showed that the display of Guiding Stars in Canada increased nutritional quality of products purchased but also increased the mean revenue of intervention supermarkets. This finding suggests that consumers accepted to pay more for products that displayed Guiding Stars and were thus of better nutritional quality. It is noteworthy, however, that most studies on shelf-labels tested specific systems, such as NuVal or Guiding Stars. It is thus difficult to disentangle whether these results are only related to the systems themselves or to the display of information using shelf-labels.

There is limited work about consumers' use of and preferences regarding shelf labels. There is, however, evidence of direct effects of shelf labels display on supermarket sales. Analysis of sales data in grocery stores displaying shelf labels suggests a small but significant increase on healthy food consumption.

Articles on the remaining means of food information provision (n=5) are very heterogeneous, and are thus difficult to compare. Three articles on point-of-sale (POS) signage in grocery stores provide initial evidence that graphic POS signs can influence consumption, by decreasing purchases of unhealthy products (e.g., sugary drinks) and increasing purchases of healthy ones. Future research is definitely needed in this area.

Taken together, the analysis of 97 articles on means of food information provision other than labels suggests that means providing direct access to food information in the marketplace, such as menu labels, shelf-labels, and POS signs, can be effective at influencing consumers towards healthy behaviors, compared to online means that require external tools to access the information (i.e., QR codes or website links). Because consumers value easiness of use and usefulness, food information that is immediately and visually available at the marketplace seems to be more effective. This finding is consistent with prior research on packaging labels suggesting that the most effective labels to influence healthier choices are interpretative labels (Dubois et al., 2020; Newman et al., 2016), notably because they increase processing fluency in comparative contexts (Newman et al., 2016), as opposed to more complex labels.

This literature review was designed to provide a better understanding of how Food Business Operators may provide information to consumers through means other than on the package. The findings suggest that, if not provided on the food package, food information should be directly visible in the marketplace to be able to influence consumers. Although this review did not include articles on (front-of-packaging (FOP)) labels, results suggest that means of food information with similar features—directly visible and available at the point-of-purchase (such as shelf labels or menu labels)—are more effective at influencing consumers compared to means of information that require tools to access (such as online means). So, if the objective is to provide information that is available to consumers in a conspicuous place, highly visible, and easily legible, then packaging labels still seem to be the best solution.

There is a considerable need for more research comparing the provision of food information through labels and digital means (for an exception, see Vecchio et al., 2018). Studies comparing information displayed on

labels and on digital means are rare and they are important to understand the differential effect of these two measures. These studies should be carefully designed not to force the use of online means, but to observe their spontaneous use by consumers when links, QR codes or barcodes are made available in grocery stores or restaurants. A formal assessment documenting if consumers spontaneously use food information through digital means in the marketplace is necessary to know if this type of support enables consumers to make informed food choices in comparison to labels. Data from well-powered randomized, controlled experiments in the field are needed to compare food choices made when digital means or labels are available. It is also particularly important to understand how these two types of means of food information provision influence consumers with different socio-economic, education, age, and health statuses.

Online means, however, may represent a complementary way to provide additional information to consumers. This report also included articles (n=7) on how food information is accessed by visually impaired persons. These articles suggest that visually impaired consumers use the internet for shopping and have important demands for food-related information adapted online. Online shopping is an important activity for visually impaired individuals, allowing them to experience autonomy when access to information is available. Online means may thus be an important tool to provide access to visually impaired individuals who are generally excluded from food information made available in-store and find online shopping a particularly appealing shopping mode. ***Providing information that can be processed through automatic screen readers seems to be important to ensure accessibility to food information online for visually impaired individuals. Providing food information in Braille in the marketplace is also an important way to improve accessibility to the specific subpopulation of visually impaired.***

This literature review has several limitations. First, by keeping the scope broad and addressing three research questions it included results from a large number of articles with important methodological and thematic differences. This approach considerably limited the possibility of comparisons among studies. Second, this literature review adopted an inclusive strategy and did not involve selection of articles based on a formal quality assessment of the evidence or risk of bias. Underpowered studies were included—results should therefore be interpreted with caution. Third, article screening and eligibility assessment were conducted by a single author, although a systematic approach was adopted to limit potential bias in article selection. Furthermore, in contrast to quantitative meta-analyses, a narrative review, such as this one, can be biased by the views of the rater or the selection of the studies. Fourth, we may not be capturing studies with null results due to publication bias. This could notably inflate statistically significant effects because significant results are more likely to get published than null results.

This literature review was also designed to document the various available means of food information provision in the European market and globally, aside from food package labels. The search strategy adopted in this work led to the inclusion of a majority of peer-reviewed scientific articles, which substantially reduced the possibility of providing an extensive documentation of the means of food information provision available. Future research involving content analysis of food operators', associations', and public policy makers' websites may be a better strategy to document all available means of food information provision, other than labels.

Another question that remains unanswered relates to the specific characteristics of consumers predicting the use of the different means of food information provision studied. Very few articles mentioned differences in reactions to the food information means according to socio-economic status, age, and gender. Also, the heterogeneity of the means studied and of the designs of the studies included prevented an integrative discussion of individual characteristics influencing consumers' reactions. Future work should definitely investigate how demographic factors influence reactions to alternative means to provide food information in the marketplace. The reduced number of studies conducted in Europe (n=20 out of 97) also limited the possibility of intercultural comparisons.

The main strength of this literature review is that it simultaneously addressed several means that could be used as alternatives to on-product labelling and included articles about relevant types of online means. This allowed the comprehensive examination of a large number of studies on consumers' responses to alternative means of food information provision in different settings.

There are four main public policy implications of this review. First, the analysis of the articles suggests that it is premature to adopt an exclusive display of food information using digital means. There is limited scientific evidence on how digital means are used by consumers in the marketplace or on their behavioral effects. Therefore, if the objective is to improve accessibility of food information enabling consumers to make informed food choices, digital means do not seem to be the best option. Second, food information directly available at the marketplace through menu labels, shelf labels, or POS signs seem to be better alternatives to facilitate consumers' choices of healthy diets in comparison to online means. They render information

accessible at the point of sale and sometimes influence behavior even when self-reported use is low, a finding that suggests these means may operate outside of consumers' awareness. Third, providing food information only through digital means seems risky because it may permit access only to consumers who use mobile devices and are also motivated to scan QR codes or open weblinks, while restricting access from others. Finally, improving accessibility of food information to visually impaired individuals may be done by providing product information online that can be processed with automatic screen readers and by providing food information in Braille in the marketplace.

10. Summary of main results

Methods

- A literature review with a systematic approach included 97 scientific articles on different means of food information provision in the marketplace: online means (n=40), menu labels (n=29), shelf labels (n=16), other means (n=5), and articles on the availability of information for visually impaired individuals (n=7).

RQ1&2: What are the type of means of food information provision apart from packaging labels that consumers use and want?

- The use of online means of food information provision is low. QR codes in the marketplace and website links are not often used or appreciated by consumers.
- Consumers have positive attitudes towards online means of food information mainly when these are easy to use, useful, and do not present too much information.
- When consumers use mobile food applications, they increase food knowledge, enhancing the identification of healthy food options or knowledge about specific food categories.
- Future research is needed to assess consumers' spontaneous use of online means of food information in the marketplace.
- For menu labels, very few articles measured consumers' use or attitudes. Awareness and use of food information increases with the display of menu labels. Consumers are positively inclined towards menu labels and support this measure.
- For shelf labels, few articles measured awareness or use. Results show low or average levels of awareness and use. Even when the use of shelf labels is low, there are behavioral effects suggesting improvement in the nutritional quality of the products purchased. It seems that shelf labels influence behavior even when consumers do not report using them.

RQ3: What is the impact of different means of food information provision apart from packaging labels on consumers' attitudes and behaviors?

- Very few articles measured behavioral effects of online means, suggesting a need for further research in this area.
- For menu labels, behavioral effects on calories ordered are mixed but suggest a reduction of calories ordered after the display of menu labels. Four studies investigated the effects of menu labels on BMI: results suggest modest, but significant reduction in BMI after the implementation of menu label mandates.
- For shelf labels, almost all articles show small but positive effects on food purchase, with either an increase in healthy food purchases or a decrease in unhealthy food purchases. One article, however, also reported an increase in sales of unhealthy products after the display of shelf-labels, due to a salience effect. This boomerang effect of this type of means of information provision deserves more attention from future research.
- Three articles on point-of-sale (POS) signage in grocery stores provide initial evidence that graphic POS signs can influence consumption, by decreasing purchases of unhealthy products (e.g., sugary drinks) and increasing purchases of healthy ones.

General conclusion

- Taken together, the analysis of 97 articles on means of food information provision other than packaging labels suggests that means providing direct access to food information in the marketplace, such as menu labels, shelf-labels, and POS signs, can be effective at influencing consumers towards healthy behaviors, compared to online means that require external tools to access the information (i.e., QR codes or website links).
- Because consumers value easiness of use and usefulness, food information that is immediately and visually available at the marketplace seems to be more effective. The findings suggest that, if not provided on the food package, food information should be directly visible in the marketplace to be able to influence consumers.

- There is a considerable need for more research comparing the provision of food information through labels and digital means.

Main public policy implications:

- Adoption of an exclusive display of food information using digital means seems inappropriate due to lack of scientific evidence on how these means are used by consumers in the marketplace or on their behavioral effects.
- Digital means do not seem to be the best option to improve accessibility of food information enabling consumers to make informed food choices.
- Food information directly available at the marketplace through menu labels, shelf labels, or POS signs seem to be better alternatives to facilitate consumers' choices of healthy diets.
- Providing food information only through digital means seems risky because it may permit access only to consumers who use mobile devices and are also motivated to scan QR codes or open weblinks, while restricting access from others.
- Improving accessibility of food information to visually impaired individuals may be done by providing product information online that can be processed with automatic screen readers and by providing food information in Braille in the marketplace.

11. Appendix 1. Complete search threads with Boolean operators

Database: EBSCO (all searches made with the following criteria: Limiters - Published Date: 20040101-20211231; Scholarly (Peer Reviewed) Journals; Narrow by Language: - english; Search modes - Boolean/Phrase)– searches were made in the abstract of the articles.

1. **Leaflets:** ((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND (leaflets OR brochures OR handout)
2. **Newspapers:** ((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND (magazines OR newspapers)
3. **Online means:** ((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND (Digital or Smartphone applications OR smartphone apps OR mobile phone app* OR mobile phone application OR mobile nutrition OR nutrition applications OR Blockchain OR QR codes OR Barcodes OR Websites)
4. **Oral information:** ((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND (oral OR verbal)
5. **Restaurant menus:** ((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND ((restaurant OR fast-food) AND (menu OR information))
6. **Retail Shelf:** ((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND (shelves OR shelf OR display OR retail shelf)
7. **Supermarket:** ((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND (supermarket OR grocery store OR food market OR convenience store)
1.

Database: Proquest (all searches made with the following criteria: Year: 2004-2021; English Language) – searches were made in the abstract of the articles.

