SANITARNO INŽENIRSTVO / International Journal of Sanitary Engineering Research 2024;17(1): 15-42. DOI: 10.2478/ijser-2024-0002

sciendo

Disposable gloves: protection or just a false sense of security?

Nastja Vrbovšek and Mojca Jevšnik Podlesnik*

Original Research Article

Received: 24. 10. 2024
Accepted: 2. 12. 2024
Published: 16. 12. 2024

ABSTRACT

This study examines the impact of disposable glove use on food hygiene, focusing on the phenomenon of a false sense of security among food handlers in the catering establishments. A systematic literature review (2000–2024) and semi-structured interviews with nine catering employees revealed that improper glove use often results in reduced handwashing, cross-contamination, and non-compliance with hygiene standards. The literature analysis confirms that previous findings on the false sense of security associated with gloves remain relevant, while highlighting an increase in research activity on the topic in recent years. Interviews emphasized the lack of formal training on proper glove use and the need for enhanced supervision and awareness among food handlers regarding the appropriate hygiene practices for gloves and handwashing. The results indicate that gloves should not be perceived as a substitute for handwashing but rather as a complementary measure that requires strict adherence to hygiene protocols. This study highlights the importance of regular practical training, improved monitoring, and fostering accountability among food handlers to ensure food safety. A comprehensive approach to glove hygiene can significantly reduce the risk of foodborne illnesses and improve hygiene practices in the catering sector.

Keywords: disposable gloves, food handlers, catering, hand hygiene, food safety knowledge

University of Ljubljana
Faculty of Health Sciences
Zdravstvena pot 5
1000 Ljubljana, Slovenia

**Corresponding author*:
Assoc. Prof. Mojca Jevšnik Podlesnik, PhD
University of Ljubljana
Faculty of Health Sciences
Zdravstvena pot 5
1000 Ljubljana, Slovenia
Email: mojca.jevsnik@zf.uni-lj.si

INTRODUCTION

Disposable gloves have by now become a common hand hygiene practice worldwide. In food handling and healthcare organizations, they are mostly used as a measure to prevent the transmission of microorganisms [1] and they are used in numerous fields. The key factors in what type of gloves is best to choose are the quality and (raw) materials used. Most common materials used in glove manufacturing are polymers (rubber and plastic), leather, fabric or a combination of these materials. It is worth to mention that no glove material is ideal for every type of work. Rubber and plastic gloves are mostly used for hand protection from chemical or biological danger and for hand hygiene (protection against microorganisms). For protection against physical and mechanical hazards, textile or leather gloves are commonly used [2].

Food handlers tend to neglect the basic principles of hand hygiene while using gloves and this results in a reduced effectiveness of gloves as a barrier against contamination.

The use of disposable gloves is quite common in healthcare organisations where nurses, doctors and other workers have to be acquainted with the protocols of infection prevention in order to ensure safe daily care [3]. Workers in food establishments may use gloves provided they change them regularly, and care is taken to wash their hands both during the glove change and after they take the gloves off [4]. While glove use in food applications can reduce the risk of microbial contamination, it can also amplify or transfer it [5]. For example, Bencardino, Amagliani, and Brandi [6] state that the proper use of gloves is shown as an effective method for reducing the transfer level of contaminants from bare hands to foods. But as far as the effectiveness of decreasing food contamination with gloves goes, there is one major factor that needs to be addressed: the problem of improper hand hygiene when using gloves. Food handlers tend to neglect the basic principles of hand hygiene while using gloves and this results in a reduced effectiveness of gloves as a barrier against contamination [6].

Misuse of gloves could potentially lead to outbreaks of foodborne illnesses, which have been proven to have significant health and economic consequences.

Protocols and guidelines for using gloves in healthcare organisations are described in the World Health Organisation (WHO) document “Glove Use Information Leaflet”. While guidelines specific for using gloves in food handling are presented in many articles, for example in Slovenia, the correct way of using gloves is presented in a document published by NIJZ [7] titled “Basic hygiene principles for food hygiene and safety for employees in the food industry”. Guidelines advise to wash and dry hands before wearing gloves, to cover wounds with waterproof bandages, to change gloves frequently, after handling raw food, and if they are damaged, to wash hands between glove changes and after breaks and to not reuse or wash gloves. In this document, it is emphasised that gloves can become contaminated, they are not fully impermeable and they do not replace hand hygiene [7].

Considering the importance of food safety and hygiene, understanding the proper use of disposable gloves in food handling is crucial. Misuse of gloves could potentially lead to outbreaks of foodborne illnesses, which have been proven to have significant health and economic consequences [8]. In more detail, Chapman et al. [9] describe foodborne illnesses as problematic, especially in developing countries where 30% of individuals annually acquire a disease from contaminated food.

