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CONSUMER PERCEPTION OF FOOD SAFETY IN EUROPE: A SYSTEMATIC REVIEW

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Abstract

Despite one of the safest food systems globally, ongoing concerns among European consumers underscore the importance of food safety across the continent. This paper explores consumer knowledge, perception, and practices of food safety in Europe, with a focus on the influence of socioeconomic factors. Through a systematic review of the past decade's publications and survey data analysis, we found diverse perception**s**, driven by factors such as age, information source, and cooking frequency. Although Europeans are generally well-informed, significant gaps in understanding emerging technologies persist. Our findings suggest enhancing consumer education to bridge perception gaps and improve food safety practices.

Keywords: Food Safety, Consumer Perception, Food Awareness, Systematic Literature Review

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1. Introduction

Foodborne diseases increasingly threaten public health, with around 600 million people falling ill from contaminated food each year. This results in approximately 420,000 deaths and arises from over 200 types of foodborne infections, disproportionately impacting the poor and young (WHO 2022). Improving food safety is crucial for reducing these illnesses and encouraging economic growth (FAO 2023a).

Globalisation has fueled consumer demand for more food options, leading to a more sophisticated and lengthy global food supply chain, amplifying food safety challenges. Minor issues can escalate into significant crises, with local incidents quickly becoming international emergencies due to the rapid spread of foodborne hazards and deficiencies in food safety protocols, allowing unsafe products to infiltrate the international market (FAO and WHO 2023). Effective management of these risks requires cross-sectoral collaboration and prompt international communication. Climate change will also impact food safety (WHO 2022), with rising temperatures, soil degradation, and periods of extreme drought followed by rainfalls, fostering conditions for pathogens in food (FAO 2022). Scientific evidence increasingly correlates climate change to a higher risk of foodborne diseases, such as rising *Salmonella* and *Campylobacter* infections in warmer temperatures (Kuhn et al. 2020; Lake 2017).

Additionally, the food and agriculture sector has faced severe disruptions from the **COVID-19 pandemic** (FAO n.d.), highlighting the vulnerability and interconnectedness of food systems. With the global population projected to reach 9.8 billion by 2050 (UN n.d.), the **demand for food** is expected to surge by over 50% (EFSA 2021), necessitating the exploration of alternative food sources and innovative production methods. Ensuring the safety of these new options is paramount for protecting human, animal, and environmental health. Moreover, the increasing complexity of foodborne diseases underscores the need for **more robust tracking technologies**

to safeguard public health and the economy (WHO 2019). On a global scale, ensuring food safety is crucial to achieving Sustainable Development Goal (SDG) 3, focusing on reducing illness and deaths from contamination and improving risk warning systems (Appendix 2) (EFSA 2021). To manage it effectively, responsibility must be shared among government entities, farmers, food businesses and consumers (World Bank 2018).

Europe's regulatory framework positions its food system among the safest globally, yet evolving challenges such as malnutrition, non-communicable diseases, and resource depletion call for innovative food safety strategies (EFSA 2021). European consumers enjoy high protection levels against food chain risks thanks to strict standards and comprehensive risk assessments conducted by scientists and governments. However, several food scandals have significantly influenced consumer confidence in food safety, leading to changes in European food policy, legislation, and safety systems. This includes adopting a more transparent and science-based approach, emphasising accountability, traceability and the distinction between risk assessment and management (Banati 2014). Despite advancements making food safer than ever, Europeans remain unsure and concerned regarding the safety of what they eat.

The paper aims to explore the food safety landscape in Europe, with a specific focus on consumer perception. It is organised as follows: Section 2 provides a background on the EU food safety system, offering theoretical and contextual understanding. Section 3 describes the study's methodology, detailing the systematic literature review (SLR) process — from the search and screening to the selection of papers and for the survey. Section 4 analyses findings from the SLR, identifying knowledge gaps. In Section 5, we analyse insights from the survey. Section 6 summarises the key takeaways from the triangulation. Finally, Section 7 concludes the paper, discussing study limitations and directions for future research.

2. Background

2.1 History of food safety in Europe

Foodborne outbreaks are “incidents in which two or more people develop the same disease or infection following the consumption of a common contaminated food” (EFSA 2022). Most pathogens responsible for these outbreaks are **zoonotic**, meaning they can be transmitted from animals to humans (EFSA 2022). Throughout history, foodborne illnesses have arisen from intentional or unintentional behaviour and the government's inability to ensure food safety and quality. Notable unintentional incidents include the BSE crisis in 1995, the contamination of chicken with dioxin in Belgium in 1999, and the E. coli outbreak linked to sprouts in 2011 (Appendix 3). On the other hand, food fraud involves intentional and deceptive practices aimed at gaining economic advantage (EFSA n.d.). This has been an issue throughout history, but recent scandals have brought it into the spotlight, raising concerns among consumers, businesses, and policymakers. In 2013, inspections showed that some pre-packaged foods like hamburgers contained horsemeat, though the label only mentioned the presence of beef, which is known to be more costly. The situation prompted a collaborative response from European and national authorities to address the issue and rebuild trust in the food market (EU 2014).

Whereas chemical contaminants were the primary cause of earlier outbreaks, recent cases have been predominantly caused by microbiological pathogens (Fung Wang and Menon 2018). Contamination that leads to these outbreaks can occur at various stages of the supply chain, from farms and processing facilities to points of consumption like restaurants and homes or during transportation and storage (EFSA 2021a; Moi et al. 2022). Annually, the EU reports an average of over 5,000 foodborne outbreaks, leading to roughly 45,000 cases of illness, although underreporting likely inflates these figures (EFSA 2021a; EFSA 2022) (Appendix 4). C*ampylobacteriosis* and *salmonellosis* are the two most frequently reported foodborne illnesses

in Europe, with eggs, meats, fish, vegetables, and mixed foods being the most frequently linked to outbreaks (Appendix 5). The year 2022 marked a decade-high in deaths, primarily caused by *Listeria monocytogenes* (EFSA and ECDC 2023). Other prevalent pathogens like *Escherichia coli* (E. coli) and *norovirus*, coupled with the challenge of antimicrobial resistance — where bacteria become resistant to antibiotics, complicating the treatment of infections — present a growing public health concern. With food being traded internationally, it is crucial to align standards across borders and establish strong national regulations, legal frameworks, and enforcement measures (FAO 2023b). The world's strictest regulations are found in the EU, impacting its 27 Member States and the international food sector (Biosafe 2023).

2.2 Overview of the European Food Safety System

2.2.1 European Food Safety Authority (EFSA)

The oversight of food safety within the EU is assigned to the European Food Safety Authority (EFSA) and the European Commission (EC) (Martirosyan and Singharaj 2016). Established in 2002 in response to several food crises, EFSA provides a scientific foundation for laws and regulations that protect European consumers from food-related risks. EFSA aims to ensure consumer protection, improve the EU food safety system, and maintain confidence in the EU food supply chain. EFSA provides independent and transparent scientific advice on food risks to risk managers and policymakers to reach these goals, supported by 600 scientists and 1,500 experts (EFSA 2023a). Furthermore, EFSA generates annual *EU Summary Reports* using data from EU Member States on zoonoses, zoonotic agents, antimicrobial resistance, and foodborne outbreaks (Amore et al. 2022; Boelaert 2016). However, this data should be evaluated cautiously because of the lack of harmonisation in reporting practices across the EU (Boqvist, Söderqvist and Vågsholm 2018). Factors such as global trade and tourism, added a worldwide perspective to food safety, leading EFSA to engage with international networks and regulatory agencies (Appendix 6) to minimise scientific disagreement (EFSA 2023a, 2024a).

2.2.2 Governance and independence

The Management Board assures that EFSA runs smoothly and satisfies the needs of national and European organisations and stakeholders while operating in the public's interest (Appendix 7). The Executive Director oversees daily operations alongside the Management Team (EFSA 2024a). A crucial part of EFSA's role is to maintain the impartiality of the experts involved, which is guided by a policy that ensures legal and financial independence (EFSA 2017).

2.2.3 Food policy, strategies, and tools

The **EU's food safety policy** is designed to protect consumers while ensuring the seamless functioning of the single market. It focuses on the entire food supply chain — from farm to fork— adopting a "one health" approach and addressing various safety considerations, including hygiene protocols, packaging, and labelling. The policy targets four critical domains— *food hygiene*, *animal health*, *plant health*, and the management of *contaminants and residues* — setting **standards** to uphold them (EU n.d.a). In 2020, the EC introduced the **Farm to Fork (F2F) strategy** as a critical component of the Green Deal, aiming to protect those critical areas and make the European food system more sustainable (EFSA 2021a, Appendix 8). The EU also implemented **warning and tracking systems** to monitor foodborne hazards in the food chain (EFSA 2022). Imports from non-EU countries must adhere to the same strict standards and undergo the same **controls** as European food products (EU n.d.b).

2.2.4 Risk assessment and risk communication

The **risk assessment** process at EFSA begins when it receives a request for scientific advice from the EC, EP, Member States or through EFSA's initiative (Appendix 9). A scientific group prepares a draft, examining scientific data and potentially seeking further information. The conclusions are published in the EFSA Journal (EFSA 2024a) upon majority panel approval. **Risk communication** is key because it connects scientific findings with public awareness.

Hence, EFSA adopted an *audience-first* approach, tailoring its communication to cater to experts and the public (EFSA 2024a, Appendix 10). Adopting the Transparency Regulation in 2021 has broadened EFSA's responsibilities towards EU citizens, emphasising its pivotal role in risk communication within today's digital landscape, which poses new challenges to how we communicate about risks (EFSA 2021b, Appendix 8).

2.3 Consumer perception of food safety

In addition to being essential for the health of consumers, access to food that is safe and nutritious is a fundamental human right (Baert et al. 2011; UN 2010). Historically, food safety has been characterised as the guarantee that food will not harm the consumer, covering *intentional* and *unintentional* contamination (Manning and Soon 2016). However, newer studies differentiate between these two aspects: *food safety* focuses on preventing unintentional contamination, while *food defence* protects against intentional threats (USDA 2023).

Consumer perception of food safety has been a dynamic field of study. Since the 90s, food safety incidents have raised concern, decreasing **public trust** in regulatory efforts (Frewer, de Jonge and van Kleef 2004; Kendall et al. 2019). Diverse dietary habits, cultural norms, and regulatory landscapes across Europe lead to different citizens' requirements for food safety information (EFSA 2021b). As awareness grows, consumer expectations evolve, demanding more stringent safety measures. However, the complexity of technological advancements in food production often remains hard to understand by the public (Banati 2014). Europeans increasingly feel the burden of food costs, prioritising price in their **buying decisions** (EFSA 2022). However, food safety remains a key purchase consideration (EU 2022a). In 2022, most EU citizens felt that food safety might be improved, while 41% assumed the food they purchase to be safe (Jaskiewicz et al. 2023; EFSA 2022). Numerous studies have helped understand consumer perception of food safety, ranging from confidence in food systems to the effect of

labels on behaviour. Factors shaping these perceptions include trust in food chain actors, experience with food safety incidents (De Jonge et al. 2007), and socioeconomic factors (Zanetta et al. 2022). However, existing literature has not come together to form a single and coherent understanding of Europeans' perceptions of food safety. To bridge this gap, this paper consolidates recent findings and presents the contemporary insights of a quantitative survey.

3. Methodology

3.1 Systematic Literature Review (SLR)

This paper presents the results of a systematic literature review (SLR), offering a structured and comprehensive overview of the existing literature on consumer perception of food safety. The choice of an SLR, known for its clarity, reproducibility, and scientific rigour (Mian et al. 2005), allows for examining the vast array of studies while reducing the likelihood of biases. The goal is to understand the current state of knowledge and identify trends and gaps in the literature. The SLR was conducted following the methodology Kitchenham and Charters (2007) outlined. Details on the course of these steps are described in the following subsections.

3.1.1 Research Questions

Defining research questions is crucial as they guide the design of the review (Kitchenham and Charters 2007). The two research questions (RQs) that were investigated are displayed below.

Table 1. Research questions

RQ1	How do consumers perceive food safety in Europe?
RQ2	What factors (social, economic, educational, cultural) influence Europeans' perception of food safety?

3.1.2 Search process

Our research was conducted across seven electronic databases —Science Direct, Springer Link, Business Source Complete, Wiley Online Library, Web of Science, PubMed, and Emerald

(Appendix 11)— chosen for their vast range of scientific articles and advanced search features. These databases provided the primary studies, which consisted of peer-reviewed papers that included specific search terms (Table 2) in their title, abstract, keywords, or main text.

Table 2. Search terms

Major terms	**Synonyms**
Food safety	"Food safety"
Consumer	Consumer OR Public
Perception	Perception OR Trust OR Awareness OR Belief
Europe	Europe OR European Union OR EU
Factors	Factors OR Drivers OR Determinants

3.1.3 Eligibility

The papers underwent a meticulous review process assessing their relevance to the subject, information accuracy and contribution to the existing body of knowledge. We defined the scope of the review to include studies published from 2014 to 2024. Inclusion and exclusion criteria were defined to determine which papers would be considered for the review (Tables 3 and 4). The selection of papers occurred in two distinct phases: an initial screening of titles and abstracts followed by a full-text review. Appendix 12 illustrates the study selection process, inspired by the PRISMA diagram, with included studies detailed in Appendix 13.

Table 3. Inclusion criteria (IC)

- Year of publication: from 2014 to April 2024
- Origin (where the study was conducted): Europe
- Purpose: studies investigating consumers' knowledge, perceptions, and practices towards food safety, including their information sources and trust in food integrity.
- Population and sample size: European consumers
- Academic peer-reviewed journals
- Articles available in English

Table 4. Exclusion criteria (EC)

• Articles that were not retrievable in full text from any of the databases • Duplicated papers • Studies on health, nutrition, or sustainability rather than food safety. • Studies on stakeholders' perspectives (experts, farmers, etc.) rather than consumers • Studies on one specific food category (meat, poultry, eggs, organic food), issue (pesticides, food additives, etc.) or new technology (GMO, traceability, etc.)

3.2 Survey

For complementary purposes, we distributed an online survey, chosen for its suitability for statistical analysis (Balla and Dimitropoulos 2022). Based on the insights from the SLR, we formulated survey questions, ensuring that the collected data enabled triangulation (Appendix 14). To analyse the data, we performed one-factor Analysis of Variance (ANOVA), a statistical method assessing the difference in average values across multiple groups (Will 2024). It helped us identify significant disparities in food safety knowledge, perception, and practices among demographic groups. The analysis assumed a normal distribution of data, similar variances within each group, and independent survey responses (Will 2024).

3.3 Triangulation

Our paper combines two methods of data gathering: the SLR and the survey. We ensure a comprehensive analysis by cross-verifying information, a method known as triangulation (Balla and Dimitropoulos 2022). Therefore, we identified different demographic groups from the SLR to serve as independent variables (e.g. age, gender, education level), and we analyzed their impact on the dependent variables, applying a 5% significance level. Next, we could validate or challenge patterns observed in the literature and assess their relevance to current consumer behaviours and perceptions.

4. Systematic Literature Review

This section outlines the findings related to the two RQs. Following the screening process, 35 eligible studies were selected for the systematic review, including the 2022 Eurobarometer on food safety — a survey conducted across Europe through interviews with 27,000 individuals. These studies explore a wide range of food safety dimensions, including knowledge, risk perception, and consumer trust. While most papers address the general population, some target specific segments such as young consumers or future food handlers. While young people do not represent a particularly high-risk group, their future roles as potential parents or professionals in food sectors are critical (Marklinder et al. 2020; Smigic, Lazarov and Djekic 2020). The review juxtaposes general findings with insights on these key subgroups.

4.1 Food safety awareness and knowledge

4.1.1 General population

Most Europeans are informed about concerns, such as the use of additives, pesticide residues in food, antibiotics, or hormones in meat (Gallani 2022). However, there are significant variations in how familiar consumers are with **different food risks**. Consumers tend to be more familiar with food poisoning and additives, while their knowledge of emerging technologies like nanotechnology, 3D printed food, and lab-grown meat remains limited (van der Vossen-Wijmenga et al. 2022; Jenkins, Harris and Osman 2020). Additionally, high levels of awareness exist regarding various components of the **EU food safety framework** (EU 2022a). Roughly 70% of Europeans recognise that strict regulations ensure the safety of their food and that EU authorities depend on scientific experts to assess food risks.