1. **Leaflets:** ab((food OR drink OR beverage OR alcohol)) AND ab((consum* AND inform*)) AND ab((leaflets OR brochures OR handout))
2. **Newspapers:** ab((food OR drink OR beverage OR alcohol)) AND ab((consum* AND inform*)) AND ab((magazines OR newspapers))
3. **Online means:** ab((food OR drink OR beverage OR alcohol)) AND ab((consum* AND inform*)) AND ab(Digital OR Smartphone applications OR Websites)
4. **Oral information:** ab((food OR drink OR beverage OR alcohol)) AND ab((consum* AND inform*)) AND ab((verbal OR oral) AND information)
5. **Restaurant menus:** ab((food OR drink OR beverage OR alcohol)) AND ab((consum* AND inform*)) AND ab((restaurant OR fast-food) AND (menu OR information))
6. **Retail Shelf:** ab((food OR drink OR beverage OR alcohol) AND (consum* AND inform*)) AND (shelves OR shelf OR display OR retail shelf)
7. **Supermarket:** ab((food OR drink OR beverage OR alcohol)) AND ab((consum* AND inform*)) AND ab(supermarket OR grocery store OR food market OR convenience store)

Database: Science Direct (all searches made with the following criteria: Year: 2004-2021; In Title, abstract, keywords; English Language) – searches were made in the abstract, title, and keywords of the articles; use of wildcard symbol (*) and number of key words were reduced due to restrictions by the database.

1. **Leaflets:** (food OR drink OR beverage OR alcohol) AND (consumer AND information) AND (leaflets OR brochures OR handout)
2. **Newspapers:** (food OR drink OR beverage OR alcohol) AND (consumer AND information) AND (newspapers OR magazines)
3. **Online means:** (food OR drink OR beverage OR alcohol) AND (consumer AND information) AND (Digital OR Smartphone applications OR Websites)
4. **Oral information:** (food OR drink OR beverage OR alcohol) AND (consumer AND information) AND (verbal OR oral)
5. **Restaurants:** (food OR beverage OR alcohol) AND (consumer AND information) AND (restaurant OR fast-food) AND (menu OR information)
6. **Retail Shelf:** (food OR drink OR beverage OR alcohol) AND (consumer AND information) AND (retail shelf OR shelf OR display)
7. **Supermarket:** (food OR beverage OR alcohol) AND (consumer AND information) AND (supermarket OR grocery store OR food market)

Database: PubMed (*Filters applied: Clinical Trial, Journal Article, Randomized Controlled Trial, English, from 2004/1/1 - 2021/5/6*) – searches were made in the abstract and title of the articles.

1. **Leaflets:** (("food"[Title/Abstract] OR "drink"[Title/Abstract] OR "beverage"[Title/Abstract] OR "alcohol"[Title/Abstract]) AND ("consum*"[Title/Abstract] AND "inform*"[Title/Abstract]) AND ("leaflets"[Title/Abstract] OR "brochures"[Title/Abstract] OR "handout"[Title/Abstract])) AND ((2004/1/1:2021/5/6[pdat]) AND (english[Filter]))
2. **Newspapers:** (("food"[Title/Abstract] OR "drink"[Title/Abstract] OR "beverage"[Title/Abstract] OR "alcohol"[Title/Abstract]) AND ("consum*"[Title/Abstract] AND "inform*"[Title/Abstract]) AND ("magazines"[Title/Abstract] OR "newspapers"[Title/Abstract])) AND ((2004/1/1:2021/5/6[pdat]) AND (english[Filter]))
3. **Online means:** (("food"[Title/Abstract] OR "drink"[Title/Abstract] OR "beverage"[Title/Abstract] OR "alcohol"[Title/Abstract]) AND ("consum*"[Title/Abstract] AND "inform*"[Title/Abstract]) AND (2004/01/01:2021/05/06[Date - Publication] AND "english"[Language]) AND (2004/01/01:2021/05/06[Date - Publication] AND "english"[Language]) AND ("Digital"[Title/Abstract] OR "smartphone applications"[Title/Abstract] OR "Websites"[Title/Abstract])) AND ((2004/1/1:2021/5/6[pdat]) AND (english[Filter]))
4. **Oral information:** ((verbal[Title/Abstract] AND information[Title/Abstract]) AND (food*[Title/Abstract] OR drink*[Title/Abstract] OR beverage*[Title/Abstract])) AND (consum*[Title/Abstract] AND information[Title/Abstract])
5. **Restaurants:** (((food[Title/Abstract] OR drink[Title/Abstract] OR beverage[Title/Abstract] OR alcohol[Title/Abstract]) AND (consum*[Title/Abstract] AND inform*[Title/Abstract])) AND (restaurant[Title/Abstract] OR fast-food[Title/Abstract])) AND (menu[Title/Abstract] OR information[Title/Abstract])
6. **Retail Shelf:** (((((food[Title/Abstract] OR drink[Title/Abstract] OR beverage[Title/Abstract] OR alcohol[Title/Abstract]) AND (consum*[Title/Abstract] AND inform*[Title/Abstract])))) AND (retail shelf[Title/Abstract] OR shelf[Title/Abstract] OR display[Title/Abstract])
7. **Supermarket:** ((("food"[Title/Abstract] OR "drink"[Title/Abstract] OR "beverage"[Title/Abstract] OR "alcohol"[Title/Abstract]) AND ("consum*"[Title/Abstract] AND "inform*"[Title/Abstract])) AND (supermarket[Title/Abstract] OR grocery store[Title/Abstract] OR food market[Title/Abstract])

Database: Web of Science (all searches were made with the following criteria: **Timespan:** 2004-2021. **Indexes:** SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI. **Language:** English) – searches were made in the title and topic of the articles because there was no option to search in the abstracts.

1. **Leaflets:TITLE:** (((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND (leaflets OR brochures OR handout)) *AND***TOPIC:** (((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND (leaflets OR brochures OR handout))
2. **Newspapers:TITLE:** (((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND (newspapers OR magazines)) *AND***TOPIC:** (((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND (newspapers OR magazines))
3. **Online_means:TITLE:** (food* OR drink* OR beverage* OR alcohol*) *AND* **TITLE:** (consum* AND inform*) *AND* **TITLE:** (Digital OR Smartphone applications OR smartphone apps OR mobile phone app* OR mobile phone application OR mobile nutrition OR nutrition applications OR Blockchain OR QR codes OR Barcodes OR Websites) AND
2. **TOPIC:** (food* OR drink* OR beverage* OR alcohol*) *AND* **TOPIC:** (consum* AND inform*) *AND* **TOPIC:** (Digital OR Smartphone applications OR smartphone apps OR mobile phone app* OR mobile phone application OR mobile nutrition OR nutrition applications OR Blockchain OR QR codes OR Barcodes OR Websites)
3. **Extra search threads applied in Web of Science for Online means:** AB=((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*) AND (Digital OR Smartphone applications OR smartphone apps OR mobile phone app* OR mobile phone application OR mobile nutrition OR nutrition applications OR QR codes OR Barcodes OR Websites OR Blockchain))) *AND* **LANGUAGE:** (English) *AND* **DOCUMENT TYPES:** (Article) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI Timespan=2004-2021*
4. **Oral_information:TITLE:** (((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND (oral OR verbal)) *AND***TOPIC:** (((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND (oral OR verbal))
5. **Restaurant_menus:TITLE:** (food* OR drink* OR beverage* OR alcohol*) *AND* **TITLE:** (consum* AND inform*) *AND* **TITLE:** ((restaurant OR fast-food) AND (menu OR information)) AND
TOPIC: (food* OR drink* OR beverage* OR alcohol*) *AND* **TOPIC:** (consum* AND inform*) *AND* **TOPIC:** ((restaurant OR fast-food) AND (menu OR information))

6. **Retail_shelf:TITLE:** (food* OR drink* OR beverage* OR alcohol*) *AND* **TITLE:** (consum* AND inform*) *AND* **TITLE:** (shelves OR shelf OR display OR retail shelf) AND
   TOPIC: (food* OR drink* OR beverage* OR alcohol*) *AND* **TOPIC:** (consum* AND inform*) *AND* **TOPIC:** (shelves OR shelf OR display OR retail shelf)
7. **Supermarket:TITLE:** (food* OR drink* OR beverage* OR alcohol*) *AND* **TITLE:** (consum* AND inform*) *AND* **TITLE:** (supermarket OR grocery store OR food market OR convenience store) AND
   TOPIC (food* OR drink* OR beverage* OR alcohol*) *AND* **TOPIC:** (consum* AND inform*) *AND* **TOPIC:**(supermarket OR grocery store OR food market OR convenience store)

Searches about the accessibility of food information to people with special needs, such as visually impaired persons were done separately following the same search strategy described above but including the terms: visually impaired, visual impairment, low vision, and blindness.

- Example of Search Thread for Visually Impaired: **Database EBSCO:** ((food* OR drink* OR beverage* OR alcohol*) AND (consum* AND inform*)) AND (visually impaired OR visual impairment OR low vision OR blindness)

12. Appendix 2. List of articles excluded after Full-text screening with reasons for exclusion (n=41)

Article	Reason for exclusion
4. Ahn, S. J. (2018). Virtual Exemplars in Health Promotion Campaigns Heightening Perceived Risk and Involvement to Reduce Soft Drink Consumption in Young Adults. Journal of Media Psychology-Theories Methods and Applications, 30(2), 91-103. https://doi.org/10.1027/1864-1105/a000184	This article was excluded because it tests different tools aiming to reduce soft-drink consumption. The subject of providing food information in the marketplace is tangential to the investigation.
5. Ayala, G. X., Castro, I. A., Pickrel, J. L., Shih-Fan, L., Williams, C. B., Madanat, H., Hee-Jin, J., & Zive, M. (2017). A Cluster Randomized Trial to Promote Healthy Menu Items for Children : The Kids' Choice Restaurant Program. International Journal of Environmental Research and Public Health, 14(12), 1494. Publicly Available Content Database. https://doi.org/10.3390/ijerph14121494	This article was excluded because it tests an intervention promoting healthy choices involving different components (e.g., marketing campaign).
6. Bedard, K., & Kuhn, P. (2015). Micro-marketing healthier choices : Effects of personalized ordering suggestions on restaurant purchases. Journal of Health Economics, 39, 106-122. https://doi.org/10.1016/j.jhealeco.2014.10.006	Excluded because it focuses on a nudging intervention in restaurants involving personalized suggestions.
7. Bergeron, S., Doyon, M., Saulais, L., & Labrecque, J. (2019). Using insights from behavioral economics to nudge individuals towards healthier choices when eating out : A restaurant experiment. Food Quality and Preference, 73, 56-64. https://doi.org/10.1016/j.foodqual.2018.12.001	Excluded because it focuses on defaults presented in restaurant menus, a nudge intervention that was outside of the scope of this review.
8. Berning, J. P., Chouinard, H. H., & McCluskey, J. J. (2008). Consumer Preferences for Detailed versus Summary Formats of Nutrition Information on Grocery Store Shelf Labels. Journal of Agricultural & Food Industrial Organization, 6(1), 1-22. bth.	Excluded because it uses the same stimuli and the same data of one article included in the review: Berning et al (2010)
9. Bialkova, S., Grunert, K. G., & van Trijp, H. (2020). From desktop to supermarket shelf : Eye-tracking exploration on consumer attention and choice. Food Quality and Preference, 81, 103839. https://doi.org/10.1016/j.foodqual.2019.103839	Excluded because it is about FOP labels and not shelf labels.
10. Bleich, S. N., Wolfson, J. A., Jarlenski, M. P., & Block, J. P. (2015). Restaurants With Calories Displayed On Menus Had Lower Calorie Counts Compared To Restaurants Without Such Labels. *Health Affairs*, *34*(11), 1877-1884. bth.	Excluded because it looks at the effects of calorie labels in menus in the offer of products by the restaurants, and not in consumers' reactions.
11. Bos, C., Van der Lans, I. A., Van Rijnsoever, F. J., & Van Trijp, H. C. (2013). Understanding consumer acceptance of intervention strategies for healthy food choices : A qualitative study. *BMC Public Health*, *13*(1), 1073. https://doi.org/10.1186/1471-2458-13-1073	Excluded because this is a qualitative study about the effectiveness of weight-loss interventions.
12. Breathnach, S., Koutoukidis, D. A., Lally, P., Boniface, D., Sutherland, A., & Llewellyn, C. H. (2021). The effect of messaging on the acceptance of swaps to reduce the energy content of snacks and non-alcoholic drinks ordered in an experimental online workplace canteen : A randomised controlled trial. Appetite, 162, 105171. https://doi.org/10.1016/j.appet.2021.105171	Excluded because it presents a nudging intervention in workplace canteens and not on food information provision.
13. Brown, O. N., O'Connor, L. E., & Savaiano, D. (2014). Mobile MyPlate : A Pilot Study Using Text Messaging to Provide Nutrition Education and Promote Better Dietary Choices in College Students. *Journal of American College Health*, *62*(5),	Excluded because it reports an intervention in which participants received two text messages per week for seven weeks while control