In this review, we focused on investigating whether the use of gloves causes a false sense of security or safety among food handlers in catering sector. The behaviour of workers who worked with gloves was also observed. The aim of the study was a systematic literature review on the use of disposable gloves when handling food and an analysis of the knowledge and attitudes of food employees in catering establishments towards disposable gloves for ensuring food safety.

METHODS

Systematic literature search

PubMed, Scopus, and Web of Science databases were searched to identify relevant scientific literature published between 2000 and 2024. The reason for choosing this time frame is the Slovenian progressive transition to the new European food safety legislation at that time. The literature was also searched on relevant websites: WHO and EU Food Safety Legislation. The search strategy was designed by using relevant keywords or strings of search terms and Boolean operators: (((disposable OR (glove OR gloves)) AND (security OR safety))) AND ((hand OR hands) AND (hygiene OR behavior)) AND (food AND (worker OR employee OR handler)) AND (hospitality OR catering OR foodservice OR "food service") where the same search strings were used for searching all three databases.

The language restitution concerned the articles published in English. Studies and review articles describing a false sense of glove security were summarized. Literature selection was made as illustrated in Table 1.

Table 1: Inclusion and exclusion criteria

	Inclusion criteria	**Exclusion criteria**
Language	English	All others
Date of publishing	2000–2024	Before 2000
Article category	Original research Systematic review Review article	Editorials Professional articles Letters
Keywords or strings of search terms and Boolean operators	((Disposable OR (glove OR gloves)) AND (security OR safety)) AND ((hand OR hands) AND (hygiene OR behavior)) AND (food AND (worker OR employee OR handler)) AND (hospitality OR catering OR foodservice OR "food service")	/
Availability	Free full access Open access	All others

Sample and semi-structured interviews

The research was conducted in July, August, and September 2024 among seven cooks and two cook assistants (three women and six men) employed in catering establishments. Using Google maps, we randomly selected catering establishments and contacted them. The data on catering establishments in Slovenia was obtained online. We called the phone number listed on their official website, got the person in charge on the phone and asked for their cooperation. Some agreed to participate, while others declined. We invited 40 restaurants. In the end, nine restaurants from Ljubljana, the capital of Slovenia, and its surroundings were included. From each establishment, one person agreed to participate in the semi-structured interviews.

The interviews were conducted immediately over the phone. Participation was voluntary, and the purpose and objectives of the study, as well as the interview process, were explained to all interviewees. All respondents verbally agreed to the recording of the interviews and the presentation of results in an anonymous format. Complete protection of personal data was ensured for all interviewees.

We invited 40 restaurants. In the end, nine restaurants from Ljubljana, the capital of Slovenia, and its surroundings were included.

Research materials were obtained through semi-structured interviews. A total of nine interviews were conducted with individuals handling food in catering establishments. The interviews included seven open-ended questions with sub-questions (Table 2), which were designed independently. Data was collected using an individual approach, with each interview lasting between 10 and 15 minutes. After reviewing the interviewees' responses, specific topics were identified. The interviews were recorded and transcribed verbatim. All personal data from the recorded interviews were anonymized. Names were coded, and any information that could reveal the identity of the speakers was omitted. Each interviewee was assigned a code (from I1 to I9, food handler number 1 to number 9). The interview quotes are presented in italics and organized according to specific topics.

Table 2: Semi-structured interview questions

Main questions	Sub-questions
1. Which work responsibilities are most demanding for you in terms of food hygiene requirements?	/
2. How often do you use disposable gloves in your work, and in what situations do you use them?	a) a. Why do you think the use of gloves is mandatory in the previously mentioned situations? b. Do you sometimes decide not to use gloves? If so, why?
3. How do you evaluate the effectiveness of disposable gloves in ensuring food hygiene?	b) What is your opinion on whether gloves prevent food contamination? c) Do you have any experience or examples where gloves did not provide adequate protection?

4. How does the use of gloves in your kitchen work affect handwashing?	d) a. Have you ever noticed that colleagues are less attentive to handwashing because of glove use?
5. Do you have any suggestions for improving the use of disposable gloves in your kitchen?	e) What advice would you give to colleagues or younger staff members entering the role of a chef regarding glove use?
6. How do you evaluate the course on food hygiene and proper personal hygiene when working with food?	/
7. Do you have any suggestions for improving the course programs? What should, in your opinion, be emphasized based on your work experience?	/

Data analysis

After conducting and transcribing the interviews, we reviewed the transcripts for accuracy. Following Vogrinec [10], we divided the data analysis into six steps: processing the material, determining the coding units, coding, selecting and defining relevant concepts and forming categories, defining the categories and forming the final theoretical formulation – topic design.