Education enhances general awareness of food safety issues and the ability to understand complex information about food risks (Gallani 2022; Etienne et al. 2018). People with a scientific background are better equipped to understand communications about food-related

uncertainties from regulatory bodies. In contrast, those without that background prefer clear conclusions about risk assessment, such as whether a product is safe, rather than uncertainties. While Bei et al. (2021) demonstrated that knowledge of food product safety is linked with **gender**, Moretro et al. (2021) noted that risk awareness varies across **countries**.

4.1.2 Youth

Research across different countries, including Sweden (Marklinder et al. 2020; Lange, Gorazon and Marklinder 2016), Slovenia (Ovca et al. 2014, 2017), Poland (Franc-Dąbrowska et al. 2021; Tomaszewska et al. 2021) and Serbia (Smigic, Lazarov and Djekic 2020), shows that young consumers often have **limited knowledge** about food safety. For example, Polish students have a relatively accurate yet incomplete understanding of food safety, primarily recognising it as food that is safe for health, appropriately stored and produced (Franc-Dąbrowska et al. 2021). They often perceive food safety through isolated aspects and fail to consider it within the multifaceted context of national and European laws. Similarly, Polish children aged 8 to 9 demonstrated limited knowledge of food preparation and storage (Tomaszewska et al. 2021). Ovca et al. (2014) also identified a knowledge gap among Slovenian children aged 10 to 12 regarding the appropriate cooking and storing temperatures. By contrast, a study in Bulgaria found that 85% of students demonstrated high food safety knowledge (Stratev et al. 2017).

Research indicates that **gender** and **age** do not significantly influence students' knowledge of food safety (Stratev et al. 2017; Marklinder et al. 2020). This is supported by Tomaszewska et al. (2021), who observed similar knowledge levels among girls and boys. However, conflicting findings by Lange et al. (2018) suggest that girls exhibit higher awareness. Factors such as students' **residential location** or **prior food poisoning experience** do not seem to impact their knowledge (Ovca et al. 2014). The strong correlation between self-assessed and actual levels of knowledge is encouraging (Smigic, Lazarov and Djekic 2020; Marklinder et al. 2020).

4.2 Sources of food safety information

4.2.1 General population

Food safety outbreaks are causing debates and influencing consumers' attitudes across Europe (Banati 2014). Mass media is often criticised for amplifying food-related risk situations or spreading emotional information that could unfavourably affect consumer decisions (Tiozzo et al. 2017). However, studies reveal that consumers primarily rely on **television** for food alerts, followed by the **Internet,** especially among younger individuals (Niewczas 2014; Tiozzo et al. 2017; Pinto et al. 2015). Interestingly, people who mainly rely on information from the mass media rather than from family and friends tend to feel more vulnerable to foodborne illness and, therefore, adopt a self-protective attitude toward food risk (Pinto et al. 2015). Most consumers are attentive to warnings about food hazards, indicating a **general vigilance** about food safety (Niewczas 2014). Following food safety incidents, Europeans with higher levels of **education** are more likely to keep an eye on the news (Gallani 2022). By contrast, lower-educated people were more inclined to seek advice from family and friends. Despite differences among countries, 70% of Europeans reported an interest in food safety (EU 2022a).

Consumers also rely on **food labels** for safety information. While many Italians frequently check food labels during purchases (Tiozzo et al. 2017; Pinto et al. 2015), 40% of Turkish consumers rarely read them (Bayram and Ozturkcan 2023). The most used indicator is the expiry date (Haas et al. 2021; Tiozzo et al. 2017; Bayram and Ozturkcan 2023; Pinto et al. 2015). Consumers also frequently check other details such as the product's origin, ingredients, storage conditions, brand and price. However, many consumers struggle to interpret food labels. Consumers believe that these labels fail to warn about potential consumption risks and that correctly interpreting these often necessitates prior knowledge (Tiozzo et al. 2017). Moreover, the growing complexity of food labelling may lead consumers to overlook crucial information, emphasising the need to balance detailed content and ease of understanding (Finardi and Vaqué

2015). **Women** were more likely than men to read expiration dates, storage conditions, and ingredient lists (Bayram and Ozturkcan 2023; Haas et al. 2021; van der Vossen-Wijmenga et al. 2022). Moreover, **more educated** consumers are more attentive to food safety information (Hass et al. 2021; Bayram and Ozturkcan 2023). Other demographic factors like **age, income,** and **household size** showed weak correlations with the perception of cues (Hass et al. 2021).

4.2.2 Youth

Research focusing on children and young adults shows that **parents** often serve as a primary source of information on food safety (Ovca et al. 2017b.; Marklinder et al. 2020). This is particularly true among girls, who are more likely to rely on their mothers, whereas boys rely on a wider range of sources like other family members and physicians (Lange et al. 2018; Ovca et al. 2014). At the primary school level, parents are generally seen as the most influential in learning about food poisoning prevention, but this changes as students grow older and turn their attention to teachers and trainers in food businesses (Ovca 2014, 2017b). Those who rely on professors tend to have better food safety knowledge than those who depend on family, friends, or the Internet (Smigic, Lazarov and Djekic 2020; Satric et al. 2021).

4.3 Attitudes towards food safety, risk perceptions and concerns

4.3.1 General population

European citizens are **primarily worried** about pesticide residues, antibiotics, hormones, and additives in their food (Gallani 2022; Banati 2014). Despite the crucial role of additives in maintaining food quality, concerns about their use have been on the rise (Bayram and Ozturkcan 2023). However, the extent of food safety concerns varies across **EU countries** (Banati 2014). For example, consumers in Croatia, Spain, and Turkey were the least concerned about food additives, while those in Poland and Slovenia considered GMOs the least concerning (Djekic

et al. 2022). **Gender** has little impact on these perceptions, and no correlation has been found between Europeans' concerns and their **education levels** (Djekic et al. 2022; Gallani 2022).

The concept of 'risk perception' is central to food safety research, as it influences public views on the safety of food. A **lack of knowledge** has been repeatedly recognised as a factor increasing risk perceptions, as consumers often overestimate risks when they do not fully understand the hazard involved (Jenkins, Harris and Osman 2020; Banati 2014). This trend is especially pronounced with **new food technologies**, where the 'fear of the unknown' makes consumers worry even though experts assure food safety (Banati 2014). **GMOs,** for instance, are often viewed negatively and feared because the public does not understand their risks and benefits (Banati 2014; Tiozzo et al. 2017). This is problematic as the effectiveness of food production technologies largely relies on consumer acceptance (Banati 2014). If consumers stay unaware of the advantages of these, they are less inclined to embrace them (Hartmann, Hübner and Siegrist 2018). In contrast to previous findings, Pinto et al. (2015) showed that people with higher knowledge tend to be more vigilant and aware of food risks as consumers.

Additionally, sociodemographic traits such as **age** and **gender** significantly affect the risk perceptions of consumers (van der Vossen-Wijmenga et al. 2022; Nardi et al. 2020; Bei et al. 2021; Pinto et al. 2015). Typically, **women** perceive higher levels of food risks than men, and risk perception tends to increase with **age** (Nardi et al. 2020). Moreover, lower levels of **education** are often associated with a higher perceived risk. Contrary to these findings, Pinto et al. (2015) found that younger and higher educated consumers exhibited more self-protective attitudes towards risks. Furthermore, Murphy et al. (2020) noted that gender did not affect consumer trust, although typically, males are thought to have higher trust levels towards food. Consumers living in households with **children under 16** and larger **family sizes** tend to be more concerned and attentive to safety aspects in their food choices, considering not only

themselves but also those close to them (Pinto et al. 2015; Nardi et al. 2020). Lastly, risk perception is also shaped by **emotional factors,** such as beliefs and the feeling of 'dread' — characterised by 'perceived likelihood and seriousness of harm' and 'worry' (Jenkins, Harris and Osman 2020; Nardi et al. 2020) with new food technologies being dreaded the most.

Overall, food risks are generally perceived as more important than those associated with non-food products (Hartmann, Hübner and Siegrist 2018). However, this perception varies depending on the **type of food risk** (van der Vossen-Wijmenga et al. 2022). The public is often more concerned about chemical risks in food rather than biological risks (Banati 2014; Hartmann, Hübner and Siegrist's 2018). Elements perceived as artificial, such as hormones in meat, tend to worry consumers even though experts assure it is safe. Europeans are more confident preventing bacterial contamination, such as Salmonella in eggs, than chemical contamination. Such fear of chemicals can lead to the rejection of safe food, hindering European innovation (Banati 2014). This contrasts with other studies indicating consumers are more concerned about microbiological contamination and foodborne illnesses (Tiozzo et al. 2017; Djekic et al. 2022). Despite significant outbreaks in the EU involving non-animal food products, **animal-origin foods** are still perceived as riskier than plant-based foods (Djekic et al. 2022; Nardi et al. 2020).

People often misunderstand food risks and safety issues, perceiving dangers that do not reflect what science shows (Banati 2014). In a van der Vossen-Wijmenga et al. (2022) study, consumers viewed new technologies and chemical risks considerably **riskier than food experts**. Consumers tend to be **more cautious** than experts as they often do not immediately recognise the advantages of new process techniques (Banati 2014). Similarly, research by Hartmann, Hübner and Siegrist (2018) highlights significant differences in concerns; experts prioritise hazards like Listeria contamination, allergens and restaurant hygiene, whereas

consumers are more concerned about GMO in food and plant treatments. Given these differences, authorities must explain why their priorities differ from consumer expectations regarding food hazard oversight. People often overestimate their ability to identify safe food, underestimating risks from home food handling (Tiozzo et al. 2017). This optimistic bias makes consumers believe they are less exposed to food risks (Moretro et al. 2021; Pinto et al. 2015). The more confident they feel about their knowledge of avoiding food risks, the less likely they are to perceive food risks (Gallani 2022). This overconfidence and the assumption that the food available for purchase is safe results in consumers disregarding food safety information. Interestingly, a study by Veflen, Scholderer and Langsrud (2020) showed that strong social norms increase risk-taking behaviours, such as accepting food perceived as dangerous.

4.3.2 Youth

While many young consumers believe their food is safe, others are undecided (Franc-Dąbrowska et al. 2021). Nevertheless, most students acknowledge the importance of food safety, prioritising biological risks and considering GMOs as posing the greatest threat (Stratev et al. 2017; Ovca et al. 2017a, 2017b). Many children do not perceive the home as a common setting for food poisoning, although domestic settings contribute to around 30% of foodborne cases (Ovca et al. 2014; EFSA and ECDC 2023) (Appendix 15). Furthermore, they tend to be confident about their skills and have a low perception of vulnerability (Ovca et al. 2017b).

Gender plays a significant role in perceptions, with girls being generally more concerned about food risks, viewing them as more severe and likely, probably due to their higher involvement in food preparation (Franc-Dąbrowska et al. 2021; Ovca et al. 2014). **Education** also shapes perceptions, with students outside of food-related programs showing greater concerns about food poisoning than future food handlers (Ovca et al. 2017b). The concept of food safety itself is ambiguous and subject to a range of interpretations (Ovca et al. 2017a). As people's education

level increases, their understanding of food safety becomes more nuanced. Students' attitudes are also influenced by **psychosocial factors**, including their consumer type and their approach towards risk (Czernyszewicz 2023). Additionally, students are more likely to prioritise food safety when they want to conform to **social norms** (Ovca et al. 2017a).

4.4 Consumer trust and assigned responsibility

Consumer trust plays a crucial role in the functioning of the food market, with expectations that products are safe and meet quality standards. However, changes in the food supply chain and safety outbreaks have led to a decline in trust, amplifying its importance as consumers become more distant from production processes (Benson et al. 2020). Therefore, one of the goals of the EU food risk framework is to prioritise consumer confidence (EFSA 2021). Using a toolkit developed by Benson et al. (2020), Murphy et al. (2020) assessed consumer trust levels in Finland, Greece, Germany, and the UK. Results show a firm trust in food systems, particularly among Finnish and British consumers. In contrast, a study by Macready et al. (2020) involving France, Germany, Poland, Spain and the UK found low confidence in the food chain and production technologies, with the UK again showing the highest trust. **Trust in food chain actors** was moderate, with consumers relying on farmers and retailers rather than authorities and food manufacturers (Macready et al. 2020). This varies by **country**: for instance, the French show significant distrust towards manufacturers, while the Polish predominantly distrust authorities. Along with trust in food chain actors, **confidence in food oversight organisations** is another key factor in building consumer trust (Murphy et al. 2020). Trust in national and EU institutions remained high in 2022 (EU 2022a). To maintain this, authorities must set rules and deliver accurate and transparent information to consumers (EFSA 2021).

Consumers' perception of **responsibility** for food safety differs across **countries** (Djekic et al. 2022). For instance, Portuguese and Spanish perceive food processors as responsible for

ensuring food safety, whereas consumers in Poland and Slovenia believe primary producers hold the most accountability. Interestingly, consumers consider themselves the least responsible for food safety despite the known correlation between consumer responsibility and risky handling practices (Nardi et al. 2020). Similarly, **young consumers** consider the initial stages of the supply chain as responsible, perceiving themselves as the least accountable (Ovca et al. 2017b; Franc-Dąbrowska et al. 2021). They typically do not view food control agencies as primarily responsible, often expressing distrust or indifference towards these institutions.

4.5 Behaviour and handling practices

4.5.1 General population

Most Europeans reported they would change their food preparation habits in response to a food incident (Gallani 2022). Such incidents typically lead consumers to **avoid repurchasing** the affected product, leading to financial and reputational losses for producers making it challenging to regain consumer trust. (Niewczas 2014). Additionally, during food scares, consumers generally prefer to purchase **familiar** or **brand-name** products, a preference that varies by **sociodemographic factors**. Men and those with only primary education are more likely to view brands as a safety guarantee and believe that **higher-priced** products are safer. This aligns with research by Tiozzo et al. (2017) and Bei et al. (2021), indicating that consumers prefer to purchase pricier brands, believing that these undergo more rigorous safety checks.

Additionally, **local food** is generally considered safer than imported options (Tiozzo et al. 2017; Haas et al. 2021). Findings by Niewczas (2014) reveal that **younger** people and those **living in urban areas** are likelier to choose **local products** as a safety measure than older rural residents. Half of the European consumers regard food safety as an important factor when buying food, and safety is also the primary consideration when selecting cooking material (Gallani 2022;

Moura, Ferreira-Pego and Fernandes 2023). While most people recognise that damaged cookware can contaminate food, only a few replace it when damaged.

4.5.2 Youth

Private environments have no supervision system or obligation for food safety competence (Marklinder et al. 2020). However, the importance of correct behaviour at home cannot be ignored and has been widely emphasised in the literature. Knowledge alone often fails to translate into adequate behaviour (Satric et al. 2021; Tomaszewska et al. 2021). One of the best methods for learning hygiene practices is to observe others' habits, especially for children who learn by looking at adults (Lange et al. 2018; Tomaszewska et al. 2021), with more regular cooks demonstrating safer practices (Lange, Gorazon and Marklinder 2016).

Numerous studies have underscored **gender** differences in safe handling practices, with male students showing riskier behaviours in warming up leftover food and preventing cross-contamination, including hand hygiene, washing kitchen surfaces, and changing clothes (Lange Gorazon and Marklinder 2016; Satric et al., 2021; Ovca et al. 2014; Czernyszewicz 2023). By contrast, research by Smigic, Lazarov and Djekic (2020), Stratev et al. (2017) and Tomaszewska et al. (2021) found no differences in practices among gender. Studies present contrasting effects of other factors on food safety practices. Stratev et al. (2017) found that **age** does not affect these practices, whereas Smigic, Lazarov and Djekic (2020) demonstrated that younger students are generally less cautious. Furthermore, Ovca et al. (2014) observed no significant impact of **prior experiences** with foodborne illness on the practices of children. By contrast, Smigic, Lazarov and Djekic (2020) noted better food handling practices among students who had encountered food poisoning, probably because they became more attentive.

Students' knowledge and behaviour are inadequate, suggesting they might leave school lacking fundamental knowledge (Lange, Gorazon and Marklinder 2016). There is a consensus among

researchers on the urgent need for **food safety education** in young people's curricula (Marklinder et al. 2020; Lange et al. 2018; Smigic, Lazarov and Djekic 2020). Both at school and university, food safety education has often shown positive effects on knowledge and behaviours. This is supported by Satric et al. (2021), who found that students acquiring their knowledge at university demonstrated more accurate knowledge and practices than those without food safety education. Smigic, Lazarov and Djekic (2020) also found a positive effect of food or health-related university curricula and students' food safety knowledge and practices.