320-327. https://doi.org/10.1080/07448481.2014.899233	participants only received one brochure in the beginning of the study.
14. Bryant, A., & Hill, R. P. (2018). A Whole or Two Halves : Serving Size Framing Effects and Consumer Healthfulness Perceptions. *Journal of Consumer Affairs*, *52*(2), 452-465. bth.	Excluded because it presents a serving size manipulation in restaurant menus.
15. Clement, J., Aastrup, J., & Charlotte Forsberg, S. (2015). Decisive visual saliency and consumers' in-store decisions. Journal of Retailing and Consumer Services, 22, 187-194. https://doi.org/10.1016/j.jretconser.2014.09.002	Excluded because it is a study that manipulates product placement, a category that was excluded from this review.
16. Coffino, J. A., & Hormes, J. M. (2018). A Default Option to Enhance Nutrition Within Financial Constraints : A Randomized, Controlled Proof-of-Principle Trial. Obesity (Silver Spring, Md.), 26(6), 961-967. https://doi.org/10.1002/oby.22151	Excluded because the same data was published in another article published by the same authors in 2020.
17. Crane, D., Garnett, C., Brown, J., West, R., & Michie, S. (2015). Behavior Change Techniques in Popular Alcohol Reduction Apps : Content Analysis. *Journal of Medical Internet Research*, *17*(5), e118. https://doi.org/10.2196/jmir.4060	Excluded because it reports a content analysis of alcohol reduction apps to identify if they have a theoretical basis.
18. DiPietro, R. B., Remar, D., & Parsa, H. G. (2016). Health consciousness, menu information, and consumers' purchase intentions : An empirical investigation. Journal of Foodservice Business Research, 19(5), 497-513. bth.	Excluded because it looks at the effects of health consciousness on the reactions to menu labels using a correlational approach that does not help in answering any of the research questions.
19. Escárcega-Centeno, D., Hérnandez-Briones, A., Ochoa-Ortiz, E., & Gutiérrez-Gómez, Y. (2015). Augmented-Sugar Intake : A Mobile Application to Teach Population about Sugar Sweetened Beverages. *Procedia Computer Science*, *75*, 275-280. https://doi.org/10.1016/j.procs.2015.12.248	Excluded because it only describes the development of a mobile application in Mexico.
20. Filimonau, V., Lemmer, C., Marshall, D., & Bejjani, G. (2017). 'Nudging' as an architect of more responsible consumer choice in food service provision : The role of restaurant menu design. *Journal of Cleaner Production*, *144*, 161-170. bth.	Excluded because it focuses on nudging and choice architecture.
21. Garnett, C., Oldham, M., Angus, C., Beard, E., Burton, R., Field, M., Greaves, F., Hickman, M., Kaner, E., Loebenberg, G., Michie, S., Munafo, M., Pizzo, E., & Brown, J. (2021). Evaluating the effectiveness of the smartphone app, Drink Less, compared with the NHS alcohol advice webpage, for the reduction of alcohol consumption among hazardous and harmful adult drinkers in the U.K. at 6-month follow-up : Protocol for a randomised controlled trial. *Addiction*, *116*(2), 412-425. https://doi.org/10.1111/add.15287	Excluded because it presents the protocol for a study with a 6-month intervention (very long term).
22. Garrido-Morgado, Á., González-Benito, Ó., Martos-Partal, M., & Campo, K. (2020). Which Products are More Responsive to In-Store Displays : Utilitarian or Hedonic? Journal of Retailing. https://doi.org/10.1016/j.jretai.2020.10.005	Excluded because it is a study that manipulates product placement, a category that was excluded from this review.
23. Grandi, B., Burt, S., & Cardinali, M. G. (2021). Encouraging healthy choices in the retail store environment : Combining product information and shelf allocation. Journal of Retailing and Consumer Services, 61, 102522. https://doi.org/10.1016/j.jretconser.2021.102522	Excluded because it is a study that manipulates product placement, a category that was excluded from this review.
24. Guha, A., Biswas, A., Grewal, D., Bhowmick, S., & Nordfält, J. (2018). An Empirical Analysis of the Joint Effects of Shoppers' Goals and Attribute Display on Shoppers' Evaluations. Journal of Marketing, 82(3), 142. Business Premium Collection.	Not included because it manipulates the order of presentation of products in the shelf, which is a manipulation of placement more than information provision.
25. Hsu, C.-H., & Chen, C.-H. (2011). Analyzing the purchase	Excluded because it does not present enough

	motivation of online shopping for health food. African Journal of Business Management, 5(12), 4699-4703.	details of the empirical survey (sample size or description). Not a rigorous study.
26.	Hunsberger, M., McGinnis, P., Smith, J., Beamer, B. A., & O'Malley, J. (2015). Calorie Labeling in a Rural Middle School Influences Food Selection : Findings from Community-Based Participatory Research. Journal of Obesity, 2015. Publicly Available Content Database. https://doi.org/10.1155/2015/531690	Excluded because it involved children and not adults
27.	Joe, M., Lee, S., & Ham, S. (2020). Which brand should be more nervous about nutritional information disclosure : McDonald's or Subway? Appetite, 155, 104805. https://doi.org/10.1016/j.appet.2020.104805	Excluded because it mainly investigates expectations related to the health halo effect of Subway vs. McDonald's
28.	Karamanos, V., Hobbs, J. E., & Slade, P. (2019). Consumer responses to private nutrition signals. Journal of Food Products Marketing, 25(2), 111-136. Business Premium Collection. https://doi.org/10.1080/10454446.2018.1498044	Excluded because it focuses on FOP labels.
29.	Klingemann, H., Flueckiger, M., Bongard, T., Buechi, M., & Carrara, M. (2020). Design and Content Quality of Alcohol-Related German, French and Italian Self-Tracking Applications. Substance Use & Misuse, 55(5), 851-859. https://doi.org/10.1080/10826084.2019.1708117	Not relevant because it presents a content analysis of 17 apps focusing on preventing alcohol addiction.
30.	Lin, B.-H., Guthrie, J., Rahkovsky, I., Chung-Tung Lin, & Jonq-Ying Lee. (2014). Simulating the Potential Effects of a Shelf-Tag Nutrition Information Program and Pricing on Diet Quality Associated with Ready-to-Eat Cereals. *International Food & Agribusiness Management Review*, *17*, 7-23. bth.	Excluded because it presents a simulation with price change for cereals, while also including self-tag manipulations.
31.	Martin-Moreno, J. M., Harris, M. E., Breda, J., Moller, L., Alfonso-Sanchez, J. L., & Gorgojo, L. (2013). Enhanced labelling on alcoholic drinks : Reviewing the evidence to guide alcohol policy. *European Journal of Public Health*, *23*(6), 1082-1087. https://doi.org/10.1093/eurpub/ckt046	Not relevant because it only discusses alcohol labelling and not online means.
32.	Moran, A. J., Khandpur, N., Polacsek, M., Thorndike, A. N., Franckle, R. L., Boulos, R., Sampson, S., Greene, J. C., Blue, D. G., & Rimm, E. B. (2019). Make It Fresh, for Less ! A Supermarket Meal Bundling and Electronic Reminder Intervention to Promote Healthy Purchases Among Families With Children. Journal of Nutrition Education and Behavior, 51(4), 400-408. https://doi.org/10.1016/j.jneb.2019.01.012	Excluded because it describes an intervention of meal bundling that lasts four weeks and does not report shelf-labels.
33.	Olzenak, K., French, S., Sherwood, N., Redden, J. P., & Harnack, L. (2020). How Online Grocery Stores Support Consumer Nutrition Information Needs. Journal of Nutrition Education and Behavior, 52(10), 952-957. https://doi.org/10.1016/j.jneb.2020.07.009	Excluded because it is about nutritional fact labels' availability.
34.	Price, M., Higgs, S., Wilkinson, L., Lee, M., Embling, R., Kuberka, P., Hamill, A., Collier, J., Keable-Steer, S., Reitmaier, T., Mukhopadhyay, S., & Lindsay, S. (2020). Construal beliefs moderate the usability and effectiveness of a novel healthy eating mobile app. Physiology & Behavior, 222, 112941. https://doi.org/10.1016/j.physbeh.2020.112941	This article was excluded from the database because it reports the test of an app designed to reduce weight. This was mainly for dieting instead of providing food information in the marketplace.
35.	Ramachandran, D., Kite, J., Vassallo, A. J., Chau, J. Y., Partridge, S., Freeman, B., & Gill, T. (2018). Food Trends and Popular Nutrition Advice Online—Implications for Public Health. *Online Journal of Public Health Informatics*, *10*(2), e213. https://doi.org/10.5210/ojphi.v10i2.9306	Excluded because it presents a content analysis of nine popular Facebook pages providing nutrition content in Australia.
36.	Rangelov, N., Della Bella, S., Marques-Vidal, P., & Suggs, L. S. (2018). Does additional support provided through e-mail or SMS in a Web-based Social Marketing program improve children's food consumption ? A Randomized Controlled Trial.	Out of target because it reports an intervention to promote healthy eating among a sample of children