RESULTS AND DISCUSSION

Systematic literature search

The search results are shown in Figure 1. By applying time criteria and language filters, 374 electronic sources were identified. By applying the availability criteria, the number of electronic sources was reduced to 161. After reviewing the duplicates from all the databases 148 electronic sources were identified. Subsequently, the titles, abstracts, and other information about the literature, were reviewed, resulting in the elimination of 142 electronic sources. These 142 sources addressed various aspects of hand hygiene and glove use; however, for the final analysis, we included 6 sources that exclusively focused on addressing the false sense of security in the use of gloves in food handling. An overview of the studies analysed is shown in Table 3.

The results further suggest that glove use might be counterproductive because workers might wash their hands less frequently when gloved, potentially leading to a false sense of security.

Figure 1: Flowchart of the literature search and selection process

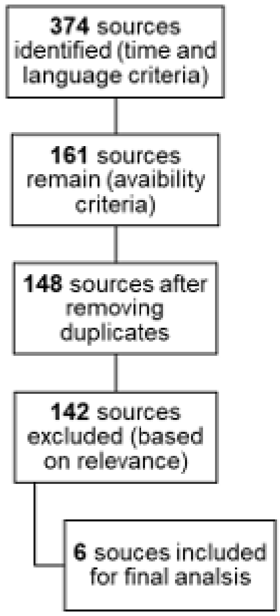

Table 3: An overview of articles included in the final analysis, addressing the false sense of security in the use of gloves by food handling employees

Authors, years	Aim	Type of study	Population	Country	Results
Rajagopal, Strohbehn [11] (2013)	To assess knowledge and behaviour related to glove use by college and university dining hall student workers and to evaluate the effectiveness of a visual intervention tool for improving proper glove use.	Case-controlled study	Student food workers	Iowa, United states of America	Knowledge was high, with 90% or more correct responses given for 6 of the 10 items. However, observational data showed non-compliance with Food Code recommendations in both groups, although non-compliance was lower in the treatment group, suggesting that the intervention was successful.
Lynch, Phillips, Elledge, Hanumanthaiah, Boatright [12] (2005)	To assess the effectiveness of glove use, compare microbiological contamination levels of food handled barehanded or with gloves and evaluate behavioural patterns of glove use among food handlers.	Observational comparative study	Food handlers in fast food restaurants	Oklahoma, United states of America	The observed tendency of food workers to wear the same pair of gloves for extended periods and complacency might account for the apparent failure of gloves to reduce or prevent bacterial contamination. The results further suggest that glove use might be counterproductive because workers might wash their hands less frequently when gloved, potentially leading to a false sense of security.

Michaels [13] (2004)	To explore the risks, limitations, and misconceptions concerning glove use in hygiene and food safety settings.	Review of literature	Food workers or/and handlers	Miami, United states of America	Gloves can create a false sense of security, mostly due to improper handwashing while gloved. Misusing gloves, not changing between tasks, increases microbiological cross-contamination potential. Proper education is needed in food safety, especially handling food with gloves.
Montville, Chen, Schaffner [14] (2001)	To evaluate the effectiveness of gloves as barriers, to quantify the bacterial transfer under different conditions, such as bare hands or with gloves used and to assess the limitations of glove use for contamination prevention.	Experimental laboratory study	University students and university staff	New Jersey, United states of America	Results indicate that gloves are permeable to bacteria although transfer from hands to food through a glove barrier was less than without a glove barrier. Our results indicate that gloves may reduce both bacterial transfer from food to the hands of food service workers and in subsequent transfer from hands back to food.
Arendt, Strohbehn, Jun [15] (2015)	To determine motivators and barriers of employees in following food safety practices in both non-commercial and commercial food service operations.	Mixed-methods observational study	Food workers	Iowa, United states of America	Indication to continue with safe food handling practices promotion among food workers, managers should infuse motivators and barriers identified in this study to effectively promote safe food handling practices.
Selvaraj, Cheng, Gan, Quan Oh, Thu Aung [1] (2023)	To assess the microbiological profile of gloves used by food handlers and to detect significant physical damage of gloves.	Quantitative laboratory-based observational study	Food handlers	Singapore	The results indicated that damaged gloves had significantly higher mean Standard Plate Counts (SPCs), suggesting an increased likelihood of bacterial transfer. Gloves with damage used to handle foods such as noodles and rice dishes exhibited notably higher mean SPCs compared to those used for handling beverages and snacks. In contrast, gloves without visible damage showed no significant differences in mean SPCs across various food types.