Other studies challenge prior conclusions: Stratev et al. (2017) show no significant effect of education on food safety awareness, raising concerns about the effectiveness of some programs. Surprisingly, students not enrolled in food-related programs had better food safety knowledge than those training to become professional food handlers, indicating gaps in the curriculum (Ovca et al. 2017b). Further concerns are raised by Ovca et al. (2017b) regarding trainees' understanding of food safety principles and habits. Despite these gaps, most students recognise the importance of food safety education and training. Children also believe their knowledge can be improved, indicating their readiness to learn (Ovca et al. 2014). Communication must include methods to prevent risks and ways to integrate them into existing routines (EFSA 2021).

5. Survey Analysis

This section presents the survey results, including general trends and the outcomes of ANOVA tests. The survey comprises responses from 182 participants, with detailed sample characteristics provided in Appendix 16.

6.2 Food safety awareness

Over 60% of respondents were aware of issues like pesticide residues, antibiotics or hormones in meat or food additives. Awareness was lowest for nanotechnology and other emerging technologies like 3D printed food and lab-grown meat (Appendix 17a). Neither **education**, **age**,

nor **nationality** significantly influenced awareness levels, including for environmental pollutants (Appendix 17b). However, **females** reported knowing less topics (Appendix 17c). A strong correlation was observed among younger individuals between **self-assessed** and actual knowledge levels (Appendix 17d). Neither **gender,** prior **food poisoning**, nor **food safety education** significantly affected younger individuals' knowledge (Appendix 17e).

6.3 Sources of food safety information

Consistent with the Eurobarometer, 70% of respondents expressed personal **interest** in food safety, but with no significant difference among countries (Appendix 18a). Many, especially those with **higher education,** follow food safety news (Appendix 18b). The Internet is the primary **source** of food safety information, especially among young respondents, followed by television and newspapers (Appendix 18c). Family and friends contribute to food safety education, but not predominantly among the **less educated** (Appendix 18d). Moreover, students taught by family and friends know fewer subjects than those educated primarily at school or university (Appendix 18e). Formal sources like national or EU health agencies and food scientists are underutilised, yet food scientists rank as the most **trusted**, followed by health agencies (Appendix 18f). Public trust in mass media is moderate, with 23% expressing little to no trust, indicating scepticism. Contrary to expectations, relying on mass media rather than on family and friends does not increase perceived vulnerability to poisoning (Appendix 18g).

Over half of respondents frequently check food labels, with the expiry date being the most reviewed item, followed by ingredients and product origin (Appendix 18h). **Education** did not influence label reading habits (Appendix 18i). **Women** were more inclined to check ingredient lists but not necessarily more likely to consult storage conditions (Appendix 18j). Certification labels are considered the **best indicator** of food safety, closely followed by ingredients and, to a lesser extent, expiry dates and product origin (Appendix 18k). Price was never mentioned,

and only 3.3% of the surveyed viewed the brand as the best indicator, with no clear preference among **men** or those with **lower education** (Appendix 18l). We found no evidence that younger individuals were likelier to choose product origin as a safety guarantee (Appendix 18m).

6.4 Attitudes towards food safety, risk perceptions and concerns

While uncertainty persists regarding improving food safety, 40% of respondents express confidence in European food safety regulations. There is a general belief that animal-derived food carries more risk than plant-based food. Chemical contaminants are the most concerning **food risks**, followed by biological hazards (Appendix 19a). New food technologies rank next in terms of concern, with more diverse levels of worry regarding their safety and impact. Concerns about food risks did not vary among **countries,** while they increased with **age** (Appendix 19b). Overall, 22% of respondents express concern about food poisoning. This is also influenced by **age**, with the 46-55 age group showing higher levels of worry (Appendix 19c). Neither **gender** nor **education** significantly impacted food risks concerns or poisoning worries (Appendix 19d), nor did consumers in households with **children under 16** or larger **family sizes** express higher concern about food poisoning or risks (Appendix 19e). Overall, respondents demonstrate confidence, with 40% feeling able to mitigate food risks and 43% rating their knowledge as good or excellent (Appendix 19f). While individuals **rating their knowledge** higher were more concerned about food risks, this concern did not correlate with **confidence** in avoiding food risks (Appendix 19g). Among young people, girls tend to worry more, although the difference is not statistically significant (Appendix 19h).

6.5 Consumer trust and assigned responsibility

The survey indicates higher confidence in national and European regulatory agencies than other food chain actors, with EFSA emerging as the most **trusted** (Appendix 20a). Retailers are the least trusted, followed by food manufacturers. Trust levels did not vary significantly by **gender**

or **country** (Appendix 20b). While over 80% of respondents believe that food manufacturers, EFSA and national control agencies are **responsible** for food safety, farmers and retailers are seen as less responsible (Appendix 20c). Only 37% consider themselves responsible for food safety, viewing themselves as the least responsible actors. Perceptions of responsibility did not differ among **countries** (Appendix 20d).

6.6 Behaviour and handling practices

We observe a high engagement with key food safety practices like checking expiry dates and handwashing before cooking. However, lower adherence to using separate cutting boards for meat and vegetables, cooking at the right temperature, and replacing cooking materials highlights the need for increased education (Appendix 21a). **Gender** differences are evident: females reported washing their hands more frequently, while males were more likely to cook and store food at correct temperatures and replace cooking materials (Appendix 21b). **Food safety training** fails to significantly improve their food handling practices (Appendix 5c). **Younger** individuals exhibit riskier practices (Appendix 21d). While there is no gender difference in the frequency of these practices among students, girls tend to wash their hands more frequently (Appendix 21e). Additionally, **prior food poisoning** and **cooking** for oneself or family did not lead to improved practices (Appendix 21f).

6. Triangulation

This section summarizes the triangulation of survey responses with review findings, detailed in Appendix 22. Triangulation confirms broad awareness among Europeans about food safety issues such as pesticides and additives, while also noting limited understanding of emerging food technologies. Both data sources align on aspects like the positive correlation between self-assessed and actual knowledge, the Internet and TV as primary information sources, and consumers' low sense of responsibility. Findings indicating that most Europeans follow food

safety news, read food labels, and express personal interest in the topic are consistent, enhancing the credibility of these conclusions.

Triangulation reveals inconsistencies, notably regarding the impact of education on food safety awareness, with the survey indicating no direct correlation and literature suggesting otherwise. While the survey shows minimal influence of nationality, literature suggests variations in food risk concerns among consumers from different countries. The literature also presents varied insights on the correlation between age and risk perception and food handling practices, whereas the survey finds that younger consumers engage in riskier practices and are less concerned about food risks and food poisoning. Additionally, discrepancies in gender influence on food safety perceptions and practices are identified. Overall, consumer trust in mass media is limited; however, the survey could not confirm whether relying on mass media for food safety information rather than consulting with family and friends increase perceived vulnerability to food poisoning. Encouragingly, survey results regarding trust in EFSA and its regulations suggest strong public confidence in authorities and standards.

7. Conclusion

European consumers are generally well-informed about food risks, yet variations exist in risk perceptions and practices across different socio-demographics. The study underscores the challenges of addressing food risks, particularly when consumers see themselves as the least responsible for ensuring food safety. This research also emphasizes the complexities of food safety awareness, pointing to the need for education strategies to bridge these gaps effectively. While consumers are generally confident in the safety of their food, continuous efforts are needed to enhance their understanding and handling practices. Effective communication from authorities is crucial to maintain public confidence in food systems and technologies. Notably, increasing the visibility and accessibility of reliable sources, like ESFA and food experts, could

ultimately boost public awareness. By addressing the identified gaps and misconceptions, Europe can maintain its reputation for having one of the safest food systems.

7.1 Limitations

Selection biases are potential validity threats in SLRs. To mitigate this, we searched for relevant papers across various databases for relevant studies published from 2014 to 2024, ensuring a contemporary perspective, thereby excluding earlier, albeit potentially relevant, research. The review includes research from European countries, including non-EU members such as Serbia, Kosovo, and Turkey, which EFSA does not regulate. This could offer different insights on consumer perception. Furthermore, we included a multi-country survey (Djekic et al. 2022), which extends to India, and a meta-analytic review (Nardi et al. 2020) not strictly limited to Europe, offering valuable perspectives. Other limitations include the survey's limited representability across gender and age groups, and its design, which complements rather than directly compares with SLR studies due to differences in variables and samples.

7.2 Further research

Further research is needed to assess the effectiveness of educational programs and current risk communication strategies across Europe. It is crucial to explore the real-life application of these practices across different age groups and improve perceptions of responsibility. Additionally, studies should further investigate how nuanced socioeconomic factors, including profession-specific demographics, urban versus rural populations, and migration backgrounds, affect food safety awareness. This can help tailor national and European interventions to meet the public's evolving needs, better reach at-risk populations, and improve overall public health outcomes. Exploring the impact of digital media and misinformation on public understanding and trust is also essential for enhancing risk communication.

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9. Appendices

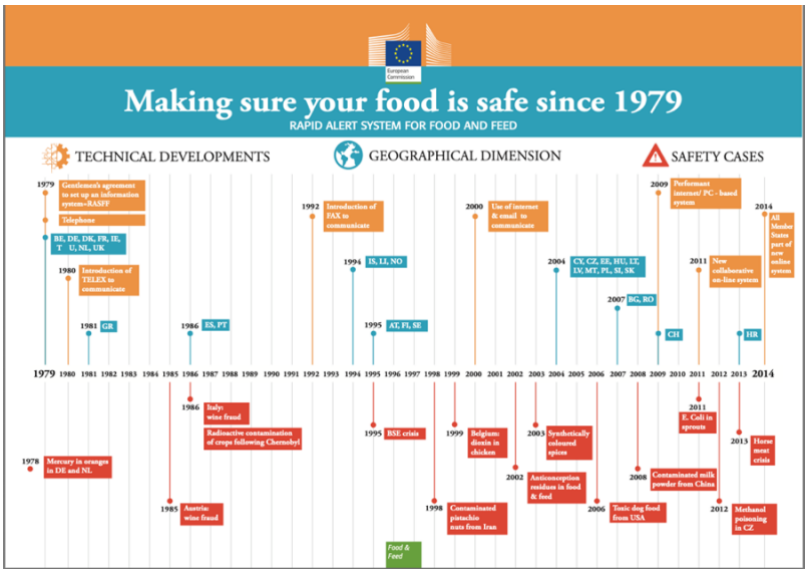
Appendix 1: Abbreviations

BSE	Bovine Spongiform Encephalitis
EFSA	European Food Safety Authority
EC	European Commission
EP	European Parliament
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
F2F	Farm to Fork
GMO	Genetically Modified Organism
SDG	Sustainable Development Goal
UN	United Nations
WHO	World Health Organization

Appendix 2: Target of SDG 3 related to food safety [1]

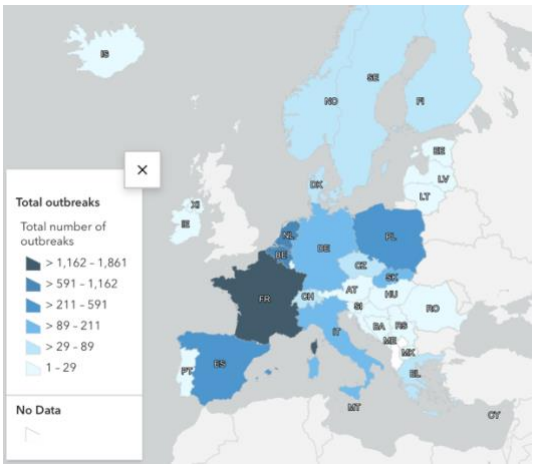
Target	SDG 3 — Ensure healthy lives and promote well-being for all at all ages
3.2	End all preventable deaths under five years of age
3.3	Combat water-borne diseases and other communicable diseases
3.9	Reduce the number of deaths and illnesses from hazardous chemicals, pollution and contamination
3.d	Improve early warning systems for global health risks

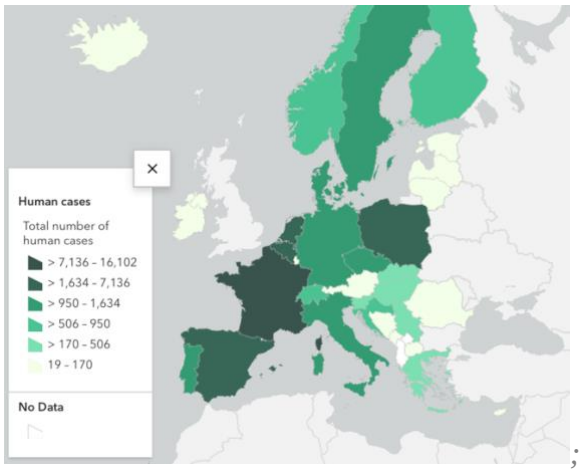
Appendix 3: Timeline of major food safety incidents in Europe [2]



[1] FAO 2023b
[2] EC n.d.

Appendix 4: Number of outbreaks and human cases (in 2022 and over time)[3]





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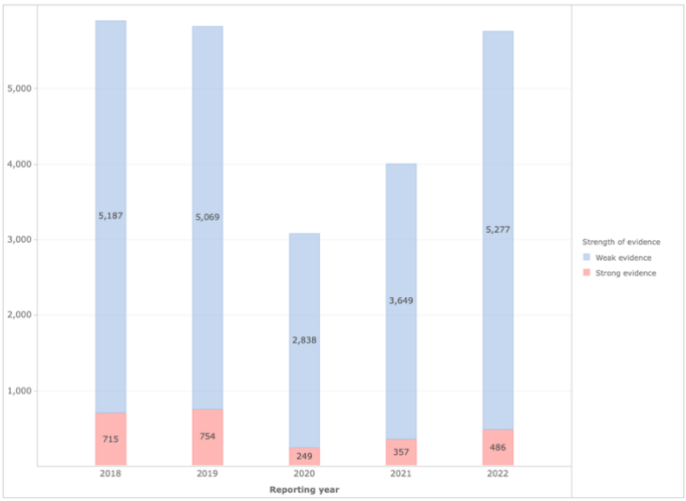
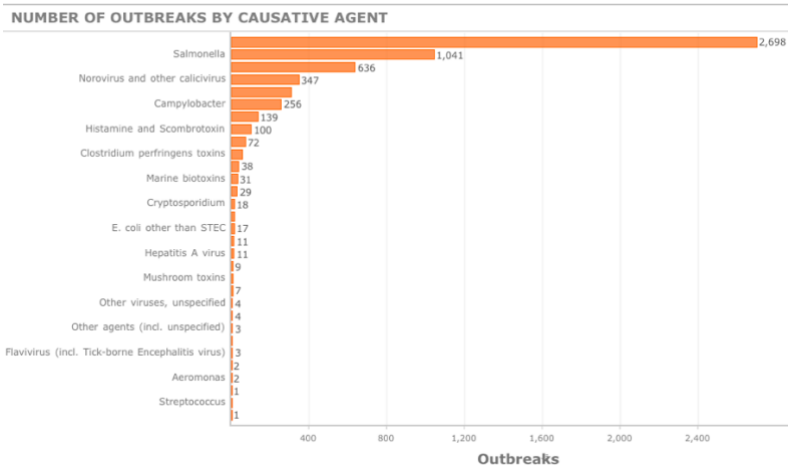
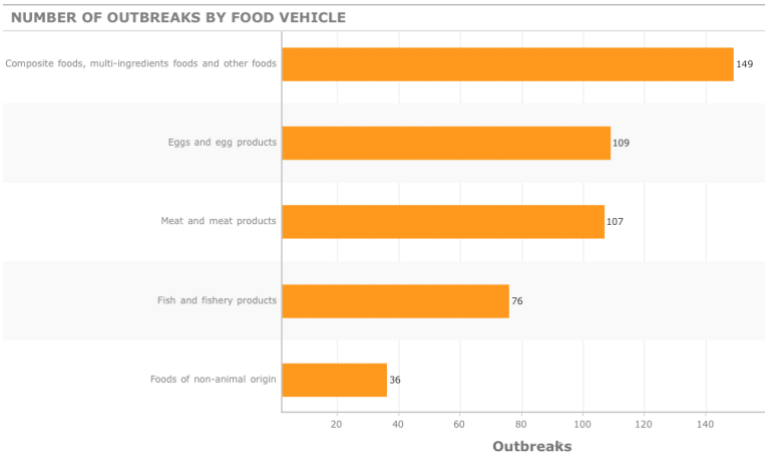
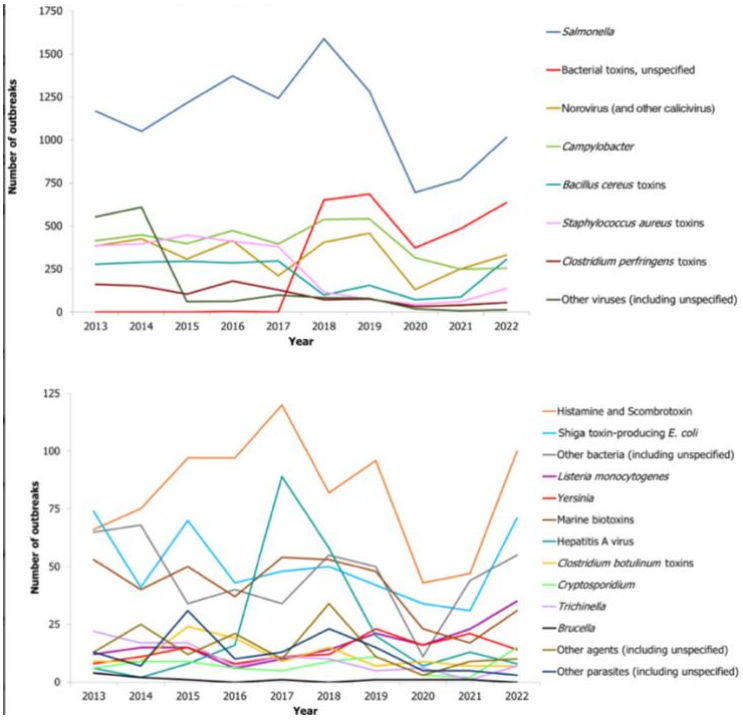