	Nutrition Journal, 17(1), 24. https://doi.org/10.1186/s12937-018-0334-1	
37.	Rutsaert, P., Pieniak, Z., Regan, Á., McConnon, Á., Kuttschreuter, M., Lores, M., Lozano, N., Guzzon, A., Santare, D., & Verbeke, W. (2014). Social media as a useful tool in food risk and benefit communication? A strategic orientation approach. *Food Policy*, *46*, 84-93. https://doi.org/10.1016/j.foodpol.2014.02.003	Excluded because it reports a qualitative study with a small sample of experts and stakeholders
38.	Sanchez-Flack, J., Pickrel, J. L., Belch, G., Shih-Fan, L., Anderson, C. A. M., Martinez, M. E., Arredondo, E. M., & Ayala, G. X. (2017). Examination of the Relationship between In-Store Environmental Factors and Fruit and Vegetable Purchasing among Hispanics. International Journal of Environmental Research and Public Health, 14(11), 1305. Publicly Available Content Database. https://doi.org/10.3390/ijerph14111305	Excluded because it is a study that manipulates product placement, a category that was excluded from this review.
39.	Scozzafava, G., Contini, C., Romano, C., & Casini, L. (2017). Eating out : Which restaurant to choose? British Food Journal, 119(8), 1870-1883. Business Premium Collection. https://doi.org/10.1108/BFJ-12-2016-0591	Excluded because it does not measure nor take into account the provision of food information.
40.	Shimakawa, T., Weingaertner, D. W., Schmit, D. M., & Brandt, M. M. (2009). Development of downloadable and printable posters for nutrition information of raw fruits, vegetables, and fish. 32nd National Nutrient Database Conference, 22, S93-S98. https://doi.org/10.1016/j.jfca.2009.02.002	Excluded because it describes development of downloadable and printable posters (by the Food and Drug Administration) containing nutrition information for the 20 most frequently consumed raw fruits, vegetables, and fish in the U.S. There are no empirical results. This is clearly an error in selection.
41.	Sigurdsson, V., Larsen, N. M., Alemu, M. H., Gallogly, J. K., Menon, R. G. V., & Fagerstrøm, A. (2020). Assisting sustainable food consumption : The effects of quality signals stemming from consumers and stores in online and physical grocery retailing. Journal of Business Research, 112, 458-471. https://doi.org/10.1016/j.jbusres.2019.11.029	Excluded because it investigates different promotion types in stores ("Best Choice" signaling).
42.	Surkan, P. J., Tabrizi, M. J., Lee, R. M., Palmer, A. M., & Frick, K. D. (2016). Eat Right–Live Well ! Supermarket Intervention Impact on Sales of Healthy Foods in a Low-Income Neighborhood. Journal of Nutrition Education and Behavior, 48(2), 112-121.e1. https://doi.org/10.1016/j.jneb.2015.09.004	This study describes a nutritional education intervention and it is thus outside the scope of this review.
43.	Theis, D. R. Z., & Adams, J. (2019). Differences in energy and nutritional content of menu items served by popular U.K. chain restaurants with versus without voluntary menu labelling : A cross-sectional study. PLoS One, 14(10). Publicly Available Content Database. https://doi.org/10.1371/journal.pone.0222773	Excluded because it investigates how the adoption of menu labels influenced nutritional content of food sold in restaurants among those who adopted this voluntary measure. There is no data about consumers' behavior.
44.	Yu, H., Tullio-Pow, S., & Akhtar, A. (2015). Retail design and the visually impaired : A needs assessment. Journal of Retailing and Consumer Services, 24, 121-129. https://doi.org/10.1016/j.jretconser.2015.03.001	Excluded because it describes retailing experiences of visually impaired but not related to food purchase (mainly related to clothing).

13. Appendix 3. List of articles on menu labels excluded (n=36) because published before the systematic review of Long and colleagues (2015) or included in the systematic review of Bleich and colleagues (2017).

1.	Auchincloss, A. H., Mallya, G. G., Leonberg, B. L., Ricchezza, A., Glanz, K., & Schwarz, D. F. (2013). Customer Responses to Mandatory Menu Labeling at Full-Service Restaurants. American Journal of Preventive Medicine, 45(6), 710-719. https://doi.org/10.1016/j.amepre.2013.07.014
2.	Barbieri, T., Rodrigues, K. de S., Silva, S. F. da, Medeiros, L. B., & Saccol, A. L. de F. (2012). Consumer attitudes toward information displayed at food buffets in commercial restaurants. Food Science and Technology, 32, 798-803. https://doi.org/10.1590/S0101-20612012005000104
3.	Breck, A., Cantor, J., Martinez, O., & Elbel, B. (2014). Who reports noticing and using calorie information posted on fast food restaurant menus? Appetite, 81, 30-36. https://doi.org/10.1016/j.appet.2014.05.027
4.	Burton, S., Creyer, E. H., Kees, J., & Huggins, K. (2006). Attacking the Obesity Epidemic : The Potential Health Benefits of Providing Nutrition Information in Restaurants. *American Journal of Public Health*, *96*(9), 1669-1675. bth.
5.	Burton, S., Howlett, E., & Tangari, A. H. (2009). Food for Thought : How Will the Nutrition Labeling of Quick Service Restaurant Menu Items Influence Consumers' Product Evaluations, Purchase Intentions, and Choices? Consumer Behavior and Retailing, 85(3), 258-273. https://doi.org/10.1016/j.jretai.2009.04.007
6.	Cranage, D. A., Conklin, M. T., & Lambert, C. U. (2004). Effect of Nutrition Information in Perceptions of Food Quality, Consumption Behavior and Purchase Intentions. *Journal of Foodservice Business Research*, *7*(1), 43-61. bth.
7.	Dodds, P., Wolfenden, L., Chapman, K., Wellard, L., Hughes, C., & Wiggers, J. (2014). The effect of energy and traffic light labelling on parent and child fast food selection : A randomised controlled trial. Appetite, 73, 23-30. https://doi.org/10.1016/j.appet.2013.10.013
8.	Downs, J. S., Wisdom, J., Wansink, B., & Loewenstein, G. (2013). Supplementing menu labeling with calorie recommendations to test for facilitation effects. American Journal of Public Health, 103(9), 1604-1609. https://doi.org/10.2105/AJPH.2013.301218
9.	Dowray, S., Swartz, J. J., Braxton, D., & Viera, A. J. (2013). Potential effect of physical activity based menu labels on the calorie content of selected fast food meals. Marketing to Children - Implications for Eating Behaviour and Obesity: A special issue with the U.K. Association for the Study of Obesity (ASO), 62, 173-181. https://doi.org/10.1016/j.appet.2012.11.013
10.	Dumanovsky, T., PhD, Huang, C. Y., MPH, Bassett, M. T., MD, MPH, & Silver, L. D., MD, MPH. (2010). Consumer Awareness of Fast-Food Calorie Information in New York City After Implementation of a Menu Labeling Regulation. *American Journal of Public Health*, *100*(12), 2520-2525. Business Premium Collection.
11.	Ellison, B., Lusk, J. L., & Davis, D. (2013). Looking at the label and beyond : The effects of calorie labels, health consciousness, and demographics on caloric intake in restaurants. International Journal of Behavioral Nutrition and Physical Activity, 10, 21. Publicly Available Content Database. https://doi.org/10.1186/1479-5868-10-21
12.	Fitch, R. C., Harnack, L. J., Neumark-Sztainer, D. R., Story, M. T., French, S. A., Oakes, J. M., & Rydell, S. A. (2009). Providing calorie information on fast-food restaurant menu boards : Consumer views. American Journal of Health Promotion: AJHP, 24(2), 129-132. https://doi.org/10.4278/ajhp.08031426
13.	Fotouhinia-Yepes, M. (2013). Menu Calorie Labelling in a Fine Dining Restaurant : Will it Make a Difference? *Journal of Quality Assurance in Hospitality & Tourism*, *14*(3), 281-293. bth.
14.	Gerend, M. A. (2009). Does calorie information promote lower calorie fast food choices among college students? The Journal of Adolescent Health: Official Publication of the Society for Adolescent Medicine, 44(1), 84-86. https://doi.org/10.1016/j.jadohealth.2008.06.014
15.	Hammond, D., Lillico, H. G., Vanderlee, L., White, C. M., & Reid, J. L. (2015). The impact of nutrition labeling on menus : A naturalistic cohort study. American Journal of Health Behavior, 39(4), 540-548. https://doi.org/10.5993/AJHB.39.4.10
16.	Haws, K. L., & Liu, P. J. (2016). Half-size me ? How calorie and price information influence ordering on restaurant menus with both half and full entrée portion sizes. Appetite, 97, 127-137. https://doi.org/10.1016/j.appet.2015.11.031
17.	Heiman, A., & Lowengart, O. (2014). Calorie information effects on consumers' food choices : Sources of observed gender heterogeneity. *Journal of Business Research*, *67*(5), 964-973. bth.
18.	HOWLETT, E. A., BURTON, S., BATES, K., & HUGGINS, K. (2009). Coming to a Restaurant Near You ? Potential Consumer Responses to Nutrition Information Disclosure on Menus. *Journal of Consumer Research*, *36*(3), 494-503. bth.