A systematic literature review of the 6 articles links the use of gloves in food handling environments with the false sense of security. Interestingly, Montville, Chen, and Schaffner [14] evaluated the effectiveness of gloves as barriers by quantifying the bacterial transfer under different conditions and demonstrated the ability of bacteria to pass from food through gloves to bare hand, and also from hand through gloves on food (Transfer rate through the glove barrier may be affected by inoculum size). The conclusive findings still point to the use of gloves as an effective way to decrease the transfer of a contaminant to hands. Building on this, Lynch et al. [12] pointed out that glove use might be counterproductive. Analysis of observed behaviour of food handlers showed that workers might wash their hands less frequently when gloved, also wearing the same pair of gloves for extended periods of time, which resulted in failure to prevent or decrease bacterial contamination. The review article of Michaels [13] confirmed previous conclusions as it emphasizes that glove use can create a false sense of security, mostly due to irregular and improper handwashing while gloved and also because of improper glove changes in between tasks.

Another concern about gloves discovered is a possibility of damage, which reduces their effectiveness in preventing micro-organisms from passing from hands to food.

In the first of the three more recent analysed studies, Rajagopal and Strohbehn [11], knowledge and behaviour related to glove use by college students and staff were evaluated. Observational data showed non-compliance with Food Code recommendations, although the non-compliance was lower in the treatment group, which received an intervention (educational flyer that explained when, why and how gloves are used), suggesting that the intervention was successful. Arendt, Strohbehn and Jun [15] are confirming the conclusions of Montville, Chen and Schaffner [14]; Lynch et al. [12] and Michaels [13] on food handlers having a false sense of security while gloved. Primarily they were studying motivators and barriers of employees in following food safety protocols where the barriers (forgetfulness/no habit; too busy; lack of knowledge) are connected to using gloves and ignoring proper handwashing and glove changes, which created a false sense of security for food handlers. Another concern about gloves discovered is a possibility of damage, which reduces their effectiveness in preventing micro-organisms from passing from hands to food. This was evaluated in the study of Selvaraj et al. [1] where damaged gloves were analysed. Of the collected gloves 54 % showed signs of physical damage which suggests an increase of bacterial transfer. Therefore, disposable gloves should be changed more frequently to minimize the possibility of food contamination.

Gloves should therefore be considered an adjunct and not an alternative to washing hands.

All six studies emphasized the importance of proper use and knowledge regarding the safe use of gloves from the perspective of food safety as the most effective way to prevent food contamination. Otherwise, gloves themselves can become a factor of contamination, as they create an environment where food handlers, due to a false sense of security, are not attentive to proper and sufficient handwashing or timely glove changes when necessary. Gloves should therefore be considered an adjunct and not an alternative to washing hands.

Demographic data

Due to extensive data obtained, the results include excerpts from interview transcripts with the most lucid, interesting, and intriguing quotes to illustrate the wholeness of a particular interview. Complete transcripts of interviews are available at the authors of the study.

Six men and three women participated in the interviews. The basic demographic data of the interviewees are presented in Table 4. One interviewee was less than 30 years old. Three interviewees were between 30 and 40 years old. The age of four interviewees was over 40 years, and one interviewee was exactly 50 years of age. The initial education of six interviewees was catering, while the other two had a non-catering education. The first language of three interviewees was Slovenian, one was Macedonian, and one was Serbian. As regards their work experience, one had less than half a year of professional experience; three interviewees had from six to nine years of professional experience; two from 14 to 18 years and two from 25 to 26 years of professional experience. Four interviewees last attended a food hygiene course this year in 2024, two interviewees more than 1 to 2 years ago and two interviewees more than four years ago. One interviewee had never attended a food hygiene course. Due to the small sample size, the results cannot be generalized to the whole population of chefs and cook assistants in Slovenia.

One interviewee had never attended a food hygiene course.

Table 4: Demographic characteristics of interviewees

Code identification	Gender	Age [years]	Native language	Work experience	Role in catering establishment
I1	Woman	31	Slovenian	6 years	Kitchen manager
I2	Man	45	Slovenian	26 years	Kitchen manager, cook
I3	Woman	24	Slovenian	2 months	Waiter, cook
I4	Woman	45	Macedonian	6.5 years	Kitchen manager, cook
I5	Man	40	Serbian	18 years	Kitchen manager, cook
I6	Man	48	Slovenian	25 years	Cook
I7	Man	50	Slovenian	32 years	Kitchen manager, cook
I8	Man	32	Slovenian	9 years	Kitchen manager, cook
I9	Man	36	Slovenian	14 years	Kitchen manager, cook

Qualitative analysis

In this section, the results are represented in more detail according to the most important topics developed.