Appendix 5: Number of outbreaks by causative agents (in 2022 and over time) and by food vehicle (2022)[4]



[3] EFSA 2023b
[4] EFSA 2023b



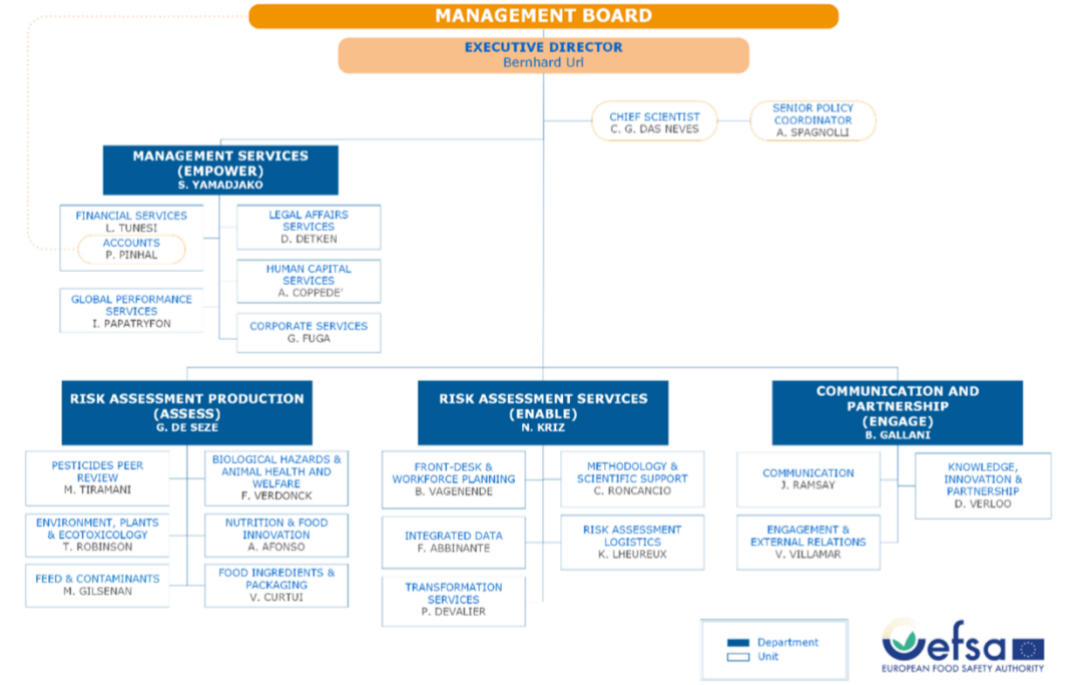


Appendix 6: International Cooperation[5]

Bilateral & multilateral relations	International organisations
Formal agreements with regulatory agencies with a risk assessment mandate, e.g., in Australia, Canada, Japan, New Zealand and the USA	Organisation for Economic Co-operation and Development (OECD)
Cooperation with counterparts across the world, and international liaison groups	World Health Organization (WHO)
	Food and Agriculture Organization (FAO)
	World Organisation for Animal Health (WOAH)
	European and Mediterranean Plant Protection Organization (EPPO)

[5] EFSA 2024a

Appendix 7: EFSA organisational chart on 01/01/2024[6]



Appendix 8: Overview of EU Food Safety Legislation and Strategy [7]

Regulation (EC) No 178/2002 — General Food Law Regulation	It strengthens the EU's food and feed safety rules and sets up the EFSA. Food legislation applies at **all stages of the food chain**, from production, processing, transport and distribution to supply. In particular, **food businesses must**: • guarantee the **traceability** of food, feed and food-producing animals at all stages of production and distribution, • immediately **withdraw food or feed from the market**, or **recall** products already supplied if these are harmful to health, and i**nform the appropriate authorities** and consumers where necessary.
Regulation (EU) 2019/1381 – transparency & sustainability of the EU risk assessment in the food chain[8]	• **Increased Transparency**: Better access to scientific studies for the public and interested parties • **Reliable & Independent Studies**: More access for EFSA to scientific evidence related to requests for authorisation • **Effective Risk Communication:** Improved coordination between risk assessors and risk managers to ensure better communication • **Sustainable Governance**: Reinforced contribution from Member States to EFSA's governance and scientific panels

[6] EFSA 2023a
[7] EU n.d.b
[8] EU 2022b

The precautionary principle	It enables a rapid response in the face of a possible danger to human, animal or plant health or to protect the environment. • In particular, where scientific data do not permit a complete evaluation of the risk, recourse to this principle may, for example, be used to stop distribution or order withdrawal from the market of products likely to be hazardous.
Regulation (EU) 2017/625 — Official controls along the agri-food chain	• It sets out common rules for EU **official controls** to ensure that agri-food chain legislation is correctly applied and enforced to protect human health, animal health and welfare, and plant health. • It introduces a more harmonised and coherent system of official controls and enforcement measures along the agri-food chain and strengthens the principle of risk-based controls.
'Farm to fork' strategy	It aims to accelerate the EU's transition to a sustainable food system that: • has a neutral or positive environmental impact; • helps to mitigate climate change and adapt to its impacts; • reverses the loss of biodiversity; • ensures food security, nutrition and public health, • preserves food affordability while generating fairer economic returns, fostering the competitiveness of the EU supply sector and promoting fair trade. The 'Farm to fork' strategy is a key element of the *European Green Deal.*

Appendix 9: Risk assessment process of EFSA[9]

1. Receipt of mandate/application	EFSA receives a request for scientific advice (from the European Commission, European Parliament or Member States) or initiates its activity. A mandate is agreed upon, including terms of reference and deadline; EFSA checks/validates their completeness for market applications and may request more scientific information from the applicant. The mandate is assigned to one of EFSA's scientific panels or Scientific Committee and is available on the OpenEFSA portal.
2. Assessment	The risk assessment is usually carried out by an expert working group, which reviews the scientific information available and may draw on EFSA's data collection networks or launch an open call for data. The working group develops a draft and submits it to the relevant panel for discussion. EFSA often holds public consultations on draft outputs to consider the comments in the revised document.

[9] EFSA 2024a

3. Adoption & Publication	Most panel members adopt the assessment, and any minority opinion is recorded. The output –usually a **scientific opinion**, but may be a **statement, guidance document** or an**other type** of output – is published in the EFSA Journal, our open-access, online scientific journal. Communication activities may accompany the publication.

Appendix 10: Target audiences of EFSA for risk communication[10]

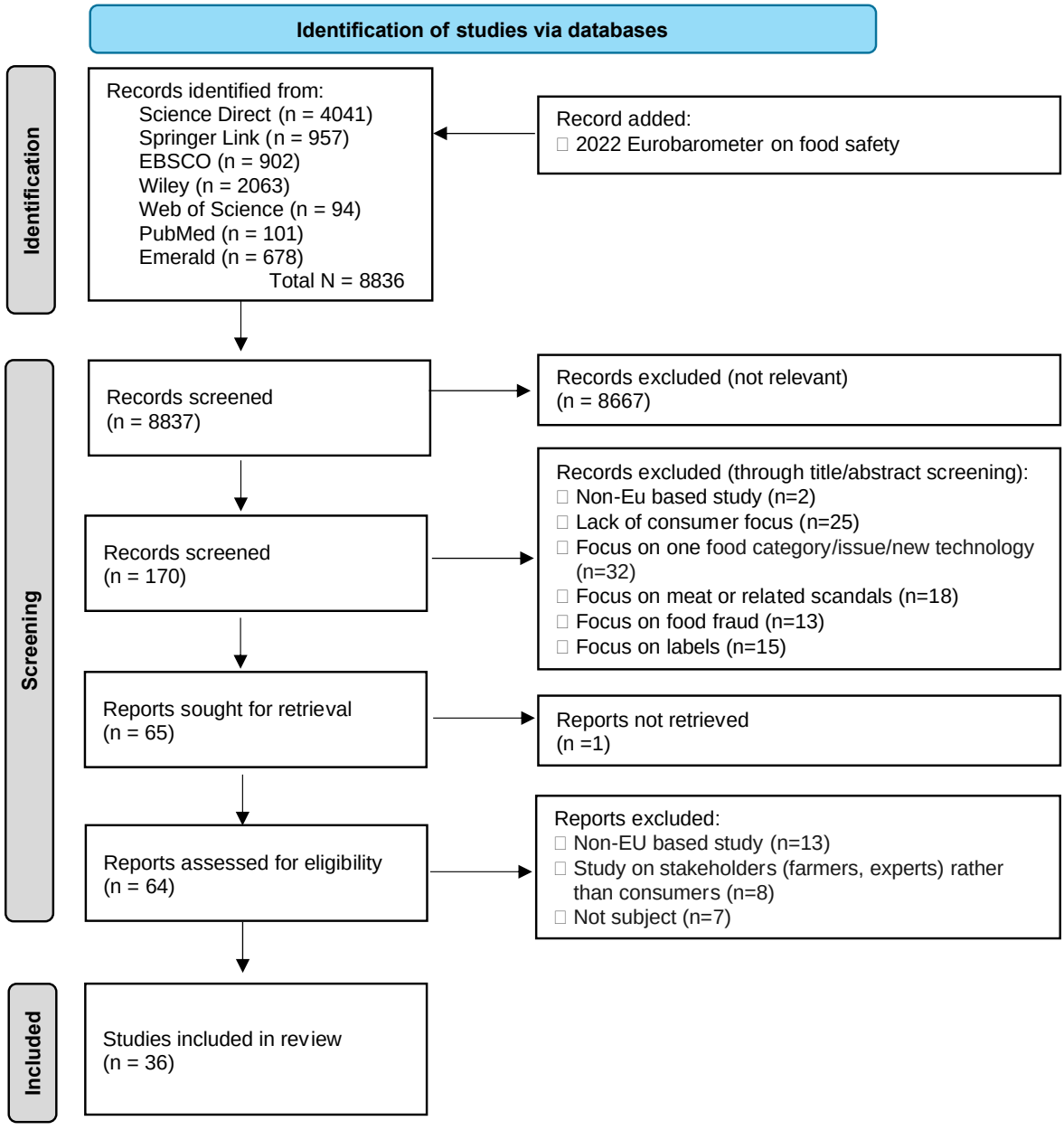
Risk managers	Policymakers	Risk assessors	Partners
Citizens	Scientific community	Media	Stakeholders

Appendix 11: Information sources

Database	Link
Science Direct	https://sciencedirect.com
Springer Link	https://springerlink.com/
Business Source Complete	https://research.ebsco.com/c/7kzg2s/search
Wiley Online Library	https://onlinelibrary.wiley.com/search/advanced
Web of Science	https://www.webofscience.com/
PubMed	https://pubmed.ncbi.nlm.nih.gov/advanced/
Emerald	https://www.emerald.com/insight/

[10] EFSA 2024a

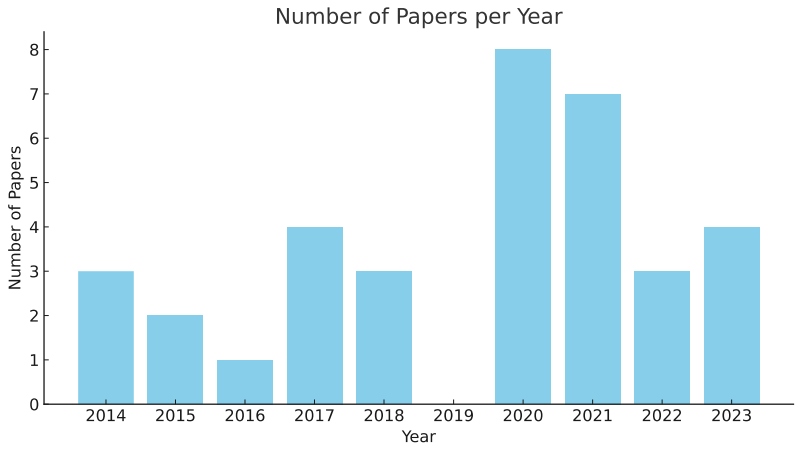
Appendix 12: PRISMA Flow Chart



Appendix 13: List of papers reviewed and number of papers per year

Author(s)	Title	Year	Journal	Database
Banati	European perspectives of food safety	2014	Society of Chemical Industry	Wiley Online Library
Bayram and Ozturkcan	Consumers' opinions, use of food labels, and knowledge of food additives	2023	Nutrition and Food Science	Emerald
Bei et al.	The impact of food quality and safety on consumer perception and attitude to food choices in Romania. Opportunities under Green Deal	2021	Global Economic Observer?	EBSCO
Benson et al.	The development and validation of a toolkit to measure consumer trust in food	2020	Food Control	Web of Science
Czernyszewicz	Determinants of Polish young adults' attitudes toward food safety	2023	Attitudes towards food safety	Emerald
Djekic et al.	How do consumers perceive food safety risks? – Results from a multi-country survey	2022	Food Control	Science Direct
EFSA	Technical assistance in the field of risk communication	2021	EFSA Journal	Web of Science
Etienne et al.	External Scientific Report on Clear Communications and Uncertain	2018	EFSA Supporting Publication	Wiley Online Library
Finardi and Vaqué	European Food (Mis)Information to Consumers: Do Safety Risks Lie Just Around the Corner?	2015	European Food and Feed Law Review	EBSCO
Franc-Dabrowska et al.	Young consumers' perception of food safety and their trust in official food control agencies	2021	British Food Journal	Emerald
Gallani	Surveying citizens on food safety	2022	Food Science and Technology	Wiley Online Library
Haas et al.	Consumer Perception of Food Quality and Safety in Western Balkan Countries: Evidence from Albania and Kosovo	2021	Foods	PubMed
Hartmann, Hübner and Siegrist	A risk perception gap? Comparing expert, producer and consumer prioritization of food hazard controls	2018	Food and Chemical Toxicology	Science Direct
Jenkins, Harris and Osman	What Drives Risk Perceptions? Revisiting Public Perceptions of Food Hazards Associated With Production and Consumption	2020	Journal of Risk Research	EBSCO
Lange, Gorazon and Marklinder	Self-reported food safety knowledge and behaviour among Home and Consumer Studies students	2016	Food Control	Science Direct
Lange et al.	Adolescents' sources for food safety knowledge and trust	2018	British Food Journal	Emerald
Laurenti et al.	Factors affecting safe and healthy diet in older adults in Italy: results of a preliminary study performed in a community-dwelling sample	2023	Public Health Nutr.	Pub Med
Macready et al.	Consumer trust in the food value chain and its impact on consumer confidence: A model for assessing consumer trust and evidence from a 5-country study in Europe	2020	Food Policy	Science Direct
Marklinder et al.	Food safety knowledge, sources thereof and self-reported behaviour among university students in Sweden	2020	Food Control	Science Direct
Moretro et al.	Consumer practices and prevalence of Campylobacter, Salmonella and norovirus in kitchens from six European countries	2021	International Journal of Food Microbiology	Pub Med
Moura, Ferreira-Pego and Fernandes	Consumers' practices and safety perceptions regarding the use of materials for food preparation and storage: Analyses by age group	2023	Food and Chemical Toxicology	Science Direct
Murphy et al.	Assessing differences in levels of food trust between European countries	2020	Food Control	Science Direct
Nardi et al.	A meta-analytic review of food safety risk perception	2020	Food Control	Science Direct