19. Josiam, B., & Foster, C. (2009). Nutritional information on restaurant menus : Who cares and why restauranteurs should bother. *International Journal of Contemporary Hospitality Management*, *21*(6/7), 876-891. bth.
20. Kim, H. J., Park, J., Kim, M.-J., & Ryu, K. (2013). Does perceived restaurant food healthiness matter ? Its influence on value, satisfaction and revisit intentions in restaurant operations in South Korea. International Journal of Hospitality Management, 33, 397-405. https://doi.org/10.1016/j.ijhm.2012.10.010
21. Krukowski, R. A., Harvey-Berino, J., Kolodinsky, J., Narsana, R. T., & DeSisto, T. P. (2006). Consumers May Not Use or Understand Calorie Labeling in Restaurants. Journal of the American Dietetic Association, 106(6), 917-920. https://doi.org/10.1016/j.jada.2006.03.005
22. Lee-Kwan, S. H., Pan, L., Maynard, L. M., McGuire, L. C., & Park, S. (2016). Factors Associated with Self-Reported Menu-Labeling Usage among US Adults. Journal of the Academy of Nutrition and Dietetics, 116(7), 1127-1135. https://doi.org/10.1016/j.jand.2015.12.015
23. Lee-Kwan, S. H., Pan, L., Maynard, L., Kumar, G., & Park, S. (2014). Restaurant menu labeling use among adults—17 states, 2012. *MMWR. Morbidity and Mortality Weekly Report*, *63*(27), 581-584.
24. Morley, B., Scully, M., Martin, J., Niven, P., Dixon, H., & Wakefield, M. (2013). What types of nutrition menu labelling lead consumers to select less energy-dense fast food ? An experimental study. Appetite, 67, 8-15. https://doi.org/10.1016/j.appet.2013.03.003
25. Park, S., Yoon, H., Cho, S., & Haugtvedt, CurtisP. (2013). Assessing the Provision of Nutritional Information on Quick Service Restaurant Menu Item Choices for College Students. *Journal of Foodservice Business Research*, *16*(4), 329-346. bth.
26. Reeves, S., Wake, Y., & Zick, A. (2011). Nutrition Labeling and Portion Size Information on Children's Menus in Fast-Food and Table-Service Chain Restaurants in London, U.K.. Journal of Nutrition Education and Behavior, 43(6), 543-547. https://doi.org/10.1016/j.jneb.2010.12.006
27. Roberto, C. A., Agnew, H., & Brownell, K. D. (2009). An Observational Study of Consumers' Accessing of Nutrition Information in Chain Restaurants. *American Journal of Public Health*, *99*(5), 820-821.
28. Roberto, C. A., Larsen, P. D., Agnew, H., Baik, J., & Brownell, K. D. (2010). Evaluating the Impact of Menu Labeling on Food Choices and Intake. *American Journal of Public Health*, *100*(2), 312-318.
29. Roseman, M. G., Mathe-Soulek, K., & Higgins, J. A. (2013). Relationships among grocery nutrition label users and consumers' attitudes and behavior toward restaurant menu labeling. Appetite, 71, 274-278. https://doi.org/10.1016/j.appet.2013.08.019
30. Scourboutakos, M. J., Corey, P. N., Mendoza, J., Henson, S. J., & L'Abbe, M. R. (2014). Restaurant menu labelling : Is it worth adding sodium to the label? Canadian Journal of Public Health = Revue Canadienne de Sante Publique, 105(5), e354-361. https://doi.org/10.17269/cjph.105.4492
31. Taksler, G. B., & Elbel, B. (2014). Calorie labeling and consumer estimation of calories purchased. International Journal of Behavioral Nutrition and Physical Activity, 11, 91. Publicly Available Content Database. https://doi.org/10.1186/s12966-014-0091-2
32. Tandon, P. S., Zhou, C., Chan, N. L., Lozano, P., Couch, S. C., Glanz, K., Krieger, J., & Saelens, B. E. (2011). The Impact of Menu Labeling on Fast-Food Purchases for Children and Parents. American Journal of Preventive Medicine, 41(4), 434-438. https://doi.org/10.1016/j.amepre.2011.06.033
33. TANGARI, A. H., BURTON, S., HOWLETT, E., CHO, Y., & THYROFF, A. (2010). Weighing in on Fast Food Consumption : The Effects of Meal and Calorie Disclosures on Consumer Fast Food Evaluations. *Journal of Consumer Affairs*, *44*(3), 431-462. bth.
34. Vanderlee, L., & Hammond, D. (2014). Does nutrition information on menus impact food choice ? Comparisons across two hospital cafeterias. Public Health Nutrition, 17(6), 1393-1402. https://doi.org/10.1017/S136898001300164X
35. Wei, W., & Miao, L. (2013). Effects of calorie information disclosure on consumers' food choices at restaurants. International Journal of Hospitality Management, 33, 106-117. https://doi.org/10.1016/j.ijhm.2012.06.008
36. Wellard, L., Glasson, C., Chapman, K., & Miller, C. (2011). Fast facts : The availability and accessibility of nutrition information in fast food chains. Health Promotion Journal of Australia : Official Journal of Australian Association of Health Promotion Professionals, 22(3), 184-188. https://doi.org/10.1071/he11184

14. Appendix 4. Database structure

Reference	Year	Abstract	CATEGORY	Mean of info	Outcome variable	*Journal*	EU/Non EU	Geographical coverage	Theory	Methodology	Procedure	Sample size	Product category	Individual Differences	Main results
Abao, R. P., Malabanan, C. V., & Galido, A. P. (2018). Design and Development of FoodGo : A Mobile Application using Situated Analytics to Augment Product Information. The 3rd International Conference on Computer Science and Computational Intelligence (ICCSCI 2018) : Empowering Smart Technology in Digital Era for a Better Life, 135, 186-193. https://doi.org/10.1016/j.procs.2018.08.165	2018	Situated analytics (SA), a combination of augmented reality and visual analytics, is a potential tool in enhancing user understanding of information. This study created a mobile application (app) named FoodGo, which utilizes SA to present product information in mobile devices, to help consumers in making a food choice in a grocery shopping scenario. FoodGo was designed in such a way that users just need to scan the barcode of a food product using the smartphone's camera and the helpful food information will then be augmented in the smartphone display using the concept of situated analytics. An iterative process of design analysis, prototype development, and user interface evaluation was used in designing and developing the mobile app prototype. The iterative process was limited to three iterations only and the data gathered in each iteration was used to improve the mobile app in the succeeding iterations. After the iteration cycles, the final version of the Android FoodGo mobile app was developed and was ensured that all the components, which includes the barcode scanning and the cloud database, were working properly. The effectiveness of using the mobile app in helping consumers make a healthier food choice was assessed in a mock-up grocery shopping environment. The result indicated that using FoodGo significantly improves the success rate of users to select a healthier food product. Further improvements for the FoodGo mobile app include putting a tutorial on how to use the mobile app when opened for the first time and having an option to input special health conditions such as diabetes for a more personalized way of informing the user about the food products.	Online means	App in grocery store	Identification of the healthier option among a pair of food products	Procedia Computer Science	Non EU	Philippines		Experiment (whithin-subjects design)	Participants were asked to select the healthier of two items of 10 different product categories twice: first manually and then using the App.	n= 30 university students	Cereals, chips, cookies, chocolates, noodles, dairy food, dairy everage, juices, canned meat, and canned fish	Not reported	Participants were better able to identify the healthier product when using an App providing augmented information when scanning the barcode of a food product, in comparison to the control condition (manual assessment).
Ahmed, M., Oh, A., Vanderlee, L., Franco-Arellano, B., Schermel, A., Lou, W., & L'Abbé, M. R. (2020). A randomized controlled trial examining consumers' perceptions and opinions on using different versions of a FoodFlip© smartphone application for delivery of nutrition information. The International Journal of Behavioral Nutrition and Physical Activity, 17(1), 22. https://doi.org/10.1186/s12966-020-0923-1	2020	BACKGROUND: Food labelling is a common intervention to improve diets, where the back-of-pack Nutrition Information Panel (or Nutrition Facts table (NFt)) provides comprehensive nutrition information on food packages. However, many consumers find it difficult and time-consuming to identify healthier foods using the NFt. As a result, different interpretative nutrition rating systems (INRS) may enable healthier food choices and it is essential that consumers have the tools to allow for easily accessible nutrition information. The objective of this study was to examine consumers' perceptions of different (INRS) for delivery of nutrition information using different versions of a smartphone app, FoodFlip©. METHODS: This study was part of a larger randomized controlled trial examining consumer perceptions of different INRS on food products. A nationally representative commercial sample of 2008 Canadians were randomized to one of four INRS intervention groups: 1) traffic light, 2) health star rating, 3) 'high-in' warning labels or 4) no INRS (NFt only; control) and asked to scan or enter 20 products into FoodFlip© from a list of food products provided to them with varying levels of healthfulness. After completing the app task, participants were asked a series of 7-point Likert-scale and open-ended questions to provide opinions on the usability and functionality of the app. RESULTS: Of the survey sample of 1997 participants, 95% (n = 1907) completed the app task, with similar number of participants in each treatment group. The mean age was 40 ± 12 years with no differences in sociodemographic characteristics between treatment groups. The health star rating ranked	Online means	App providing NI	attitudes towards the app	The International Journal of Behavioral Nutrition and Physical Activity	Non EU	Canada	not specified	Experiment (RCT)	One-factor four-level between-subjects design with nutrition information presented through traffic light, health star rating, "high-in" warning labels or control (no info). Participants were asked to scan 20 products into FoodFlip© from a list provided.	n=1997 nationally representative sample (mean age: 40 years old)	Groceries	Not reported	a food app, the majority of participants considered the app easy to use and perceived that it provided useful information, allowing comparison of healthiness between similar products. The study compared different types of systems providing food information in the app, and interpretive systems were NOT considered more useful or easier to understand in comparison with the control (Nutritional Facts Panel). Participants preferred traffic lights and 'high in' warning nutrition information in the smartphone app for comparing the healthfulness of similar products, for understanding of nutrient levels in foods and for providing useful nutritional information