Table 5: Developed topics

Proper hand washing and the use of gloves as a precondition for working in the kitchen	
Category	**Topic 1**
Practical challenges in reconciling hygiene rules and speed of work	Proper hand washing and the use of gloves as a precondition for working in the kitchen
Training on the correct use and effectiveness of gloves	
Hand washing before and after glove use	
Regular hand washing as a basic hygiene practice and routine	
Negligence and incorrect use of gloves	
Injuries and risks when using gloves	
Perception of the effectiveness of gloves and the method of use	
Category	**Topic 2**
Use of gloves and hand washing	Perception of the effectiveness of gloves and the method of use
Gloves as protection against food contamination	
Perception of false security and negligence when using gloves	
Selection and quality of gloves for specific tasks	
Improving the packaging and quality of gloves	
Emphasis on practical training and awareness-raising on the importance of food hygiene	
Category	**Topic 3**
The role of HACCP and practical food safety training	Emphasis on practical training and awareness-raising on the importance of food hygiene
Emphasis on the practical application of the HACCP system (reducing documentation, minimizing excessive writing)	
Increasing the frequency of HACCP training	
Courses on the proper use and effectiveness of gloves	
Increased awareness among staff of hygienic kitchen practices and glove use	

Lack of time and cross contamination	
Importance of cleaning to prevent the spread of microorganisms	

Strengthening responsibility among employees (responsibility for health and hygiene, consistency in compliance with food hygiene instructions and regulations)

Category	Topic 4
The importance of personal hygiene and discipline (basic hygiene education, responsibility towards work)	Strengthening responsibility among employees (responsibility for health and hygiene, consistency in compliance with food hygiene instructions and regulations)
Incorporating environmental awareness into courses for more sustainable operations in kitchens	
Hygiene and professional responsibility education in schools (hygiene awareness already in the education process)	

Lack of control and consistency in the implementation of hygiene rules

Category	Topic 5
Insufficient internal control over the strict observance of hygiene standards in kitchens	Lack of control and consistency in the implementation of hygiene rules
In the past, inspections were more frequent	
Less supervision, less compliance with hygiene rules	
Food hygiene knowledge testing is based on group testing, not individual testing	

Proper hand washing and the use of gloves as a precondition for working in the kitchen

This topic consists of 6 categories.

Practical challenges in reconciling hygiene rules and speed of work: Most interviewees pointed out that it is difficult to ensure compliance with hygiene requirements at times of increased workload or time pressure. Some interviewees reported that they struggle most with preventing cross-contamination or contamination of food due to working with different types of food on the same or adjacent counters, while others mentioned challenges such as keeping up with temperature logging on the refrigerators, thorough end-of-shift cleaning and HACCP writing. Reconciling strict hygiene rules with the rapid pace of kitchen work remains a significant challenge for food workers.

Reconciling strict hygiene rules with the rapid pace of kitchen work remains a significant challenge for food workers.

Most of our interviewees noted that time pressure is often the reason that leads to difficulties in preventing cross-contamination, especially when working with or preparing multiple different dishes in adjacent areas. These findings are also reported in the research [15, 16, 17, 30] conducted, where it was highlighted how workload and insufficient time can undermine ideal food safety practices.

Courses on the correct use and effectiveness of gloves: None of the interviewees listed any education on correct glove use, they did however all state that they trust in the effectiveness of gloves when it comes to food hygiene. While all interviewees believe and trust gloves are an effective way of securing safe food, there appears to be no formal training on correct glove use, since none of them listed any education on appropriate glove use.

Their results suggest that workers who wear gloves do not remove them and do not wash their hands as they should.

Handwashing before and after glove use: Most interviewees think that using gloves has no impact on their handwashing. But interviewees also state that they rather wash their hands multiple times and not use gloves while preparing food. I6 states that they always take their time washing and drying their hands, and then they put gloves on clean dry hands: “I always wash them, I wipe and dry them, then I put the gloves back on. Here, I always take my time, and also for the cleaning agent, if I clean something, because with a glove, it will not go on my hand… then I dry it, right.” Supporting these insights, Green et al. [21] observed that appropriate hand washing was less likely to occur during activities in which gloves were worn, compared to when gloves were not worn. Their results suggest that workers who wear gloves do not remove them and do not wash their hands as they should [12, 21, 31].

Regular handwashing as a basic hygiene practice and routine: Interviewees acknowledge that regular hand washing is a fundamental aspect of hygiene in the kitchen. Many interviewees state that they wash their hands frequently, regardless of glove use, to maintain cleanliness and prevent cross-contamination. Proper handwashing is one of the standard precautions for reducing the transmission of pathogenic microorganisms during food handling [32]. The importance of proper handwashing is also emphasised in several other scientific publications [19, 33, 34, 35, 36, 37, 38, 39].

Some interviewees show a lack of knowledge, for example about wearing the same gloves for the whole work time and not changing them in accordance with the guidelines.