Moura, Ferreira-Pego and Fernandes	Consumers' practices and safety perceptions regarding the use of materials for food preparation and storage: Analyses by age group	2023	Food and Chemical Toxicology	Science Direct
Murphy et al.	Assessing differences in levels of food trust between European countries	2020	Food Control	Science Direct
Nardi et al.	A meta-analytic review of food safety risk perception	2020	Food Control	Science Direct
Niewczas	Consumers' reactions to food scares	2014	International Journal of Consumer Studies	Wiley Online Library
Ovca et al.	Food safety awareness, knowledge and practices among students in Slovenia	2014	Food Control	Science Direct
Ovca et al.	Future professional food handlers' perspectives towards food safety	2017a	British Food Journal	Emerald
Ovca et al.	Food safety knowledge and attitudes among future professional food handlers	2017b	Food Control	Science Direct
Pinto et al.	Italian consumers' attitudes towards food risks: self-protective and non-self-protective profiles for effective risk communication	2015	Journal of Risk Research	EBSCO
Satric et al.	Food safety at home: Serbian students	2021	British Food Journal	Emerald
Smigic, Lazarov and Djekic	Does the university curriculum impact the level of students' food safety knowledge?	2020	British Food Journal	Emerald
Stratev et al.	Food safety knowledge and hygiene practices among veterinary medicine students at Trakia University, Bulgaria	2017	J Infect Public Health	Pub Med
Tiozzo et al.	Consumers' perceptions of food risks: A snapshot of the Italian Triveneto area	2017	Appetite	Science Direct
Tomaszewska et al.	Self-reported food safety knowledge and practices of early-school-aged children - a result of analysis in towns near the Warsaw city	2021	British Food Journal	Emerald
van der Vossen-Wijmenga et al.	Perception of food-related risks: Difference between consumers and experts and changes over time	2022	Food Control	Science Direct
Veflen, Scholderer and Langsrud	Situated Food Safety Risk and the Influence of Social Norms	2020	Risk Analysis	EBSCO



Appendix 14: Survey Questionnaire

Consumer perceptions of food safety in Europe

Hello,

As part of my Master Thesis in Management at NOVA SBE, I am trying to understand **consumer perceptions of food safety in Europe.** My goal is to explore how we perceive and respond to food safety matters, and to identify the factors that influence our knowledge, concerns and practices in this area.

This survey takes only about **10min** and your participation would provide me with valuable insights.

Please note that the questionnaire is entirely **anonymous** and that there is no good or bad answer. What I am interested in is your honest opinion.

Thank you for your help!

Clara

Demographics

1. Age *

Une seule réponse possible.

- ◯ Under 18
- ◯ 18-24
- ◯ 25-35
- ◯ 36-45
- ◯ 46-55
- ◯ 55+

2. Gender *

Une seule réponse possible.

- ◯ Female
- ◯ Male
- ◯ Prefer not to say

3. Nationality *

Une seule réponse possible.

- ◯ Belgian
- ◯ Portuguese
- ◯ French
- ◯ Italian
- ◯ Dutch
- ◯ German
- ◯ Autre : _____

4. Occupation *

Une seule réponse possible.

- ◯ Employed
- ◯ Self-employed/freelancer
- ◯ Student
- ◯ Retired
- ◯ Unemployed

5. Highest level of education obtained *

Une seule réponse possible.

- ◯ Primary School
- ◯ Secondary School
- ◯ Bachelor's Degree
- ◯ Master's Degree
- ◯ Doctorate
- ◯ Autre : _____

6. Total number of people living in your household *

Une seule réponse possible.

- ◯ 1 member
- ◯ 2-3 members
- ◯ 4-5
- ◯ 5+

7. Are there **children under the age of 16** living in your household? *

Une seule réponse possible.

- ◯ Yes
- ◯ No

8. Are there people having a **weakened immune system** in your household? *

Une seule réponse possible.

- ◯ Yes
- ◯ No

9. Are you responsible for **buying** food for yourself/family ? *

Une seule réponse possible.

- ◯ Yes, most of the time
- ◯ Yes, sometimes
- ◯ No

10. Are you responsible for **preparing** food for yourself/family ? *

Une seule réponse possible.

- ◯ Yes, most of the time
- ◯ Yes, sometimes
- ◯ No

11. Have you ever **experienced food poisoning** ? *

Une seule réponse possible.

- ◯ Yes
- ◯ No
- ◯ Not sure

Food Safety Awareness and Knowledge

12. How would you **rate your knowledge** on food safety (e.g. correct way to prepare/store food, techniques to prevent food contamination)?

Une seule réponse possible par ligne.

	Very poor	Poor	Moderate	Good	Excellent
Knowledge	◯	◯	◯	◯	◯

13. Which of the following topics are you **aware of**? (Select all that apply) *

Plusieurs réponses possibles.

- ☐ Antibiotics or hormones in meat
- ☐ Nanotechnology
- ☐ Pesticide residues
- ☐ Food additives
- ☐ 3D printed food
- ☐ Lab-grown meat
- ☐ Environmental pollutants in fish, meat or day
- ☐ Microplastics in food
- ☐ None of them

14. Where do you **primarily receive information** about food safety? *

Une seule réponse possible.

- ◯ Television/newspapers
- ◯ Internet
- ◯ School/university
- ◯ National/EU health agencies
- ◯ Family
- ◯ Friends
- ◯ Food scientists and experts

15. To what extent do you **trust these sources** for food safety information? *

1 = Not trust at all
5 = Completely trust

Une seule réponse possible par ligne.

	1	2	3	4	5
The media (TV/newspaper/online)	◯	◯	◯	◯	◯
School/university	◯	◯	◯	◯	◯
National/EU health agencies	◯	◯	◯	◯	◯
Family and friends	◯	◯	◯	◯	◯
Food scientists and experts	◯	◯	◯	◯	◯

16. **How often** do you check food labels when purchasing products *

Une seule réponse possible.

- ◯ Always
- ◯ Often
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

17. **What information** do you look for on food labels? (Select all that apply) *

Plusieurs réponses possibles.

- [ ] Brand
- [ ] Product origin
- [ ] Storage conditions
- [ ] Price
- [ ] Expiry date
- [ ] Ingredients
- [ ] Origin of the product
- [ ] Environmental impact of the product
- [ ] Autre : _____

18. What aspects do you believe is the **best indicator of food safety**? *

Une seule réponse possible.

- ◯ Brand
- ◯ Product origin
- ◯ Price
- ◯ Expiry date
- ◯ Ingredients
- ◯ Certification labels (e.g. organic)
- ◯ Autre : _____

Food Safety Perception

19. Please indicate your **level of agreement** with the following statements: *

1 = Strongly Disagree
5 = Strongly Agree

Une seule réponse possible par ligne.

	1	2	3	4	5
I believe the safety of food is continuously improving	◯	◯	◯	◯	◯
Food products are safer than they have ever been	◯	◯	◯	◯	◯
My trust over food products has diminished over recent years	◯	◯	◯	◯	◯
I am very confident in the food safety regulations in Europe	◯	◯	◯	◯	◯
I am extremely worried about food poisoning	◯	◯	◯	◯	◯
I know how to avoid food risks	◯	◯	◯	◯	◯
I pay attention to news alerts concerning food risks	◯	◯	◯	◯	◯
I personally believe that animal-derived foos (e.g. meat, eggs, fish) carry more risk compared to plant-based foods (e.g. fruits, vegetables, nuts)	◯	◯	◯	◯	◯

20. **How concerned** are you about the following food safety risks? *

1 = Not concerned at all
5 = Extremely concerned

Une seule réponse possible par ligne.

	1	2	3	4	5
Chemical contaminants (e.g. pesticides, additives)	◯	◯	◯	◯	◯
Biological hazards (e.g. bacteria, viruses)	◯	◯	◯	◯	◯
Allergens	◯	◯	◯	◯	◯
New food technologies (e.g. GMOs, lab-grown meat, 3D food printing)	◯	◯	◯	◯	◯

21. To what extent do you believe the following actors are **responsible** for ensuring food safety?

1 = Not responsible at all
5 = Extremely responsible

Une seule réponse possible par ligne.

	1	2	3	4	5
Farmers	◯	◯	◯	◯	◯
Food manufacturers	◯	◯	◯	◯	◯
Retailers	◯	◯	◯	◯	◯
National food control agencies	◯	◯	◯	◯	◯
The European food safety agency (EFSA)	◯	◯	◯	◯	◯
Consumers	◯	◯	◯	◯	◯

22. To what extent **do you trust** the following actors for ensuring food safety? *

1 = Not trust at all
5 = Completely trust

Une seule réponse possible par ligne.

	1	2	3	4	5
Farmers	◯	◯	◯	◯	◯
Food manufacturers	◯	◯	◯	◯	◯
Retailers	◯	◯	◯	◯	◯
National food control agencies	◯	◯	◯	◯	◯
European food safety agency	◯	◯	◯	◯	◯

Food Safety Practices at Home

23. **How often** do you practice the following? *

1 = Never
5 = Always

Une seule réponse possible par ligne.

	1	2	3	4	5
Washing hands before handling food	◯	◯	◯	◯	◯
Checking expiry dates on food products	◯	◯	◯	◯	◯
Using separate cutting boards for meat and vegetables	◯	◯	◯	◯	◯
Cooking food at the right temperature	◯	◯	◯	◯	◯
Storing food at the right temperature	◯	◯	◯	◯	◯
Replacing cooking material (e.g. pans and pots) when scratched	◯	◯	◯	◯	◯

24. Have you ever received **formal education or training** in food safety? *

Une seule réponse possible.

◯ Yes
◯ No

25. **If yes,** did this education change your food handling practices?

Une seule réponse possible.

◯ Yes
◯ No

Interest in the topic

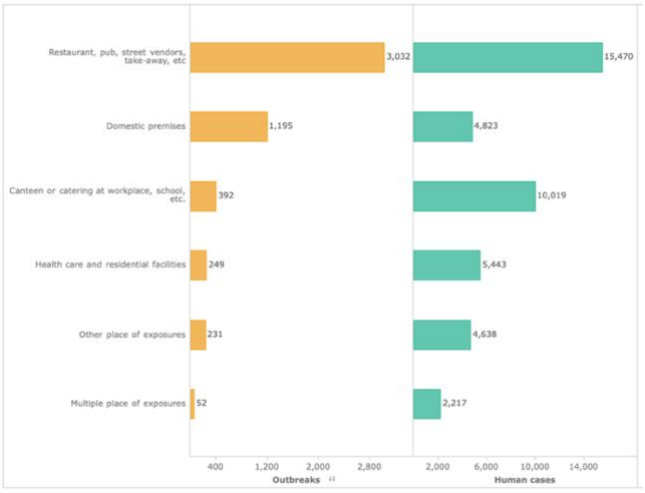
Thank you for your time and contribution !

26. Are you personally **interested** in the topic? *

Une seule réponse possible.

◯ Yes
◯ No
◯ Not particularly

Appendix 15: Number of outbreaks and human cases by place of exposure (2022)[11]



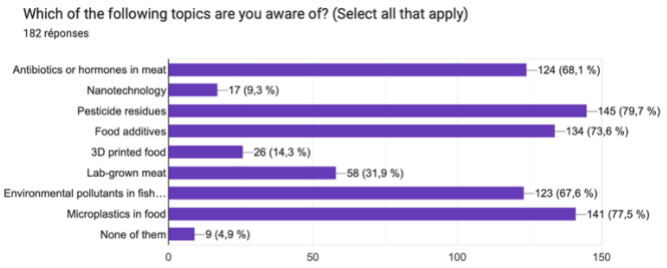
Appendix 16: Sample characteristics

Variable	Category	N	%
Age	Under 18	1	0.5%
	18-24	112	61.5%
	25-35	11	6%
	36-45	2	1.1%
	46-55	23	12.6%
	55+	33	18.1%
Gender	Male	52	28.6%
	Female	127	69.8%
	Prefer not to say	3	1.6%
Nationality	Belgian	107	58.8%
	Italian	19	10.4%
	French	14	7.7%
	Other	60	23.1%
Education Level	Secondary School	20	11%
	Bachelor's Degree	85	46.7%
	Master's Degree	75	41.2%
	Doctorate	2	1.1%
Occupation	Student	107	58.8%
	Employed	41	22.5%
	Self-employed	27	14.8%
	Unemployed	4	2.2%
	Retired	3	1.6%
Household Size	1 member	25	13.7%
	2-3 members	72	39.6%
	4-5 members	72	39.6%
	5+ members	13	7.1%
Children under 16	Yes	31	17%
	No	151	83%
Weakened Immune System	Yes	30	15%
	No	170	85%
Responsible for Buying Food	Yes, most of the time	92	50.5%
	Yes, sometimes	48	26.4%
	No	42	23.1%
Responsible for Preparing Food	Yes, most of the time	93	51.1%
	Yes, sometimes	60	33%
	No	29	15.9%
Experienced Food Poisoning	Yes	62	34.1%
	No	95	52.2%
	Not sure	25	13.7%

[11] EFA 2023b

Appendix 17: Survey analysis: Food safety awareness

a)



b)

SUMMARY: Number of topics aware of

Groups	*Count*	*Sum*	*Average*	*Variance*
Secondary	20	82	4,1	2,30526316
Bachelor	85	350	4,11764706	3,60504202
Master/Doctorate	77	345	4,48051948	3,01606288

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	5,96338368	2	2,98169184	0,92685268	0,39768845	3,04643275
Within Groups	575,844309	179	3,21700731			
Total	581,807692	181				

SUMMARY: Number of topics aware of

Groups	*Count*	*Sum*	*Average*	*Variance*
Under 18	1	3	3	#DIV/0!
18-24	112	460	4,10714286	2,90733591
25-35	11	51	4,63636364	3,05454545
36-45	2	13	6,5	0,5
46-55	23	101	4,39130435	3,52173913
55+	33	149	4,51515152	4,13257576

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	18,3272669	5	3,66545339	1,14488413	0,33850399	2,26546426
Within Groups	563,480425	176	3,20159333			
Total	581,807692	181				

SUMMARY: Environmental pollutants' awareness

Groups	*Count*	*Sum*	*Average*	*Variance*
Secondary	20	14	0,7	0,22105263
Bachelor	85	50	0,58823529	0,24509804
Master/Doctorate	77	59	0,76623377	0,18147642

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1,29318329	2	0,64659164	2,99996306	0,05229885	3,04643275
Within Groups	38,5804431	179	0,2155332			
Total	39,8736264	181				

SUMMARY: Number of topics aware of

Groups	*Count*	*Sum*	*Average*	*Variance*
Belgian	130	550	4,23076923	3,17113894
French	14	65	4,64285714	3,01648352
Italian	20	88	4,4	3,30526316
Others	18	74	4,11111111	3,9869281

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	2,93870574	3	0,97956858	0,30121359	0,82449145	2,6553588
Within Groups	578,868987	178	3,25207296			
Total	581,807692	181				

c)

SUMMARY: Number of topics aware of

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	127	519	4,08661417	2,60354956
Male	52	243	4,67307692	4,42043741

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	12,6892192	1	12,6892192	4,05787568	**0,04547966**	3,89453333
Within Groups	553,489552	177	3,12705961			
Total	566,178771	178				

d)

SUMMARY: Number of topics aware of (among young individuals <24)

Groups	*Count*	*Sum*	*Average*	*Variance*
Very poor	2	7	3,5	12,5
Poor	16	54	3,375	1,71666667
Moderate	51	203	3,98039216	2,53960784
Good	40	176	4,4	3,37435897
Perfect	3	18	6	1