15. Appendix 5. Articles included in the database (n=97)

1. Abao, R. P., Malabanan, C. V., & Galido, A. P. (2018). Design and Development of FoodGo : A Mobile Application using Situated Analytics to Augment Product Information. The 3rd International Conference on Computer Science and Computational Intelligence (ICCSCI 2018) : Empowering Smart Technology in Digital Era for a Better Life, 135, 186-193. https://doi.org/10.1016/j.procs.2018.08.165
2. Ahmed, M., Oh, A., Vanderlee, L., Franco-Arellano, B., Schermel, A., Lou, W., & L'Abbé, M. R. (2020). A randomized controlled trial examining consumers' perceptions and opinions on using different versions of a FoodFlip© smartphone application for delivery of nutrition information. The International Journal of Behavioral Nutrition and Physical Activity, 17(1), 22. https://doi.org/10.1186/s12966-020-0923-1
3. Albăstroiu, I., & Felea, M. (2015). Enhancing the shopping experience through QR codes : The perspective of the Romanian users. *Amfiteatru Economic Journal*, *17*(39), 553-566.
4. Appleton, K. M., Passmore, D., Burn, I., Pidgeon, H., Nation, P., Boobyer, C., & Jiang, N. (2019). An Interactive Mobile Phone App (SMART 5-A-DAY) for Increasing Knowledge of and Adherence to Fruit and Vegetable Recommendations : Development and Pilot Randomized Controlled Trial. *Journal of Medical Internet Research*, *21*(11), N.PAG-N.PAG. Library, Information Science & Technology Abstracts.
5. BALABANIS, G., MITCHELL, V. W., BRUCE, I., & RIEFLER, P. (2012). A Conceptual Stress-Coping Model of Factors Influencing Marketplace Engagement of Visually Impaired Consumers. *The Journal of Consumer Affairs*, *46*(3), 485-505. JSTOR.
6. Berning, J. P., & Sprott, D. E. (2011). Examining the Effectiveness of Nutrition Information in a Simulated Shopping Environment. *Journal of Food Distribution Research*, *42*(3), 60-76. bth.
7. Berning, J. P., Chouinard, H. H., Manning, K. C., McCluskey, J. J., & Sprott, D. E. (2010). Identifying consumer preferences for nutrition information on grocery store shelf labels. Food Policy, 35(5), 429-436. International Bibliography of the Social Sciences (IBSS). https://doi.org/10.1016/j.foodpol.2010.05.009
8. Berry, C., Burton, S., Howlett, E., & Newman, C. L. (2019). Understanding the Calorie Labeling Paradox in Chain Restaurants : Why Menu Calorie Labeling Alone May Not Affect Average Calories Ordered : JPP&M. Journal of Public Policy & Marketing, 38(2), 192-213. Business Premium Collection. https://doi.org/10.1177/0743915619827013
9. Bollinger, B., Liebman, E., Hammond, D., Hobin, E., & Sacco, J. (2021). Educational Campaigns for Product Labels : Evidence from On-Shelf Nutritional Labeling. *Journal of Marketing Research (JMR)*, 1. bth.
10. Bray, J., Hartwell, H., Price, S., Viglia, G., Kapuściński, G., Appleton, K., Saulais, L., Perez-Cueto, F., & Mavridis, I. (2019). Food information presentation : Consumer preferences when eating out. https://doi.org/10.1108/BFJ-09-2018-0605
11. Briliana, V., Ruswidiono, W., & Deitiana, T. (2020). Do Millennials Believe in Food Vlogger Reviews ? A Study of Food Vlogs as a Source of Information. *Journal of Management & Marketing Review (JMMR)*, *5*(3), 170-178. bth.
12. Cantor, J., Torres, A., Abrams, C., & Elbel, B. (2015). Five Years Later : Awareness Of New York City's Calorie Labels Declined, With No Changes In Calories Purchased. *Health Affairs*, *34*(11), 1893-1900. bth.
13. Caplette, M.-E., Provencher, V., Bissonnette-Maheux, V., Dugrenier, M., Lapointe, A., Gagnon, M.-P., Straus, S., & Desroches, S. (2017). Increasing Fruit and Vegetable Consumption Through a Healthy Eating Blog : A Feasibility Study. JMIR Research Protocols, 6(4), e59. https://doi.org/10.2196/resprot.6622
14. Cawley, J., Susskind, A., & Willage, B. (2018). The Impact of Information Disclosure on Consumer Behavior : Evidence from a Randomized Field Experiment of Calorie Labels on Restaurant Menus. NBER Working Paper, http://www.nber.org/papers/w24889
15. Cawley, J., Susskind, A., & Willage, B. J. (2021). Does Information Disclosure Improve Consumer Knowledge? Evidence from a Randomized Experiment of Restaurant Menu Calorie Labels. American Journal of Health Economics. https://doi.org/10.1086/714987
16. Cawley, J., Sweeney, M. J., Sobal, J., Just, D. R., Kaiser, H. M., Schulze, W. D., Wethington, E., & Wansink, B. (2014). The impact of a supermarket nutrition rating system on purchases of nutritious and less nutritious foods. Public Health Nutrition, 18(1), 8-14. https://doi.org/10.1017/S1368980014001529
17. Chen, R., Smyser, M., Chan, N., Ta, M., Saelens, B. E., & Krieger, J. (2015). Changes in awareness and use of calorie information after mandatory menu labeling in restaurants in King County, Washington. American Journal of Public Health, 105(3), 546-553. https://doi.org/10.2105/AJPH.2014.302262
18. Childers, T. L., & Kaufman-Scarborough, C. (2009). Expanding opportunities for online shoppers with disabilities. Journal of Business Research, 62(5), 572-578. https://doi.org/10.1016/j.jbusres.2008.06.017
19. Colapinto, C. K., & Malaviarachchi, D. (2009). Paint your plate : Effectiveness of a point-of-purchase display. Canadian Journal of Dietetic Practice and Research : A Publication of Dietitians of Canada = Revue Canadienne de La Pratique et de La Recherche En Dietetique : Une Publication Des Dietetistes Du Canada, 70(2), 66-71. https://doi.org/10.3148/70.2.2009.66
20. Coomber, K., Martino, F., Barbour, I. R., Mayshak, R., & Miller, P. G. (2015). Do consumers 'Get the facts' ? A survey of alcohol warning label recognition in Australia. Bmc Public Health, 15, 816. https://doi.org/10.1186/s12889-015-2160-0

21. Dallas, S. K., Liu, P. J., Ubel, P. A., Mukhopadhyay, A., & Botti, S. (2019). Don't Count Calorie Labeling Out : Calorie Counts on the Left Side of Menu Items Lead to Lower Calorie Food Choices. *Journal of Consumer Psychology (John Wiley & Sons, Inc.)*, *29*(1), 60-69. bth.
22. Daunfeldt, S.-O., & Rudholm, N. (2014). Does shelf-labeling of organic foods increase sales ? Results from a natural experiment. Journal of Retailing and Consumer Services, 21(5), 804-811. https://doi.org/10.1016/j.jretconser.2014.06.009
23. Dias de Faria, M., Ferreira da Silva, J., & Brantes Ferreira, J. (2012). The visually impaired and consumption in restaurants. International Journal of Contemporary Hospitality Management, 24(5), 721-734. https://doi.org/10.1108/09596111211237264
24. Dillaway, R., Messer, K. D., Bernard, J. C., & Kaiser, H. M. (2011). Do Consumer Responses to Media Food Safety Information Last? *Applied Economic Perspectives & Policy*, *33*(3), 363-383. bth.
25. DiPietro, R. B., Remar, D., & Parsa, H. G. (2016). Health consciousness, menu information, and consumers' purchase intentions : An empirical investigation. *Journal of Foodservice Business Research*, *19*(5), 497-513. bth.
26. Doub, A. E., Levin, A., Heath, C. E., & LeVangie, K. (2015). Mobile app-etite : Consumer attitudes towards and use of mobile technology in the context of eating behaviour. Journal of Direct, Data and Digital Marketing Practice, 17(2), 114-129. https://doi.org/10.1057/dddmp.2015.44
27. Droms Hatch, C. M. (2016). Examining the Use of Nutrition Information on Restaurant Menus. *Journal of Food Products Marketing*, *22*(1), 118-135. bth.
28. Dumas, A.-A., Lemieux, S., Lapointe, A., Provencher, V., Robitaille, J., & Desroches, S. (2020). Effects of an Evidence-Informed Healthy Eating Blog on Dietary Intakes and Food-Related Behaviors of Mothers of Preschool- and School-Aged Children : A Randomized Controlled Trial. Journal of the Academy of Nutrition and Dietetics, 120(1), 53-68. https://doi.org/10.1016/j.jand.2019.05.016
29. Dunford, E., Trevena, H., Goodsell, C., Ng, K. H., Webster, J., Millis, A., Goldstein, S., Hugueniot, O., & Neal, B. (2014). FoodSwitch : A Mobile Phone App to Enable Consumers to Make Healthier Food Choices and Crowdsourcing of National Food Composition Data. *Journal of Medical Internet Research*, *16*(8), 1-1. lxh.
30. Eyles, H., McLean, R., Neal, B., Jiang, Y., Doughty, R. N., McLean, R., & Ni Mhurchu, C. (2017). A salt-reduction smartphone app supports lower-salt food purchases for people with cardiovascular disease : Findings from the SaltSwitch randomised controlled trial. European Journal of Preventive Cardiology, 24(13), 1435-1444. https://doi.org/10.1177/2047487317715713
31. Finkelstein, E. A., Li, W., Melo, G., Strombotne, K., & Zhen, C. (2018). Identifying the effect of shelf nutrition labels on consumer purchases : Results of a natural experiment and consumer survey. The American Journal of Clinical Nutrition, 107(4), 647-651. https://doi.org/10.1093/ajcn/nqy014
32. Freedman, M. R., & Connors, R. (2010). Point-of-purchase nutrition information influences food-purchasing behaviors of college students : A pilot study. Journal of the American Dietetic Association, 110(8), 1222-1226. https://doi.org/10.1016/j.jada.2010.05.002
33. Gamburzew, A., Darcel, N., Gazan, R., Dubois, C., Maillot, M., Tome, D., Raffin, S., & Darmon, N. (2016). In-store marketing of inexpensive foods with good nutritional quality in disadvantaged neighborhoods : Increased awareness, understanding, and purchasing. International Journal of Behavioral Nutrition and Physical Activity, 13. Publicly Available Content Database. https://doi.org/10.1186/s12966-016-0427-1
34. Garaus, M., & Treiblmaier, H. (2021). The influence of blockchain-based food traceability on retailer choice : The mediating role of trust. Food Control, 129, 108082. https://doi.org/10.1016/j.foodcont.2021.108082
35. Gauthier, C., Bally, F., & Fornerino, M. (2021). From individual to collective empowerment : Investigating the Yuka mobile application case. *Working paper*.
36. GfK Belgium. (2014). CONSUMER INSIGHTS: KNOWLEDGE OF INGREDIENT AND NUTRITION INFORMATION OF ALCOHOLIC BEVERAGES OFF-LABEL INFORMATION AND ITS USE. Report.
37. Ghvanidze, S., Velikova, N., Dodd, T., & Oldewage-Theron, W. (2017). A discrete choice experiment of the impact of consumers' environmental values, ethical concerns, and health consciousness on food choices. British Food Journal, 119(4), 863-881. Business Premium Collection. https://doi.org/10.1108/BFJ-07-2016-0342
38. Goodman, S., Vanderlee, L., White, C. M., & Hammond, D. (2018). A quasi-experimental study of a mandatory calorie-labelling policy in restaurants : Impact on use of nutrition information among youth and young adults in Canada. Preventive Medicine, 116, 166-172. https://doi.org/10.1016/j.ypmed.2018.09.013
39. Grunert, K. G., Hieke, S., & Juhl, H. J. (2018). Consumer wants and use of ingredient and nutrition information for alcoholic drinks : A cross-cultural study in six EU countries. Food Quality and Preference, 63, 107-118. https://doi.org/10.1016/j.foodqual.2017.08.005
40. Gumirakiza, J. D., & VanZee, S. M. (2018). The Most Preferred Food Labels Among Online Shoppers. *Journal of Agricultural Science*, *10*(10).
41. Heller, J., Chylinski, M., de Ruyter, K., Mahr, D., & Keeling, D. I. (2019). Let Me Imagine That for You : Transforming the Retail Frontline Through Augmenting Customer Mental Imagery Ability. Journal of Retailing, 95(2), 94-114. https://doi.org/10.1016/j.jretai.2019.03.005