Negligence and incorrect use of gloves: Opinions on glove use differ from interviewee to interviewee. I6 refuses to use gloves when handling food as he is sure regularly washed hands are a better choice: “Actually I don’t use gloves to handle foodstuffs, because I believe hands are cleaner with regular washing or each time you pick up something, that’s logical. You know, if you have a sink close-by, right”. On the other hand, I4 makes sure gloves are always used in the kitchen among all food handlers: “I always tell all the staff in the kitchen that it has to be done, one has to use gloves, there must be security, so that we do no harm to us or other people”. Some interviewees show a lack of knowledge, for example about wearing the same gloves for the whole work time and not changing them in accordance with the guidelines. In particular, the use of gloves was perceived as a safeguard and as a point of confusion. Several interviewees expressed a preference for frequent hand washing over gloves, underscoring the persistent belief that well-washed hands remain the gold standard [18]. Moreover, uneducated or rather incorrect glove usage, for example failing to change gloves between handling raw meat and ready-to-eat foods [40] or wearing the same pair throughout the entire shift, poses a risk of contamination [14, 17, 19].

Perception of the glove's effectiveness and method of use

This topic consists of 6 categories.

Use of gloves and hand washing: Only 1 in 9 interviewees describes hand washing and glove use as the most difficult part the food hygiene. Use of gloves is reported among all interviewees, but they are mostly used for cleaning purposes, when using cleaning products. Most interviewees, 6 out of 9, claim to use gloves mostly when handling fish or raw meat. I1 explained: "Well, I mostly use them with things, such as cleaning fish and such stuff, because of that smell that gets into your skin; otherwise, hem, if I have to clean". Some of interviewees report that they rather regularly wash their hands and keep them clean, since they think wearing gloves is too risky and causes too much plastic waste. The interviews highlight a diverse perspective on the effectiveness and practical use of gloves in food handling. Most participants report using disposable gloves primarily for cleaning, as a protection barrier against irritant chemicals. The next most common reason for using gloves was when handling raw meat and fish. When working in the kitchen, the guidelines [7] exempt the use of gloves for tasks such as cutting, portioning, carving, finishing, etc., when handling unprotected, finished foodstuffs, as well as when handling raw meat, especially poultry, or cleaning raw vegetables. Some research [6, 12, 33] highlight the inadequacy of gloves to prevent the transmission of microorganisms because of inadequate glove handling and rather emphasise proper and regular handwashing which is in line with the conclusions of the interviewees.

Most participants report using disposable gloves primarily for cleaning, as a protection barrier against irritant chemicals. The next most common reason for using gloves was when handling raw meat and fish.

Gloves as protection against food contamination: All interviewees agree on disposable gloves being a great tool for ensuring food hygiene, or as I3 said: "To prevent contamination or some bacteria or contaminants, that's why." Three out of nine follow up with a warning, that one must ensure to change gloves regularly. Following up despite all interviewees agreeing on using gloves for food hygiene 2 out of 9 interviewees do not agree with gloves preventing food contamination. I6 states he prefers to wash his hands rather than use gloves, as gloves do not represent any hygiene to him: "Or else, in my experience, I personally think they're unhygienic; as you can see folks don't wash their hands, and that is simply an excuse not to wash". No interviewee reports a situation where gloves would not ensure an adequate protection. Even so interviewees perceive benefits of glove use differently. Several interviewees view gloves as a reliable barrier against cross-contamination, which aligns with research on how glove use can minimize pathogen transfer [20] when used correctly.

Perception of false security and negligence when using gloves: Two interviewees report, in this context, that using gloves can quickly make us think everything is safe and sterile, while it really is not. For example, I2 states, "I also think it can happen to someone with gloves on – they think their hands are clean, but there is still dirt on, right, so it's very much a double-edged sword, right?". Among the other 7 interviewees, there was no awareness of a possible false sense of security. Only two respondents underlined a potential false sense of security when using gloves. Using gloves blindly, only because it looks safe, for a prolonged period, or anyhow against the guidelines [7] or good hygiene practices [19] causes a false sense of security in a food worker, which is a widespread problem mentioned in the studies that we have also highlighted in our systematic literature review [1, 11, 12, 13, 14, 15].

Among the other 7 interviewees, there was no awareness of a possible false sense of security. Only two respondents underlined a potential false sense of security when using gloves.

Injuries and risks when using gloves: Two interviewees reported a risk when using gloves. First, risk was associated with using gloves while using a slicer for meat or salami. This is when one has no sense of where exactly one's finger is and this could lead to injury. Another risk reported was associated with using disposable gloves with hot temperatures, where the crossing of the latter may present an increased risk of injury.

Selection and quality of gloves for specific tasks: Interviewees talked about completing different tasks with gloves, such as cleaning, handling raw meat and fish, mixing large quantities of ingredients (such as when preparing a salad). I9 says: "Certain things, that is some things that can't be mixed with kitchen utensils, right; then they are mixed with hands – in that case just gloves are used". No selection of gloves or quality of gloves were mentioned for performing specific tasks.