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	24,2767507	4	6,06918768	2,17314938	0,07688915	2,45656573
Within Groups	298,830392	107	2,7928074			
Total	323,107143	111				

SUMMARY: Number of topics aware of (among young individuals <24)

Groups	*Count*	*Sum*	*Average*	*Variance*
Very poor/Poor	18	61	3,38888889	2,25163399
Good/excellent	43	194	4,51162791	3,35105205

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	15,9944296	1	15,9944296	5,27126017	**0,02525038**	4,0039825
Within Groups	179,021964	59	3,03427057			
Total	195,016393	60				

e)

SUMMARY: Number of topics aware of (among young individuals <24)

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	89	354	3,97752809	2,61312564
Male	21	97	4,61904762	4,24761905

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	6,99256287	1	6,99256287	2,39815482	0,12440391	3,92901172
Within Groups	314,907437	108	2,9158096			
Total	321,9	109				

SUMMARY: Number of topics aware of (among young individuals <24)

Groups	*Count*	*Sum*	*Average*	*Variance*
No previous food pois	48	198	4,125	3,09042553
Yes	48	193	4,02083333	2,7016844

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,26041667	1	0,26041667	0,08992118	0,76493949	3,94230334
Within Groups	272,229167	94	2,89605496			
Total	272,489583	95				

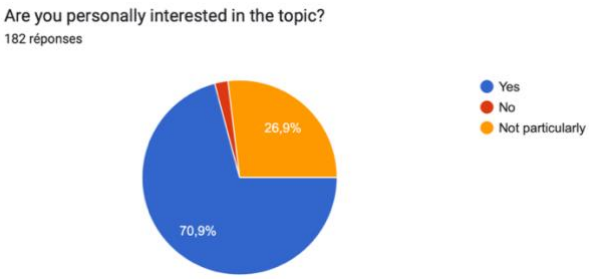
SUMMARY: Receive formal education or training in food safety (among young individuals <24)				
Groups	*Count*	*Sum*	*Average*	*Variance*
With food safety education	12	48	4	4,18181818
Without	100	410	4,1	2,7979798

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,10714286	1	0,10714286	0,03648828	0,84886279	3,92739363
Within Groups	323	110	2,93636364			
Total	323,107143	111				

Appendix 18: Survey analysis: Sources of food safety information

a)



SUMMARY: Interest in food safety				
Groups	*Count*	*Sum*	*Average*	*Variance*
Belgian	130	93	0,71538462	0,20518784
French	14	9	0,64285714	0,24725275
Italian	20	12	0,6	0,25263158
Other	17	14	0,82352941	0,15441176

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,52655826	3	0,17551942	0,84068977	0,47324896	2,65564718
Within Groups	36,9541047	177	0,20878025			
Total	37,480663	180				

b)

SUMMARY: "I pay attention to news alerts concerning food risks"				
Groups	*Count*	*Sum*	*Average*	*Variance*
Secondary	20	56	2,8	1,22105263
Bachelor	85	244	2,87058824	1,44733894
Master	75	241	3,21333333	1,19711712
Doctorate	2	9	4,5	0,5

ANOVA

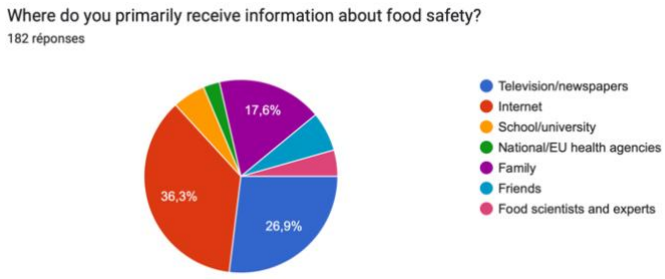
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	10,0489507	3	3,34965022	2,5495157	0,05731	2,6553588
Within Groups	233,863137	178	1,31383785			
Total	243,912088	181				

SUMMARY: "I pay attention to news alerts concerning food risks"				
Groups	*Count*	*Sum*	*Average*	*Variance*
Secondary/Bachelor	105	300	2,85714286	1,39285714
Master/doctorate	77	250	3,24675325	1,21462748

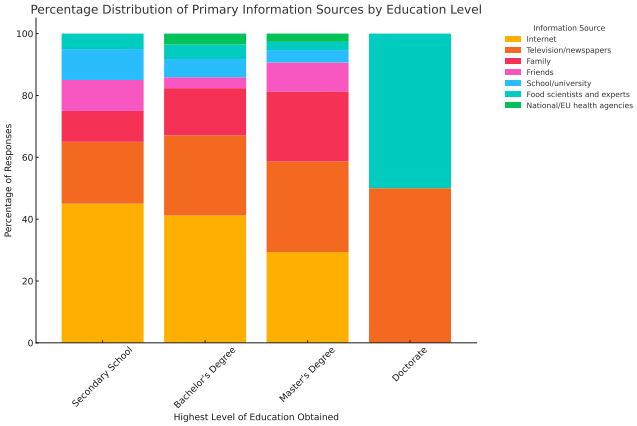
ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	6,74325674	1	6,74325674	5,11781505	**0,02487677**	3,89363988
Within Groups	237,168831	180	1,31760462			
Total	243,912088	181				

c)



d)



e)

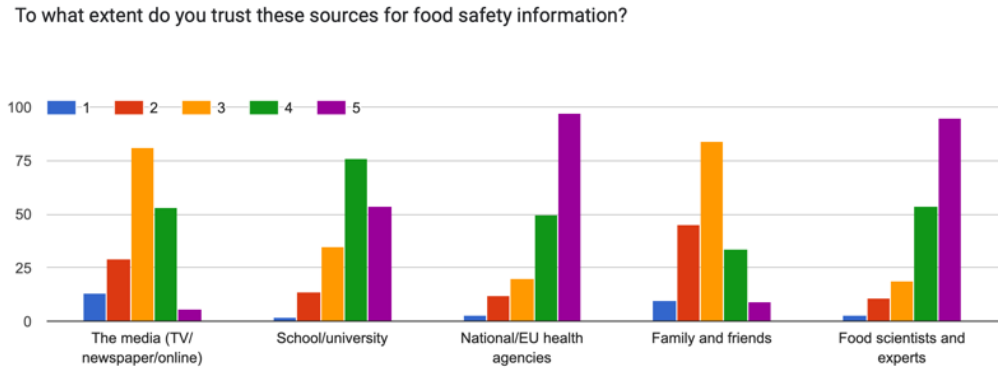
SUMMARY: Number of topics aware of (among students)

Groups	*Count*	*Sum*	*Average*	*Variance*
Family/Friends	32	120	3,75	2,58064516
University	9	47	5,22222222	2,69444444

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	15,2249322	1	15,2249322	5,84677376	**0,02037669**	4,09127856
Within Groups	101,555556	39	2,6039886			
Total	116,780488	40				

f)



g)

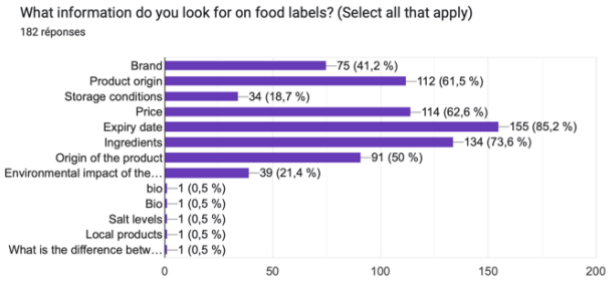
SUMMARY: "I am extremely worried about food poisoning"

Groups	*Count*	*Sum*	*Average*	*Variance*
Mass media (TV/newspaper/web)	115	265	2,30434783	1,31884058
Family and friends	44	104	2,36363636	1,49260042

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,11186517	1	0,11186517	0,08186669	0,77516069	3,90137223
Within Groups	214,529644	157	1,36643086			
Total	214,641509	158				

h)



i)

SUMMARY: Frequency reading labels

Groups	*Count*	*Sum*	*Average*	*Variance*
Secondary	20	48	2,4	0,98947368
Bachelor	85	190	2,23529412	1,42016807
Master	75	174	2,32	1,62594595
Doctorate	2	6	3	0

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1,56390433	3	0,52130144	0,35908122	0,78262778	2,6553588
Within Groups	258,414118	178	1,45176471			
Total	259,978022	181				

SUMMARY: Checking expiry dates on food products

Groups	*Count*	*Sum*	*Average*	*Variance*
Secondary	20	91	4,55	0,57631579
Bachelor	85	368	4,32941176	0,81876751
Master	75	332	4,42666667	0,54522523
Doctorate	2	10	5	0

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1,64664296	3	0,54888099	0,81367755	0,4878471	2,6553588
Within Groups	120,073137	178	0,67456819			
Total	121,71978	181				

j)

SUMMARY: Read ingredients list

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	127	99	**0,77952756**	0,17322835
Male	52	32	0,61538462	0,2413273

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,99402766	1	0,99402766	5,15440629	**0,02439281**	3,89453333
Within Groups	34,134464	177	0,19285008			
Total	35,1284916	178				

SUMMARY: Read strorage conditions

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	127	26	0,20472441	0,16410449
Male	52	8	0,15384615	0,13273002

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,09550332	1	0,09550332	0,6158946	0,4336261	3,89453333
Within Groups	27,4463961	177	0,15506438			
Total	27,5418994	178				

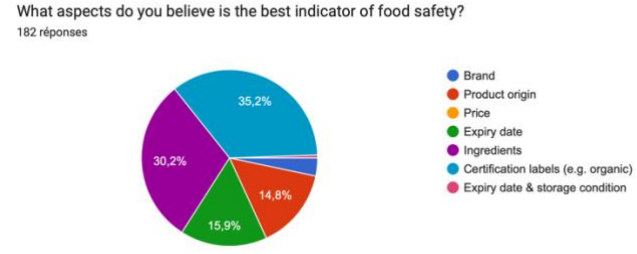
SUMMARY: Check expiry date on food products

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	127	114	0,8976378	0,09261342
Male	52	39	0,75	0,19117647

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,80417235	1	0,80417235	6,6453415	0,01075543	3,89453333
Within Groups	21,4192913	177	0,12101295			
Total	22,2234637	178				

k)



l)

SUMMARY: Viewing brand as best indicator of food safety				
Groups	*Count*	*Sum*	*Average*	*Variance*
Female	127	3	0,02362205	0,02324709
Male	52	3	0,05769231	0,05542986

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,04282575	1	0,04282575	1,316901	0,2526977	3,89453333
Within Groups	5,75605694	177	0,0325201			
Total	5,79888268	178				

SUMMARY: Viewing brand as best indicator of food safety				
Groups	*Count*	*Sum*	*Average*	*Variance*
Secondary	20	0	0	0
Bachelor	85	4	0,04705882	0,04537815
Master/Doctorate	77	2	0,02597403	0,02563226

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,04238115	2	0,02119057	0,65854748	0,51885206	3,04643275
Within Groups	5,75981665	179	0,03217775			
Total	5,8021978	181				

m)

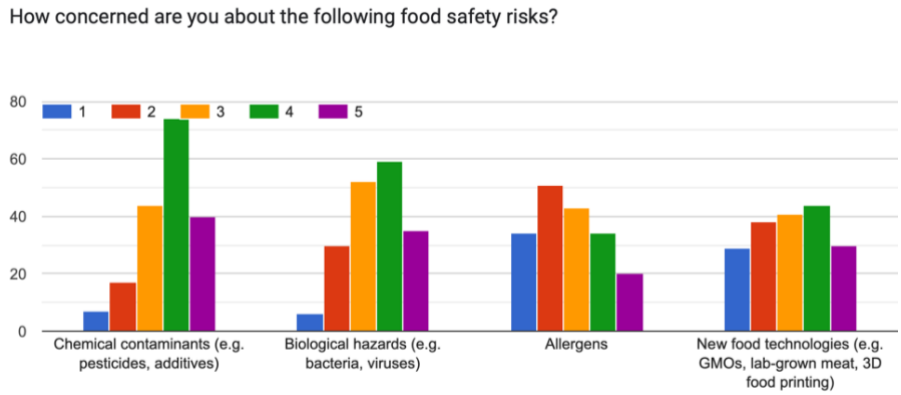
SUMMARY: Product origin as best indicator for food safety				
Groups	*Count*	*Sum*	*Average*	*Variance*
Under 24	113	16	0,14159292	0,12262958
Above 24	69	11	0,15942029	0,13597613

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Entre Groupes	0,01361541	1	0,01361541	0,10664398	0,74437715	3,89363988
A l'intérieur des groupes	22,9808901	180	0,12767161			
Total	22,9945055	181				

Appendix 19: Survey analysis: Attitudes towards food safety, risk perception and concerns

a)



b)

SUMMARY: Food safety concerns*				
Groups	*Count*	*Sum*	*Average*	*Variance*
Belgian	130	1707	13,1307692	11,1998211
French	14	175	12,5	13,5
Italian	20	226	11,3	5,69473684
Other	18	249	13,8333333	11,6764706

*∑ concerns of chemical contaminants, biological risks, allergens and new food technologies

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	75,578022	3	25,192674	2,32711452	0,07625851	2,6553588
Within Groups	1926,97692	178	10,8257131			
Total	2002,55495	181				

SUMMARY: Concern about chemical contaminants (e.g. pesticides, additives)				
Groups	*Count*	*Sum*	*Average*	*Variance*
Belgian	130	484	3,72307692	1,13202147
French	14	54	3,85714286	1,05494505
Italian	20	66	3,3	0,95789474
Other	18	65	3,61111111	0,83986928

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3,65079365	3	1,21693122	1,1268888	0,33960581	2,6553588
Within Groups	192,222833	178	1,07990355			
Total	195,873626	181				

SUMMARY: Food safety concerns*				
Groups	*Count*	*Sum*	*Average*	*Variance*
Under 24	113	1377	12,1858407	11,1169406
Above 24	69	980	14,2028986	8,57587383

*∑ concerns of chemical contaminants, biological risks, allergens and new food technologies

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	174,29818	1	174,29818	17,16043	**5,2772E-05**	3,89363988
Within Groups	1828,25677	180	10,156982			
Total	2002,55495	181				

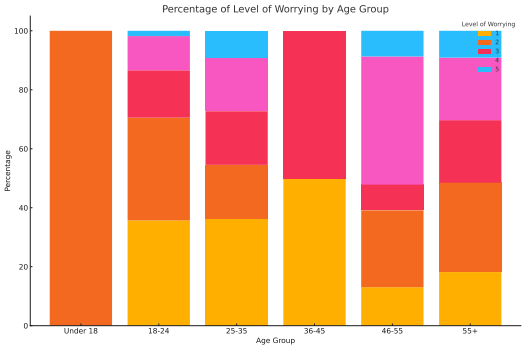
c)

SUMMARY: "I am extremely worried about food poisoning"

Groups	*Count*	*Sum*	*Average*	*Variance*
Under 18	1	2	2	#DIV/0!
18-24	112	234	2,08928571	1,1451094
25-35	11	27	2,45454546	2,07272727
36-45	2	4	2	2
46-55	23	71	**3,08695652**	1,6284585
55+	33	90	2,72727273	1,57954545

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	25,2885484	5	5,05770968	3,76856247	**0,00288245**	2,26546426
Within Groups	236,205957	176	1,3420793			
Total	261,494506	181				



d)

SUMMARY: Food safety concerns*

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	127	1630	12,8346457	11,1073616
Male	52	688	13,2307692	11,4358974

*∑ concerns of chemical contaminants, biological risks, allergens and new food technologies

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	5,78915775	1	5,78915775	0,51679567	0,47315974	3,89453333
Within Groups	1982,75833	177	11,2020245			
Total	1988,54749	178				

SUMMARY: Concern about chemical contaminants (e.g. pesticides, additives)

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	127	455	3,58267717	0,97525309
Male	52	202	3,88461538	1,31975867

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3,36349055	1	3,36349055	3,13023364	0,07857482	3,89453333
Within Groups	190,189582	177	1,07451741			
Total	193,553073	178				

SUMMARY: Concerns about biological hazards (e.g. bacteria, viruses)

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	127	439	3,45669291	1,23422072
Male	52	182	3,5	1,03921569

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,06919456	1	0,06919456	0,05873738	0,8087834	3,89453333
Within Groups	208,511811	177	1,17803283			
Total	208,581006	178				