42. Hobin, E., Bollinger, B., Sacco, J., Liebman, E., Vanderlee, L., Zuo, F., Rosella, L., L'ABBE, M., Manson, H., & Hammond, D. (2017). Consumers' Response to an On-Shelf Nutrition Labelling System in Supermarkets : Evidence to Inform Policy and Practice. The Milbank Quarterly, 95(3), 494-534. International Bibliography of the Social Sciences (IBSS). https://doi.org/10.1111/1468-0009.12277
43. Hoffmann, S., Joerß, T., Mai, R., & Akbar, P. (2021). Augmented Reality-Delivered Product Information at the Point of Sale. *WP (under revision at JAMS)*.
44. Hou, Y., Yang, W., & Sun, Y. (2017). Do pictures help ? The effects of pictures and food names on menu evaluations. International Journal of Hospitality Management, 60, 94-103. https://doi.org/10.1016/j.ijhm.2016.10.008
45. Huang, A., Barzi, F., Huxley, R., Denyer, G., Rohrlach, B., Jayne, K., & Neal, B. (2006). The effects on saturated fat purchases of providing internet shoppers with purchase- specific dietary advice : A randomised trial. PLoS Clinical Trials, 1(5), e22. https://doi.org/10.1371/journal.pctr.0010022
46. Joerß, T., Hoffmann, S., Mai, R., & Akbar, P. (2021). Digitalization as solution to environmental problems? When users rely on augmented reality-recommendation agents. Journal of Business Research, 128, 510-523. https://doi.org/10.1016/j.jbusres.2021.02.019
47. Juan, M.-C., Charco, J. L., García-García, I., & Mollá, R. (2019). An Augmented Reality App to Learn to Interpret the Nutritional Information on Labels of Real Packaged Foods. Frontiers in Computer Science, 1. https://doi.org/10.3389/fcomp.2019.00001
48. Kaufman-Scarborough, C., & Childers, T. L. (2009). Understanding Markets as Online Public Places : Insights from Consumers with Visual Impairments. *Journal of Public Policy & Marketing*, *28*(1), 16-28. Business Source Complete.
49. Kerins, C., Cunningham, K., Finucane, F. M., Gibson, I., Jones, J., & Kelly, C. (2017). Effects of an icon-based menu labelling initiative on consumer food choice. Perspectives in Public Health, 137(1), 45-52. https://doi.org/10.1177/1757913916640826
50. Kiesel, K., & Villas-Boas, S. B. (2013). Can information costs affect consumer choice ? Nutritional labels in a supermarket experiment. International Journal of Industrial Organization, 31(2), 153-163. https://doi.org/10.1016/j.ijindorg.2010.11.002
51. Kostyra, E., Żakowska-Biemans, S., Śniegocka, K., & Piotrowska, A. (2017). Food shopping, sensory determinants of food choice and meal preparation by visually impaired people. Obstacles and expectations in daily food experiences. Appetite, 113, 14-22. https://doi.org/10.1016/j.appet.2017.02.008
52. Krešić, G., Liović, N., & Pleadin, J. (2019). Effects of menu labelling on students' food choice : A preliminary study. British Food Journal, 121(2), 479-491. Business Premium Collection. https://doi.org/10.1108/BFJ-03-2018-0188
53. Lee-Kwan, S. H., Pan, L., Maynard, L. M., McGuire, L. C., & Park, S. (2016). Factors Associated with Self-Reported Menu-Labeling Usage among US Adults. Journal of the Academy of Nutrition and Dietetics, 116(7), 1127-1135. https://doi.org/10.1016/j.jand.2015.12.015
54. Li, T., & Messer, K. D. (2019). To Scan or Not to Scan : The Question of Consumer Behavior and QR Codes on Food Packages. *Journal of Agricultural and Resource Economics*, *44*(2), 311-327.
55. Lin, X., Chang, S.-C., Chou, T.-H., Chen, S.-C., & Ruangkanjanases, A. (2021). Consumers' Intention to Adopt Blockchain Food Traceability Technology towards Organic Food Products. International Journal of Environmental Research and Public Health, 18(3), 912. http://dx.doi.org.grenoble-em.idm.oclc.org/10.3390/ijerph18030912
56. Lu, L., & Chi, C. G.-Q. (2018). Examining diners' decision-making of local food purchase : The role of menu stimuli and involvement. International Journal of Hospitality Management, 69, 113-123. https://doi.org/10.1016/j.ijhm.2017.10.012
57. Marty, L., Jones, A. & Robinson, E. Socioeconomic position and the impact of increasing availability of lower energy meals vs. menu energy labelling on food choice: two randomized controlled trials in a virtual fast-food restaurant. *Int J Behav Nutr Phys Act***17,** 10 (2020). https://doi.org/10.1186/s12966-020-0922-2
58. Melo, G., Zhen, C., & Colson, G. (2019). Does point-of-sale nutrition information improve the nutritional quality of food choices? Economics & Human Biology, 35, 133-143. https://doi.org/10.1016/j.ehb.2019.07.001
59. Minnens, F., Marques, A., Domingo, J. L., & Verbeke, W. (2020). Consumers' acceptance of an online tool with personalized health risk-benefit communication about seafood consumption. Food and Chemical Toxicology, 144, 111573. https://doi.org/10.1016/j.fct.2020.111573
60. Montandon, A. C., & Colli, C. (2016). Effective nutrition labels for fast food consumers. British Food Journal, 118(10), 2534-2549. Business Premium Collection. https://doi.org/10.1108/BFJ-03-2016-0111
61. Nianogo, R. A., Kuo, T., Smith, L. V., & Arah, O. A. (2016). Associations between self-perception of weight, food choice intentions, and consumer response to calorie information : A retrospective investigation of public health center clients in Los Angeles County before the implementation of menu-labeling regulation. BMC Public Health, 16, 1. Publicly Available Content Database. https://doi.org/10.1186/s12889-016-2714-9
62. Nicholson, J., Kulyukin, V., & Coster, D. (2009). ShopTalk : Independent Blind Shopping Through Verbal Route Directions and Barcode Scans. The Open Rehabilitation Journal, 11-23, 11-23. https://doi.org/10.2174/1874943700902010011
63. Nikolova, H. D., & Inman, J. J. (2015). Healthy Choice : The Effect of Simplified Point-of-Sale Nutritional Information

on Consumer Food Choice Behavior. Journal of Marketing Research (JMR), 52(6), 817-835. https://doi.org/10.1509/jmr.13.0270
64. Olstad, D. L., Vermeer, J., McCargar, L. J., Prowse, R. J. L., & Raine, K. D. (2015). Using traffic light labels to improve food selection in recreation and sport facility eating environments. Appetite, 91, 329-335. https://doi.org/10.1016/j.appet.2015.04.057
65. Oonk, L. (2013). QR CODES, QUICK RESPONSE OR QUICK REJECTION? : A study about the contribution of the phenomenon QR codes on food products, on the intention to seek information and the purchase intention. [Master's Thesis]. University of Twente.
66. Palacios, C., Torres, M., López, D., Trak-Fellermeier, M. A., Coccia, C., & Pérez, C. M. (2018). Effectiveness of the Nutritional App « MyNutriCart » on Food Choices Related to Purchase and Dietary Behavior : A Pilot Randomized Controlled Trial. Nutrients, 10(12). https://doi.org/10.3390/nu10121967
67. Perski, O., Jackson, S. E., Garnett, C., West, R., & Brown, J. (2019). Trends in and factors associated with the adoption of digital aids for smoking cessation and alcohol reduction : A population survey in England. Drug and Alcohol Dependence, 205, 107653. https://doi.org/10.1016/j.drugalcdep.2019.107653
68. Petimar, J., Moran, A. J., Ramirez, M., & Block, J. P. (2020). A Natural Experiment to Evaluate the Nutritional Content of Restaurant Meal Purchases After Calorie Labeling. Journal of the Academy of Nutrition and Dietetics, 120(12), 2039-2046. https://doi.org/10.1016/j.jand.2020.06.006
69. Petticrew, M., Douglas, N., Knai, C., Hessari, N. M., Durand, M. A., Eastmure, E., & Mays, N. (2017). Provision of information to consumers about the calorie content of alcoholic drinks : Did the Responsibility Deal pledge by alcohol retailers and producers increase the availability of calorie information? Public Health, 149, 159-166. https://doi.org/10.1016/j.puhe.2017.04.020
70. Pratt, N. S., Ellison, B. D., Benjamin, A. S., & Nakamura, M. T. (2016). Improvements in recall and food choices using a graphical method to deliver information of select nutrients. Nutrition Research, 36(1), 44-56. https://doi.org/10.1016/j.nutres.2015.10.009
71. Rahkovsky, I., Lin, B.-H., Lin, C.-T. J., & Lee, J.-Y. (2013). Effects of the Guiding Stars Program on purchases of ready-to-eat cereals with different nutritional attributes. Food Policy, 43, 100-107. https://doi.org/10.1016/j.foodpol.2013.08.013
72. Restrepo, B. J. (2017). Calorie Labeling in Chain Restaurants and Body Weight : Evidence from New York. Health Economics, 26(10), 1191-1209. Business Premium Collection. https://doi.org/10.1002/hec.3389
73. Ryu, J. S., & Murdock, K. (2013). Consumer acceptance of mobile marketing communications using the QR code. Journal of Direct, Data and Digital Marketing Practice, 15(2), 111-124. https://doi.org/10.1057/dddmp.2013.53
74. Sacks, G., Tikellis, K., Millar, L., & Swinburn, B. (2011). Impact of « traffic-light » nutrition information on online food purchases in Australia. *Australian & New Zealand Journal of Public Health*, *35*(2), 122-126. bth.
75. Sahingoz, S. A. (2012). Visually Impaired Consumers and Food Shopping. *British Journal of Humanities and Social Sciences*, *7*(1), 63-74.
76. Salmon, S. J., De Vet, E., Adriaanse, M. A., Fennis, B. M., Veltkamp, M., & De Ridder, D. T. D. (2015). Social proof in the supermarket : Promoting healthy choices under low self-control conditions. Food Quality and Preference, 45, 113-120. https://doi.org/10.1016/j.foodqual.2015.06.004
77. Samoggia, A., & Riedel, B. (2020). Assessment of nutrition-focused mobile apps' influence on consumers' healthy food behaviour and nutrition knowledge. Food Research International, 128, 108766. https://doi.org/10.1016/j.foodres.2019.108766
78. Sander, F., Semeijn, J., & Mahr, D. (2018). The acceptance of blockchain technology in meat traceability and transparency. *British Food Journal*, *120*(9), 2066–2079. http://dx.doi.org.grenoble-em.idm.oclc.org/10.1108/BFJ-07-2017-0365
79. Scully, M., Morley, B., Wakefield, M., & Dixon, H. (2020). Can point-of-sale nutrition information and health warnings encourage reduced preference for sugary drinks? : An experimental study. Appetite, 149, 104612. https://doi.org/10.1016/j.appet.2020.104612
80. Seenivasan, S., & Thomas, D. (2016). Negative consequences of nutrition information disclosure on consumption behavior in quick-casual restaurants. *Journal of Economic Psychology*, *55*, 51-60. bth.
81. Shew, A. M., Snell, H. A., Nayga, R. M., & Lacity, M. C. (2021). Consumer valuation of blockchain traceability for beef in the United States. *Applied Economic Perspectives and Policy*, *n/a*(n/a), 25. https://doi.org/10.1002/aepp.13157
82. Smith, K. C., Cukier, S., & Jernigan, D. H. (2014). Defining strategies for promoting product through « drink responsibly » messages in magazine ads for beer, spirits and alcopops. Drug and Alcohol Dependence, 142, 168-173. https://doi.org/10.1016/j.drugalcdep.2014.06.007
83. Stran, K. A., Knol, L. L., Turner, L. W., Severt, K., McCallum, D. M., & Lawrence, J. C. (2016). College Students Must Overcome Barriers to Use Calorie Labels in Fast-Food Restaurants. Journal of Nutrition Education and Behavior, 48(2), 122-130.e1. https://doi.org/10.1016/j.jneb.2015.09.009
84. Sutherland, L. A., Kaley, L. A., & Fischer, L. (2010). Guiding stars : The effect of a nutrition navigation program on consumer purchases at the supermarket. The American Journal of Clinical Nutrition, 91(4), 1090S-1094S.