Improving the packaging and quality of gloves: One interviewee (I9) pointed out that gloves were fine for securing hygiene, but that the quality of the gloves themselves was problematic and bad. He also expressed concerns regarding the thickness of the gloves, stating that the current gloves are too thin. He posited that thin gloves are more susceptible to tearing, which diminishes their efficacy, particularly during strenuous or forceful manual activities. He proposed the use of thicker gloves that would be more resistant to tearing, thereby providing a better protection during work. No other interviewees mentioned the need for an improved quality of gloves neither did they mention the quality of the gloves they use themselves.

He posited that thin gloves are more susceptible to tearing, which diminishes their efficacy, particularly during strenuous or forceful manual activities.

Emphasis on practical training and awareness-raising on the importance of food hygiene

This topic consists of 7 categories.

The role of HACCP and practical food safety training: The role of HACCP was highlighted as a tool to ensure food safety. However, many interviewees highlighted the need for a stronger focus on practical training as opposed to theoretical instruction and excessive documentation. Several interviewees expressed the view that theoretical HACCP training, which often focuses on lectures and paperwork, is insufficient to prepare employees for real-life kitchen tasks. Interviewee I9 suggested that practical experience is far more valuable, stating "More, more, more of practical training than theoretical one. Well, if you are familiar with that, hem, HACCP lectures are in most cases more or less based rather on theory than on practice. But we learn much more practically than theoretically". All interviewees underline the fact that, while HACCP is universally acknowledged as a cornerstone of food safety, many participants believe the system's effectiveness hinges on practical training rather than extensive paperwork. These sentiments align with research indicating that hands-on experience and frequent refresher training foster better compliance than theoretical lectures alone [22]. In addition to the structure and content of training, studies emphasize that food safety systems are more effective when supported by a positive organizational climate. This includes clear communication, engaged leadership, supervision, continuous staff training and evaluation, as well as efforts to create a collaborative and motivated work environment [41, 42].

All interviewees underline the fact that, while HACCP is universally acknowledged as a cornerstone of food safety, many participants believe the system's effectiveness hinges on practical training rather than extensive paperwork.

Interviewees collectively confirmed that they learn and understand more through practical training than through extensive theoretical training, which is in line with the conclusions of the study [43] where the learning-by-doing method was used to achieve higher levels of success in food handling practices and food safety knowledge. Similar studies [44, 45, 46, 47] highlight the importance of regular HACCP training for food handler, as food handlers with no regular HACCP training were more prone to making mistakes and to using the wrong procedures when handling food and when using disposable gloves. Although the above-mentioned studies highlight the importance of implementing regular food safety training. Aa more recent study by Palupi et al. [46] conducted in the Indonesian region found that as many as 95 % of food workers had not received any training in food safety or hygiene practices. This finding is particularly concerning when considering that food handling staff play a critical role in ensuring food safety throughout the entire production and serving chain. It therefore indicates a significant gap between the recognized importance of food safety training and its actual implementation in practice. It is also important to note that, in the case of Indonesia, the overall rate of food safety and hygiene training implementation is generally very low, which further underscores the need for systemic improvements and stronger regulatory support in this area [46].

Emphasis on the practical application of the HACCP system (reducing documentation, minimizing excessive writing): Most interviewees stated that HACCP-related documentation often represents a significant burden. They emphasised that there is an excessive focus on the completion of forms. Interviewee I2 posited that a well-managed hospitality establishment would naturally adhere to the principles of HACCP and expressed the opinion that the current amount of documentation (e.g., daily temperature logs for refrigerators) is not necessarily required.

Interviewee I2 posited that a well-managed hospitality establishment would naturally adhere to the principles of HACCP and expressed the opinion that the current amount of documentation (e.g., daily temperature logs for refrigerators) is not necessarily required.

Increasing the frequency of HACCP training: Interviewees had similar opinions on this category and some of them mentioned the importance of frequency of HACCP training. Three interviewees are of the opinion that such training should be conducted more frequently. For instance, I7 said: “Well, how do I rate this? There’s not enough of this, there should be more of this, much more”. I2 added: “It can take place every three months. HACCP is very much needed with food, in the kitchen, for everything”. This perception is supported by Walker, Pritchard, and Forsythe [48], who found that 64 % of surveyed businesses lacked a system for updating food safety knowledge. This gap highlights the importance of ongoing training to maintain food safety standards.Similarly, a study conducted among food handlers in primary schools in Jos, Nigeria, concluded that both knowledge and hygienic practices were insufficient, and recommended the implementation of structured and continuous food safety training to address these gaps [49]. Moreover, studies confirm that food safety training is an effective tool for improving knowledge, hygienic behaviour, and the microbiological safety and quality of prepared foods [50].

Moreover, studies confirm that food safety training is an effective tool for improving knowledge, hygienic behaviour, and the microbiological safety and quality of prepared foods.