SUMMARY: Concerns about allergens

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	127	354	2,78740157	1,6607924
Male	52	141	2,71153846	1,54260935

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,21233195	1	0,21233195	0,13052608	0,71831808	3,89453333
Within Groups	287,932919	177	1,62673966			
Total	288,145251	178				

SUMMARY: Concerns about new food technologies (e.g. GMOs, lab-grown meat, 3D food printing)

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	127	382	3,00787402	1,65866767
Male	52	163	3,13461538	1,96191554

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,59263981	1	0,59263981	0,33941857	0,56090647	3,89453333
Within Groups	309,049818	177	1,74604417			
Total	309,642458	178				

SUMMARY: "I am extremely worried about food poisoning"

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	127	294	2,31496063	1,42382202
Male	52	128	2,46153846	1,54751131

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,79266671	1	0,79266671	0,5431228	0,46211715	3,89453333
Within Groups	258,324652	177	1,45946131			
Total	259,117318	178				

SUMMARY: Food safety concerns*

Groups	*Count*	*Sum*	*Average*	*Variance*
Secondary	20	233	11,65	13,3973684
Bachelor	85	1099	12,9294118	10,2092437
Master	75	997	13,2933333	10,4533333
Doctorate	2	28	14	72

*∑ concerns of chemical contaminants, biological risks, allergens and new food technologies

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	44,8818078	3	14,9606026	1,36028186	0,25653374	2,6553588
Within Groups	1957,67314	178	10,9981637			
Total	2002,55495	181				

SUMMARY: "I am extremely worried about food poisoning"

Groups	*Count*	*Sum*	*Average*	*Variance*
Secondary	20	42	2,1	2,2
Bachelor	85	199	2,34117647	1,2512605
Master	75	178	2,37333333	1,39927928
Doctorate	2	9	4,5	0,5

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	10,5419565	3	3,51398549	2,49246091	**0,06167636**	2,6553588
Within Groups	250,952549	178	1,40984578			
Total	261,494505	181				

e)

SUMMARY: Food safety concerns*

Groups	*Count*	*Sum*	*Average*	*Variance*
With children living in household	20	202	10,1	9,98947368
Without	162	1601	9,88271605	6,0296373

*∑ concerns of chemical contaminants, biological risks, allergens and new food technologies

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,84048297	1	0,84048297	0,13035554	0,71848708	3,89363988
Within Groups	1160,5716	180	6,44762003			
Total	1161,41209	181				

SUMMARY: "I am extremely worried about food poisoning"

Groups	*Count*	*Sum*	*Average*	*Variance*
With children living in household	20	50	2,5	1,73684211
Without	162	378	2,33333333	1,41614907

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,49450549	1	0,49450549	0,34103827	0,55996164	3,89363988
Within Groups	261	180	1,45			
Total	261,494505	181				

SUMMARY: Food safety concerns*

Groups	Count	Sum	Average	Variance
1member	25	330	13,2	13,3333333
2-3 members	72	931	12,9305556	8,88243349
4-5 members	72	944	13,1111111	12,7762128
5+	13	152	11,6923077	10,0641026

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	24,0218254	3	8,00727513	0,72037964	0,54103803	2,6553588
Within Groups	1978,53312	178	11,1153546			
Total	2002,55495	181				

SUMMARY: "I am extremely worried about food poisoning"

Groups	Count	Sum	Average	Variance
1 member	25	52	2,08	1,32666667
2-3 members	72	182	2,52777778	1,60485133
4-5members	72	171	2,375	1,42077465
5+	13	23	1,76923077	0,52564103

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	8,52736874	3	2,84245625	2,00009068	0,11567621	2,6553588
Within Groups	252,967137	178	1,42116369			
Total	261,494505	181				

f)

g)

SUMMARY: Food safety concerns

Groups	Count	Sum	Average	Variance
I know how to avoid food risks: level 1/2*	40	514	12,85	15,0538462
I know how to avoid food risks: level 3*	70	912	13,0285714	10,0571429
I know how to avoid food risks: level 4/5*	72	931	12,9305556	10,1500391

*agreement level

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0,85931013	2	0,42965507	0,03842155	0,96231512	3,04643275
Within Groups	2001,69563	179	11,1826572			
Total	2002,55495	181				

SUMMARY: Food safety concerns*

Groups	Count	Sum	Average	Variance
Poor/Very poor*	24	285	11,875	15,1576087
Excellent/Good*	79	1070	13,5443038	9,86660175

*Self-rated knowledge

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	51,2946264	1	51,2946264	4,63303962	**0,03374391**	3,93518869
Within Groups	1118,21994	101	11,0714845			
Total	1169,51456	102				

h)

SUMMARY: "I am extremely worried about food poisoning" (Among young individuals <24)

Groups	Count	Sum	Average	Variance
Female	91	196	2,15384615	1,26495726
Male	21	39	1,85714286	0,52857143

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Entre Groupes	1,50206044	1	1,50206044	1,32800079	0,25165946	3,92739363
A l'intérieur des groupes	124,417582	110	1,13106893			
Total	125,919643	111				

SUMMARY: Food safety concerns* (Among young individuals <24)

Groups	Count	Sum	Average	Variance
Female	91	1132	12,4395604	11,9379731
Male	21	234	11,1428571	7,02857143

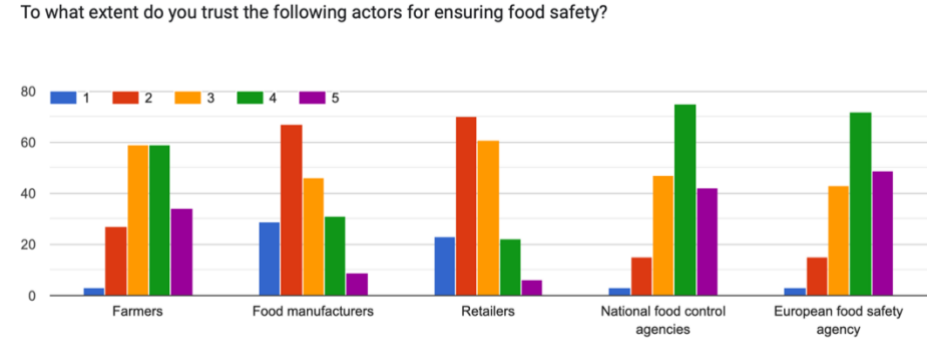
*∑ concerns of chemical contaminants, biological risks, allergens and new food technologies

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Entre Groupes	28,6895604	1	28,6895604	2,59743226	0,10990269	3,92739363
A l'intérieur des groupes	1214,98901	110	11,0453546			
Total	1243,67857	111				

Appendix 20: Survey analysis: Consumer trust and assigned responsibility

a)



b)

SUMMARY: Trust towards food chain actors*

Groups	Count	Sum	Average	Variance
Belgian	130	2122	16,3230769	13,3676804
French	14	234	16,7142857	16,0659341
Italian	20	320	16	8,52631579
Other	18	282	15,6666667	12

*Sum of trust towards farmers, food manufacturers, retailers, national food control agencies and EFSA

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	11,0857143	3	3,6952381	0,28606786	0,83541982	2,6553588
Within Groups	2299,28791	178	12,9173478			
Total	2310,37363	181				

SUMMARY: Trust towards food chain actors*

Groups	Count	Sum	Average	Variance
Female	127	2066	16,2677165	12,8007749
Male	52	833	16,0192308	12,9211916

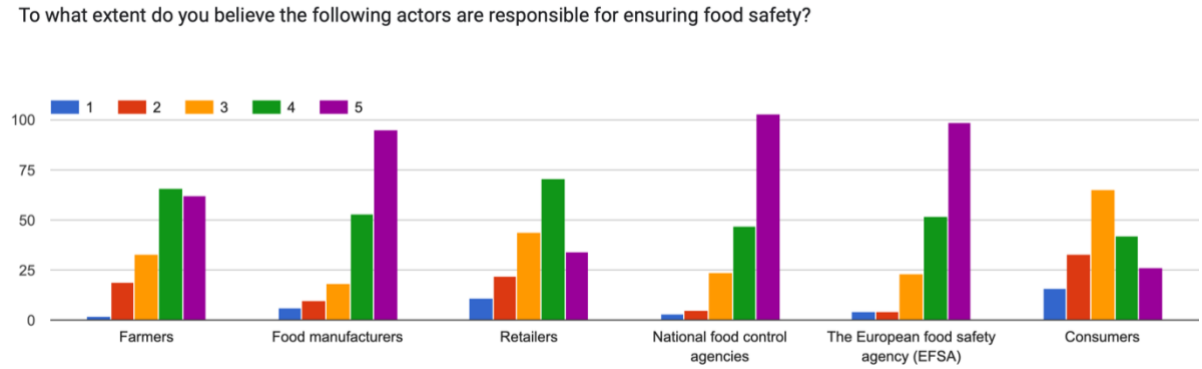
ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2,27801755	1	2,27801755	0,1774783	0,67406051	3,89453333
Within Groups	2271,87841	177	12,8354712			
Total	2274,15642	178				

Trust in food chain actors*	Farmers	Food manufacturers	Retailers	National food control agencies	EFSA
Belgian	22,24%	15,83%	15,79%	23,00%	23,14%
French	22,65%	14,53%	15,38%	23,50%	23,93%
Italian	18,41%	15,56%	16,83%	24,44%	24,76%
Other	20,21%	18,09%	14,18%	22,70%	24,82%

*#trust in actor (scale 1-5)/#sum trust in every actor (scale 1-5)

c)



d)

SUMMARY: Food chain actors' responsibility

Groups	Count	Sum	Average	Variance
Belgian	130	2615	20,1153846	13,9168157
French	14	294	21	9,53846154
Italian	20	406	20,3	17,4842105
Other	18	378	21	8,82352941

ANOVA

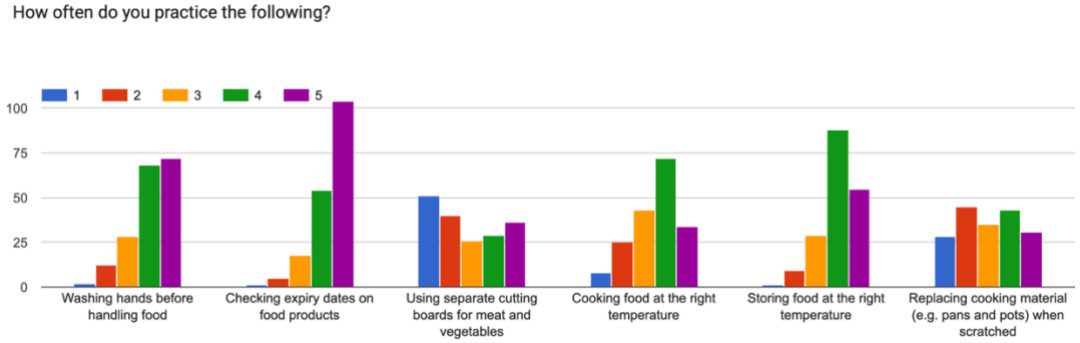
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	20,0967033	3	6,6989011	0,4965312	0,68514686	2,6553588
Within Groups	2401,46923	178	13,4914002			
Total	2421,56593	181				

Assigned responsibility*	Farmers	Food manufacturers	Retailers	National food control agencies	EFSA
Belgian	19,43%	20,54%	17,13%	21,57%	21,34%
French	18,03%	21,43%	18,37%	21,09%	21,09%
Italian	18,72%	20,69%	17,49%	21,43%	21,67%
Other	19,20%	20,95%	16,96%	21,20%	21,70%

*#assigned responsibility actor (scale 1-5)/#sum assigned responsibility to every actor (scale 1-5)

Appendix 21: Survey analysis: Behaviour and food handling practices

a)



SUMMARY: Frequency of safe food handling practices

Groups	Count	Sum	Average	Variance
Washing hands before handling food	182	742	4,07692308	0,91117722
Checking expiry dates on food products	182	801	4,4010989	0,67248497
Using separate cutting boards for meat and vegetables	182	505	2,77472527	2,25283832
Cooking food at the right temperature	182	645	3,54395604	1,16656548
Storing food at the right temperature	182	733	4,02747253	0,71194827
Replacing cooking material (e.g. pans and pots) when scratched	182	550	3,02197802	1,78956955

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	374,952381	5	74,9904762	59,9557375	3,18E-55	2,22234213
Within Groups	1358,32967	1086	1,25076397			
Total	1733,28205	1091				

b)

SUMMARY: Frequency of safe food handling practices

Groups	Count	Sum	Average	Variance
Female	127	2756	21,7007874	16,1637295
Male	52	1150	22,1153846	13,6726998

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	6,34171604	1	6,34171604	0,41057401	0,52250702	3,89453333
Within Groups	2733,93761	177	15,4459752			
Total	2740,27933	178				

SUMMARY : [Handwashing frequency]

Groups	Count	Sum	Average	Variance
Female	127	531	4,18110236	0,86376703
Male	52	196	3,76923077	0,92609351

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	6,25860745	1	6,25860745	7,09813586	**0,00842921**	3,89453333
Within Groups	156,065415	177	0,88172551			
Total	162,324022	178				

SUMMARY [Checking expiry dates frequency]

Groups	Count	Sum	Average	Variance
Female	127	568	4,47244094	0,56867892
Male	52	220	4,23076923	0,92609351

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2,15479361	1	2,15479361	3,20814799	0,07498108	3,89453333
Within Groups	118,884313	177	0,67166278			
Total	121,039106	178				

SUMMARY: [Using separate cutting boards for meat and vegetables]

Groups	Count	Sum	Average	Variance
Female	127	359	2,82677165	2,31896013
Male	52	136	2,61538462	2,04524887

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1,64858271	1	1,64858271	0,73594348	0,39212357	3,89453333
Within Groups	396,496669	177	2,24009417			
Total	398,145251	178				

SUMMARY: [Cooking food at the right temperature]

Groups	Count	Sum	Average	Variance
Female	127	433	3,40944882	1,22784652
Male	52	202	3,88461538	0,88838612

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	8,33001499	1	8,33001499	7,37146051	**0,00728308**	3,89453333
Within Groups	200,016354	177	1,1300359			
Total	208,346369	178				

SUMMARY: Storing food at the right temperature

Groups	Count	Sum	Average	Variance
Female	127	500	3,93700787	0,82139733
Male	52	220	4,23076923	0,41628959

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	3,1837823	1	3,1837823	4,51810936	**0,03492478**	3,89453333
Within Groups	124,726832	177	0,70467137			
Total	127,910615	178				

SUMMARY: [Replacing cooking material (e.g. pans and pots) when scratched]

Groups	Count	Sum	Average	Variance
Female	127	365	2,87401575	1,76177978
Male	52	176		1,65309201

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	9,61867025	1	9,61867025	5,55843752	**0,01948398**	3,89453333
Within Groups	306,291944	177	1,73046296			
Total	315,910615	178				

c)

SUMMARY: Frequency of safe food handling practices

Groups	Count	Sum	Average	Variance
Secondary	20	412	20,6	18,0421053
Bachelor	85	1874	22,0470588	14,5215686
Master	75	1635	21,8	15,4864865
Doctorate	2	55	27,5	0,5

ANOVA

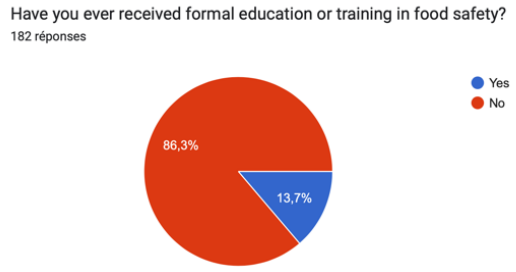
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	98,580543	3	32,860181	2,15905165	0,09452257	2,6553588
Within Groups	2709,11176	178	15,219729			
Total	2807,69231	181				

SUMMARY: Frequency of safe food handling practices (among young consumers)

Groups	Count	Sum	Average	Variance
With food safety education	24	551	22,9583333	18,9981884
Without	89	1895	21,2921348	16,3455056

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	52,4778802	1	52,4778802	3,10608946	0,08075262	3,92660681
Within Groups	1875,36283	111	16,8951606			
Total	1927,84071	112				



d)

SUMMARY: Frequency of safe food handling practices

Groups	*Count*	*Sum*	*Average*	*Variance*
Under 24	113	2406	21,2920354	14,8514539
Above 24	69	1570	22,7536232	15,4825234