https://doi.org/10.3945/ajcn.2010.28450C
85. Theis, D. R. Z., & Adams, J. (2019). Differences in energy and nutritional content of menu items served by popular U.K. chain restaurants with versus without voluntary menu labelling : A cross-sectional study. PLoS One, 14(10). Publicly Available Content Database. https://doi.org/10.1371/journal.pone.0222773
86. Todd, J. E., Mancino, L., Restrepo, B. J., Kavanaugh, C., Dicken, C., & Breneman, V. (2021). FOOD AWAY FROM HOME AND CALORIC INTAKE: THE ROLE OF RESTAURANT MENU LABELING LAWS. *Economic Inquiry*, *59*(1), 53-71. bth.
87. Tsai, H., Lee, Y.-P., & Ruangkanjanases, A. (2020). Understanding the Effects of Antecedents on Continuance Intention to Gather Food Safety Information on Websites. Frontiers in Psychology, 11. https://doi.org/10.3389/fpsyg.2020.579322
88. van Esch, P., Arli, D., Gheshlaghi, M. H., Andonopoulos, V., von der Heidt, T., & Northey, G. (2019). Anthropomorphism and augmented reality in the retail environment. Journal of Retailing and Consumer Services, 49, 35-42. https://doi.org/10.1016/j.jretconser.2019.03.002
89. Vanderlee, L. (2016). Examining the Impact of a Nutrition Labelling Program on Menus in a Cafeteria Setting [UWSpace]. http://hdl.handle.net/10012/10401
90. Vasiljevic, M., Fuller, G., Pilling, M., Hollands, G. J., Pechey, R., Jebb, S. A., & Marteau, T. M. (2019). What is the impact of increasing the prominence of calorie labelling ? A stepped wedge randomised controlled pilot trial in worksite cafeterias. Appetite, 141, 104304. https://doi.org/10.1016/j.appet.2019.05.035
91. Vecchio, R., Annunziata, A., & Mariani, A. (2018). Is More Better ? Insights on Consumers' Preferences for Nutritional Information on Wine Labelling. Nutrients, 10(11), 1667. https://doi.org/10.3390/nu10111667
92. White, C. M., Lillico, H. G., Vanderlee, L., & Hammond, D. (2016). A voluntary nutrition labeling program in restaurants : Consumer awareness, use of nutrition information, and food selection. Preventive Medicine Reports, 4, 474-480. https://doi.org/10.1016/j.pmedr.2016.08.015
93. Woodward-Lopez, G., Kao, J., Kuo, E. S., Rauzon, S., Taylor, A. C., Goette, C., Collins, C., Gonzalez, E. P., Ronshausen, D. R., Boyle, K., Williamson, D., & Cheadle, A. (2018). Changes in Consumer Purchases in Stores Participating in an Obesity Prevention Initiative. Building Thriving Communities Through Comprehensive Community Health Initiatives: Evaluations from 10 Years of Kaiser Permanente's Community Health Initiative to Promote Healthy Eating and Active Living, 54(5, Supplement 2), S160-S169. https://doi.org/10.1016/j.amepre.2017.12.002
94. Yeh, J.-Y., Liao, S.-C., Wang, Y.-T., & Chen, Y.-J. (2019). Understanding Consumer Purchase Intention in a Blockchain Technology for Food Traceability and Transparency context. *2019 IEEE Social Implications of Technology (SIT) and Information Management (SITIM)*, 1–6. https://doi.org/10.1109/SITIM.2019.8910212
95. You, J.-J., Jong, D., & Wiangin, U. (2020). Consumers' Purchase Intention of Organic Food via Social Media : The Perspectives of Task-Technology Fit and Post-acceptance Model. Frontiers in Psychology, 11, 579274. https://doi.org/10.3389/fpsyg.2020.579274
96. Zhen, C., & Zheng, X. (2020). The Impact of NuVal Shelf Nutrition Labels on Food Purchase. *Applied Economic Perspectives & Policy*, *42*(4), 870-887. bth.
97. Zou, P., & Liu, J. (2019). How nutrition information influences online food sales. Journal of the Academy of Marketing Science, 47(6), 1132-1150. https://doi.org/10.1007/s11747-019-00668-4

16. References

Azuma, R., Baillot, Y., Behringer, R., Feiner, S., Julier, S., & MacIntyre, B. (2001). Recent advances in augmented reality. *IEEE computer graphics and applications*, *21*(6), 34-47.

BEUC - The European Consumer Organization. (2021). *WHY MOVING ESSENTIAL PRODUCT INFORMATION ONLINE IS A NO-GO*.

Bleich, S. N., Economos, C. D., Spiker, M. L., Vercammen, K. A., VanEpps, E. M., Block, J. P., Elbel, B., Story, M., & Roberto, C. A. (2017). A Systematic Review of Calorie Labeling and Modified Calorie Labeling Interventions : Impact on Consumer and Restaurant Behavior. *Obesity (Silver Spring, Md.)*, *25*(12), 2018-2044. https://doi.org/10.1002/oby.21940

Bruce, I., Harrow, J., & Obolenskaya, P. (2007). Blind and partially sighted people's perceptions of their inclusion by family and friends. *British Journal of Visual Impairment*, *25*(1), 68-85. https://doi.org/10.1177/0264619607071778

Carrefour. (2018). *Carrefour is now using blockchain technology with Auvergne farmyard fattened chicken and Carrefour Quality Line oranges*. Carrefour Group. https://www.carrefour.com/en/newsroom/carrefour-now-using-blockchain-technology-auvergne-farmyard-fattened-chicken-and-carrefour

Crockett, R. A., King, S. E., Marteau, T. M., Prevost, A. T., Bignardi, G., Roberts, N. W., Stubbs, B., Hollands, G. J., & Jebb, S. A. (2018). Nutritional labelling for healthier food or non-alcoholic drink purchasing and consumption. *Cochrane Database of Systematic Reviews*, *2*. https://doi.org/10.1002/14651858.CD009315.pub2

Dubois, P., Albuquerque, P., Allais, O., Bonnet, C., Bertail, P., Combris, P., Lahlou, S., Rigal, N., Ruffieux, B., & Chandon, P. (2021). Effects of front-of-pack labels on the nutritional quality of supermarket food purchases : Evidence from a large-scale randomized controlled trial. *Journal of the Academy of Marketing Science*, *49*(1), 119-138.

Facts and figures | European Blind Union. (s. d.). Consulté 4 juillet 2021, à l'adresse http://www.euroblind.org/about-blindness-and-partial-sight/facts-and-figures#details

Fernandes, A. C., Oliveira, R. C., Proença, R. P., Curioni, C. C., Rodrigues, V. M., & Fiates, G. M. (2016). Influence of menu labeling on food choices in real-life settings : A systematic review. *Nutrition reviews*, *74*(8), 534-548.

Gallus, B. (2021). *METRO FAO Blue Fishing Port Workshop*.

Harnack, L. J., & French, S. A. (2008). Effect of point-of-purchase calorie labeling on restaurant and cafeteria food choices : A review of the literature. *International Journal of Behavioral Nutrition and Physical Activity*, *5*(1), 1-6.

IBM Institute for Business Value. (2020). *Meet the 2020 consumers driving change*.

Jarvis, R. (2020). *How food producers can leverage blockchain to build consumer trust*. https://www.refrigeratedfrozenfood.com/articles/98960-how-food-producers-can-leverage-blockchain-to-build-consumer-trust?v=preview

Katz, D. L., Njike, V. Y., Faridi, Z., Rhee, L. Q., Reeves, R. S., Jenkins, D. J., & Ayoob, K. T. (2009). The stratification of foods on the basis of overall nutritional quality : The overall nutritional quality index. *American Journal of Health Promotion*, *24*(2), 133-143.

Kiszko, K. M., Martinez, O. D., Abrams, C., & Elbel, B. (2014). The influence of calorie labeling on food orders and consumption : A review of the literature. *Journal of community health*, *39*(6), 1248-1269.

Long, M. W., Tobias, D. K., Cradock, A. L., Batchelder, H., & Gortmaker, S. L. (2015). Systematic review and meta-analysis of the impact of restaurant menu calorie labeling. *American journal of public health*, *105*(5), e11-e24.

Matsunaka, K., Inoue, A., & Miyata, Y. (2002). The effect of sight levels on daily stressors and coping styles. *Japanese Psychological Research*, *44*(1), 1-8.

Newman, C. L., Howlett, E., & Burton, S. (2016). Effects of objective and evaluative front-of-package cues on food evaluation and choice : The moderating influence of comparative and noncomparative processing contexts. *Journal of Consumer Research*, *42*(5), 749-766.

Nott, G. (2019). *Can blockchain join the dots at last in grocery?* The Grocer. https://www.thegrocer.co.uk/supply-chain/can-blockchain-join-the-dots-at-last-in-grocery/599245.article

Redmayne, J. (2019). *From bait to plate : Blockchain platform tracks food's journey—CIO New Zealand*. https://www2.cio.co.nz/article/656633/from-bait-plate-blockchain-platform-tracks-food-journey/

Roberto, C. A., Schwartz, M. B., & Brownell, K. D. (2009). Rationale and evidence for menu-labeling legislation. *American journal of preventive medicine*, *37*(6), 546-551.

Roembke, J. (2019, mai 31). Blockchain technology has big potential beyond transparency. *Feed Strategy*. https://www.feedstrategy.com/feed-mill-management/blockchain-technology-has-big-potential-beyond-transparency/

Sarink, D., Peeters, A., Freak-Poli, R., Beauchamp, A., Woods, J., Ball, K., & Backholer, K. (2016). The impact of menu energy labelling across socioeconomic groups : A systematic review. *Appetite*, *99*, 59-75.

Schwarz, N. (2004). Metacognitive experiences in consumer judgment and decision making. *Journal of Consumer Psychology*, *14*(4), 332-348.

Sinclair, S. E., Cooper, M., & Mansfield, E. D. (2014). The influence of menu labeling on calories selected or consumed : A systematic review and meta-analysis. *Journal of the Academy of Nutrition and Dietetics*, *114*(9), 1375-1388.

Spirits of Europe. (2021). *Memorandum of Understanding (MoU) on the provision of nutrition information & ingredient listing of spirits drinks sold in the EU*.

Spirits Summit. (2020). *EU leadership in digital consumer information*.

Swartz, J. J., Braxton, D., & Viera, A. J. (2011a). Calorie menu labeling on quick-service restaurant menus : An updated systematic review of the literature. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 1-8.

Swartz, J. J., Braxton, D., & Viera, A. J. (2011b). Calorie menu labeling on quick-service restaurant menus : An updated systematic review of the literature. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 1-8.

Treiblmaier, H. (2018). The impact of the blockchain on the supply chain : A theory-based research framework and a call for action. *Supply Chain Management: An International Journal*.

U.S. Food and Drug Administration. (2021). Menu Labeling Requirements. *FDA*. https://www.fda.gov/food/food-labeling-nutrition/menu-labeling-requirements

VanEpps, E. M., Roberto, C. A., Park, S., Economos, C. D., & Bleich, S. N. (2016). Restaurant menu labeling policy : Review of evidence and controversies. *Current obesity reports*, *5*(1), 72-80.

Zlatevska, N., Neumann, N., & Dubelaar, C. (2018). Mandatory Calorie Disclosure : A Comprehensive Analysis of Its Effect on Consumers and Retailers. *Journal of Retailing*, *94*(1), 89-101. https://doi.org/10.1016/j.jretai.2017.09.007

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