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	91,5178816	1	91,5178816	6,06486039	**0,01473044**	3,89363988
Within Groups	2716,17443	180	15,0898579			
Total	2807,69231	181				

e)

SUMMARY: Frequency of safe food handling practices (Among students)

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	87	1841	21,1609195	16,1598503
Male	18	387	21,5	13,5588235

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1,71477833	1	1,71477833	0,1090094	0,74194534	3,93333667
Within Groups	1620,24713	103	15,7305546			
Total	1621,9619	104				

SUMMARY : [Handwashing frequency] (Among students)

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	87	365	4,1954023	0,83346699
Male	18	63	3,5	1,20588235

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	7,21231527	1	7,21231527	8,05905071	**0,00545529**	3,93333667
Within Groups	92,1781609	103	0,8949336			
Total	99,3904762	104				

SUMMARY [Checking expiry dates frequency] (Among students)

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	87	387	4,44827586	0,55252606
Male	18	78	4,33333333	0,70588235

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,19704433	1	0,19704433	0,34100315	0,56052747	3,93333667
Within Groups	59,5172414	103	0,57783729			

SUMMARY: [Using separate cutting boards for meat and vegetables] (Among students

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	87	237	2,72413793	2,43464314
Male	18	47	2,61111111	2,60457516

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,19053093	1	0,19053093	0,07736699	0,78145541	3,93333667
Within Groups	253,657088	103	2,46269018			

SUMMARY: [Cooking food at the right temperature] (Among students)

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	87	288	3,31034483	1,42582197
Male	18	70	3,88888889	1,04575163

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	4,99200876	1	4,99200876	3,66226862	0,05843382	3,93333667
Within Groups	140,398467	103	1,36309192			
Total	145,390476	104				

SUMMARY: Storing food at the right temperature (Among students)

Groups	*Count*	*Sum*	*Average*	*Variance*
Female	87	335	3,85057471	0,96578455
Male	18	74	4,11111111	0,45751634

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1,01237001	1	1,01237001	1,14794765	0,2864833	3,93333667
Within Groups	90,835249	103	0,88189562			
Total	91,847619	104				

SUMMARY: [Replacing cooking material (e.g. pans and pots) when scratched] (Among students)

Groupes	*bre d'échantil*	*Somme*	*Moyenne*	*Variance*
Female	87	229	2,63218391	1,79337076
Male	18	55	3,05555556	1,82026144

ANOVA

Source des variations	*mme des carnegré de libertvenne des cari*		*F*	*Probabilité*	*ur critique pour F*
Entre Groupes	2,67328955	1	1,48697081	0,22547213	3,93333667
A l'intérieur des groupes	185,17433	103	1,79780902		
Total	187,847619	104			

f)

SUMMARY: Frequency of safe food handling practices (Among students)

Groups	*Count*	*Sum*	*Average*	*Variance*
Never experienced food poisoning	47	980	20,8510638	18,0860315
Experienced food poisoning	46	992	21,5652174	14,9178744

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	11,8564849	1	11,8564849	0,71773269	0,39911126	3,9456942
Within Groups	1503,26179	91	16,5193604			
Total	1515,11828	92				

SUMMARY: Frequency of safe food handling practices (Among students)

Groups	*Count*	*Sum*	*Average*	*Variance*
Not responsible for cooking	17	367	21,5882353	18,3823529
Responsible for cooking (most of time/often)	90	1904	21,1555556	15,3463171

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	2,67695315	1	2,67695315	0,16933148	0,68154536	3,93155641
Within Groups	1659,93987	105	15,8089511			
Total	1662,61682	106				

Appendix 22: Triangulation

Food safety awareness

Aspect	Survey Findings	SLR Findings	Triangulation
General Awareness	Over 60% of respondents aware of pesticides, additives, microplastics in food, antibiotics or hormones in meat, and environmental pollutants in fish, meat, and dairy	Most Europeans are informed about concerns (e.g. use of additives, pesticide residues in food, antibiotics, or hormones in meat) with more than 60% of them being aware of each of these topics (Gallani 2022).	Validate
Emerging Technologies	Limited awareness of nanotechnology, 3D printed food and lab-grown meat.	Consumers' knowledge of emerging technologies like nanotechnology, 3D printed food, and lab-grown meat remains limited (van der Vossen-Wijmenga et al. 2022; Jenkins, Harris and Osman 2020)	Validate
Impact of Education	No influence of educational background on awareness of food-safety issues[12], including for environmental pollutants	• Education influences food safety knowledge (Bei et al. 2021) • Educational background significantly impacts Europeans' awareness of food safety issues; those with a higher education level are more likely to be familiar with topics like environmental pollutants in food (Gallani 2022)	Contrast
Country Differences	No influence of nationality (Belgian, French, Italian, other) on awareness levels	Risk awareness varies across countries (Moretro et al. 2021)	Contrast
Age Differences	No influence of age on awareness levels	\	\
Gender Differences	Female respondents reported to know less food safety topics	\	\
Self-assessed and Actual Knowledge Levels	Positive correlation among young individuals (under 24): those who rated their knowledge[13] as good/excellent knew more topics than those rating it as poor/very poor	Strong positive correlation between self-assessed and actual levels of knowledge (Smigic, Lazarov and Djekic 2020; Marklinder et al. 2020)	Validate
Gender Differences	No impact of gender on knowledge of young individuals	Gender does not significantly influence students' food safety knowledge (Stratev et al. 2017; Marklinder et al. 2020; Tomaszewska et al. 2021)	Validate

[12] Antibiotics or hormones in meat, nanotechnology, pesticides residues, food additives, 3D printed food, lab-grown meat, environmental pollutants in fish, meat or dairy, microplastics in food

[13] Such as the correct way to prepare and store food, techniques to prevent food contamination

Impact of Prior Experience of Food Poisoning	No impact of experience with food poisoning on knowledge of young individuals	Prior experience of food poisoning does not impact their knowledge (Ovca et al. 2014 Marklinder et al. 2020)	Validate
Impact of Food Safety Education	No impact of food safety education on knowledge of young individuals	• Food safety education (at school or university) has a positive effect on young individuals' knowledge (Marklinder et al. 2020). • No significant effect of food safety education on food safety awareness among students (Stratev et al. 2017)	Validate Stratev et al. (2017)

Sources of food safety information

Aspect	Survey Findings	SLR Findings	Triangulation
Interest in Food Safety and Country Difference	70% of respondents express personal interest in food safety, no significant difference among countries	70% Europeans reported a personal interest in food safety, although significant differences among countries (EU 2022)	Approximate
Food Safety News	Many respondents follow food safety news	A majority is attentive to warnings about food hazards (Niewscaz 2014)	Validate
Impact of Education	Respondents with higher education follow more frequently food safety news	Europeans with higher levels of education are more likely to keep an eye on the news (Gallani 2022)	Validate
Primary Information Source	Internet, especially among young respondents, followed by TV and newspapers	Television, followed by the internet, especially among younger individuals (Niewczas 2014; Tiozzo et al. 2017; Pinto et al. 2015).	Approximate
Impact of Education on Information Source	Education level does not influence reliance on family and friends	Lower-educated people were more inclined to seek advice from family and friends (Gallani 2022)	Contrast
Impact of Information Source on Awareness	Students educated primarily at school/university know more subjects than those taught by family/friends	Young consumers who rely on professors tend to have better food safety knowledge than those who depend on family and-friends or the Internet (Smigic, Lazarov and Djekic 2020; Satric et al. 2021)	Validate
Trust in Mass Media	Public trust in mass media is moderate, with 23% expressing little to no trust (highest distrust level compared to other food chain actors)	Mass media is often criticized for amplifying food-related risk situations or spreading emotional information that could unfavorably affect consumer decisions (Tiozzo et al. 2017)	Validate
Impact of Mass Media Reliance on Perceived	Reliance on mass media rather than on family and friends do not increase perceived vulnerability to food poisoning	People who mainly rely on information from the mass media rather than from family and friends tend to feel more vulnerable to foodborne illness (Pinto et al. 2015)	Contrast

Vulnerability to Food Poisoning			
Food Labels Reading	Over half of respondents frequently check food labels	• Many Italians frequently check food labels during purchases (Tiozzo et al. 2017; Pinto et al. 2015) • 40% of consumers in Turkey rarely read labels (Bayram and Ozturkcan 2023)	Validate Tiozzo et al. (2017)
Most Frequently Checked Item	Expiry date is the item checked the most	The most used indicator is the expiry date (Haas et al. 2021; Tiozzo et al. 2017; Bayram and Ozturkcan 2023; Pinto et al. 2015)	Validate
Impact of Education	Education does not influence label reading habits	More educated consumers are more attentive to food safety information (Bayram and Ozturkcan 2023; Haas et al. 2021)	Contrast
Gender Differences	Women are more inclined to check ingredient lists but not significantly more likely to consult storage conditions or expiry dates	Women are more likely than men to read expiration dates, storage conditions, and ingredient lists (Bayram and Ozturkcan 2023; Haas et al. 2021; van der Vossen-Wijmenga et al. 2022)	Approximate
Price as Food Safety Indicator	Price is never mentioned as best indicator of food safety	Consumers prefer to purchase well-known, pricier brands (Tiozzo et al. 2017; Bei et al. 2021)	Contrast
Brand as Food Safety Indicator	• 3.3% of respondents view brand as the best indicator • No clear preference based on gender or education	• During food scares, consumer generally prefer to purchase familiar or brand-name products • Men and those with only basic education are more likely to view brands as a safety guarantee (Niewczas 2014)	Contrast
Product Origin as Food Safety Indicator	Age does not impact likelihood to choose product origin as safety guarantee	Younger people are more likely to choose local products as a safety measure compared to older ones (Niewczas 2014)	Contrast

Attitudes towards food safety, risk perception and concerns

Aspect	Survey Findings	SLR Findings	Triangulation
Concerns about Animal Foods	Higher risk perception for animal-derived foods compared to plant-based foods	Animal-origin foods, such as meat and eggs, are still perceived as riskier than plant-based foods (Djekic et al. 2022; Nardi et al. 2020).	Validate
Concerns about Food Risks	Chemical contaminants are the most concerning food risks for respondents, followed by biological hazards	• Europeans are mostly worried about pesticide residues, antibiotics, hormones, and additives in their food, rather than biological risks (Gallani 2022; Banati 2014; Hartmann, Hübner and Siegrist 2018)	Validate Gallani (2022); Banati (2014);

		• Consumers are more concerned about microbiological contamination and foodborne illnesses over chemical risks (Tiozzo et al. 2017; Djekic et al. 2022)	Hartmann, Hübner and Siegrist (2018)
New Food Technologies	New food technologies rank third in terms of concern, with more diverse levels of worry	The 'fear of the unknown' makes consumers worry regarding new food technologies (Banati 2014).	Approximate
Country Differences	Concerns about food risks[14] do not vary across countries	The extent of food safety concerns (e.g. pesticide, hormones, and additives) varies across EU countries (Banati 2014)	Contrast
Age Differences	• Respondents above 24 years old are more concerned about food risks • Respondents aged 46-55 show higher levels of worry about food poisoning	• Risk perception tends to increase with age (Nardi et al. 2020; van der Vossen-Wijmenga et al. 2022) • Younger consumers exhibited more self-protective attitudes towards risks (Pinto et al. 2015)	Validate Nardi et al. (2020), van der Vossen-Wijmenga et al. (2022)
Gender Differences	No gender differences in concerns about food risks or worrying levels about food poisoning	• Women perceive higher levels of food risks than men (Nardi et al. 2020) • Gender has little impact on food safety concerns (e.g. additives, GMOs) (Djekic et al. 2022)	Approximate Djekic et al. (2022)
Impact of Education	No education differences in concerns about food risks or worrying levels about poisoning	• No significant correlation between Europeans' concerns and their education levels (Gallani 2022) • Higher educated consumers exhibit more self-protective attitudes towards food risks (Pinto et al. (2015)	Validate Gallani (2022)
Impact of Children in Households and Family Sizes	Presence children under 16 or larger family sizes do not affect concerns about food poisoning or food risks	Consumers living in households with children under 16 and larger family sizes tend to be more concerned and attentive to safety aspects in their food choices (Pinto et al. 2015; Nardi et al. 2020)	Contrast
Confidence in Mitigating Risks	40% of respondents feel able to mitigate food risks (agree/completely agree), 38% moderately agree	People often overestimate their ability to identify safe food (Tiozzo et al. 2017)	Validate

[14] Chemical and biological risks, allergens and new food technologies

Consumer trust and assigned responsibility

Aspect	Survey Findings	SLR Findings	Triangulation
Trust in Food Chain Actors	• Highest trust towards EFSA and national agencies • Retailers are the least trusted, followed by food manufacturers. • 40% of respondents express confidence in European food safety regulations	• Moderate trust in food chain actors, with consumers generally relying on *farmers* and *retailers* rather than *authorities* and *food manufacturers* (Macready et al. 2020) • Trust in national and EU institutions remained high in 2022 (EU 2022)	Contrast Macready et al. (2020) Validate EU (2022)
Impact of Gender on Trust	No significant gender differences	Gender does not affect consumer trust (Murphy et al. 2020)	Validate
Impact of Country on Trust	Trust in food chain actors did not vary significantly by country	Trust in food chain actors varies by country (Macready et al. 2020)	Contrast
Highest Perceived Responsibility	• Food manufacturers, EFSA and national control agencies are seen as responsible by over 80% of respondents • Farmers and retailers are seen as responsible, but to a lesser extent	• Food processors and primary producers are seen as the most responsible actors (Djekic et al. 2022) • Young consumers consider initial stages of the supply chain as responsible, rather than food control agencies (Ovca et al. 2017b; Franc-Dąbrowska et al. 2021)	Contrast
Lowest Perceived Responsibility	Respondents view themselves as the least responsible actor (only 37% consider themselves somewhat or highly responsible)	• Consumers consider themselves the least responsible for food safety (Nardi et al. 2020) • Young consumers perceive themselves as the least accountable (Franc-Dąbrowska et al. 2021; Ovca et al. 2017b).	Validate
Impact of Country on Responsibility	Perceptions of responsibility do not differ among countries	Consumers' perception of responsibility for food safety differs across countries (Djekic et al. 2022)	Contrast

Behaviour and handling practices

Aspect	Survey Findings	SLR Findings	Triangulation
Food Safety Practices	• High engagement with checking expiry dates and handwashing before cooking • Lowest adherence to using separate boards for meat and vegetables, followed by cooking at	/	/

	the right temperature, and replacing cooking materials		
Gender Differences	• Women report to wash their hands more frequently than men • Men report to cook and store food at correct temperatures and replace cooking materials more often than women	/	/
Impact of Food Safety Training	No impact of food safety training on the frequency of food handling practices among young individuals[15]	• Food safety education has a positive effect on behaviours (Marklinder et al. 2020) • Students acquiring their knowledge at university demonstrated more accurate practices than those without food safety education (Satric et al. 2021)	Contrast
Age Differences	Younger individuals (under 24) exhibit riskier practices	• Younger students are generally less cautious (Smigic, Lazarov and Djekic 2020) • Age does not affect practices among young consumers (Stratev et al. 2017)	Validate Smigic, Lazarov and Djekic (2020)
Gender Differences in Youth Practices	• No gender difference in the frequency of food handling practices among students • Girls tend to *wash their hands* more frequently	• No gender differences in practices (Smigic, Lazarov and Djekic 2020; Stratev et al. 2017; Tomaszewska et al. 2021) • Male students show riskier behaviours in preventing cross-contamination (e.g. hand hygiene, washing kitchen surfaces) (Lange Gorazon and Marklinder 2016; Satric et al. 2021; Ovca et al. 2014)	Approximate
Impact of Prior Experience of Food Poisoning	No impact of prior experience on food handling practices among students	• No significant impact of prior experience with foodborne illness on practices of children (Ovca et al. 2014) • Better food handling practices among students who encountered food poisoning (Smigic, Lazarov and Djekic 2020)	Validate Ovca et al. (2014)
Influence of Regular Cooking	Students cooking for oneself or family *most of the time or often* reported improved practices	More regular cooks demonstrate safer practices (Lange, Gorazon and Marklinder 2016)	Validate

[15] Handwashing, cooking and storing food at right temperatures, checking expiry dates, using separate boards for meat and vegetables, and replacing cooking materials when damaged.