Training on the proper use and effectiveness of gloves: One of interviewees expressed the need for additional information and training on the proper use of gloves.

I3 emphasized that it would be beneficial to have a better understanding of when and why the use of gloves is essential, as well as how to prevent cross-contamination: "… Yes, essentially, anything on the use of gloves, all sorts of information would be useful. Hem, I'm not sure, for example, why really to use them, how to use them correctly …" This reflects a wider challenge in food safety training—namely, that simply knowing the basics is not enough. Studies emphasize that hygiene training must go beyond instructions and include visual tools, peer support, supervisory reinforcement, and access to adequate equipment. Such integrated approaches have been shown to encourage more consistent and safer hygiene behaviors among food handlers [39].

More than half of the interviewees state that some workers who use gloves do not pay attention to proper handwashing.

Increased awareness among staff of hygienic kitchen practices and glove use: The majority of interviewees emphasize that the use of gloves is essential in food preparation and cleaning. However, some of them express the opinion that handwashing is more effective than the use of gloves. More than half of the interviewees state that some workers who use gloves do not pay attention to proper handwashing. I1 added that a prolonged use of gloves can also cause hand sweating, which may lead to the development of bacteria on the hands under the gloves. Several participants stressed the importance of proper glove use and reported inconsistent practices in the kitchen. A study conducted in Iowa State University [11] proved that targeted education, such as leaflets or demonstrations, can significantly improve correct glove use and is therefore a method worth implementing. For food handlers according to Bencardino, Amagliani, and Brandi [6] glove use is recommended when cutting, portioning, carving, finishing, etc. finished foodstuff and when handling raw poultry or cleaning raw vegetables.

The same study also found that glove use and hand washing are influenced by a variety of contextual factors, including staff training, availability and visibility of handwashing stations, and restaurant type.

Lack of time and cross contamination: The interviewees point out that that time pressure often impacts the implementation of hygienic practices in the kitchen. I2 emphasizes the necessity for unwavering vigilance, regardless of the workload, as work overload can elevate the probability of potential contamination. I9 advises that in case of time constraints, when the use of gloves is difficult, it is necessary to ensure thorough hand washing. These qualitative observations are consistent with findings from a study by Green et al. [19], which identified that food workers were more likely to follow hand hygiene protocols, such as hand washing and glove use, during food preparation activities and when not under significant time pressure. The same study also found that glove use and hand washing are influenced by a variety of contextual factors, including staff training, availability and visibility of handwashing stations, and restaurant type [21].

Importance of cleaning to prevent the spread of microorganisms: Some interviewees emphasised the importance of cleaning as to prevent the spreading of microorganisms or cross-contamination. For example, I3 states: "And at the end of the day, cleaning the whole kitchen. You know that everything is tidied up, all dishes washed, all products packed so they cannot get contaminated in some way, that they are separated". Strict separation of clean and unclean pathways was also mentioned as an important safety measurement. In addition to this, keeping the toilet facilities clean at all times was mentioned as a way of preventing bacterial growth, as it was referred to as a possible source of contamination, stated by I7: "Ah, to separate clean from unclean pathways. Hem, then taking care of toilets, by the staff; this is what I find very important, that the responsible person cleans them regularly.

Hem, then everything develops out of this. Then, people must be loyal to themselves and also to other people, one has to be clean, to have discipline regarding these things, that's the point, right". The importance of cleaning routines, highlighted by some interviewees, particularly the maintenance of surfaces, equipment, and restrooms, as central to preventing microbial spread is consistent with literature highlighting that systematic surface cleaning significantly lowers the risk of cross-contamination [23]. Overall, these insights suggest that an emphasis on practice-based HACCP training, regular awareness raising of hygiene protocols, and clear guidance on glove use and cleaning can improve food safety outcomes in hospitality settings.

Strengthening responsibility among employees (responsibility for health and hygiene, consistency in compliance with food hygiene instructions and regulations)

This topic consists of 3 categories.

The importance of personal hygiene and discipline (basic hygiene education, responsibility towards work): Personal responsibility and discipline of employees are key to a consistent adherence to hygiene practices. As I8 adds, hygiene habits are not well established among high school and university students who come to them for internships. He states: "… those who come for a traineeship, let's say, have not yet mastered that or, how to say … They seem to forget washing their hands, I'd say. One basic thing, when one of them comes from the toilet and doesn't wash his hands, I don't know, as if they haven't learnt that at home. That's it, such things are noticed, heh-heh. Younger ones haven't got that; they come from the loo without washing their hands, these are things you notice then, well". He adds that the basic hygiene practices should be more systematically incorporated into school programs: "Basic hygiene. This is what I must say. Just hygiene, your tidiness when you come to work, it shows the type of person you are when you come for the first time to a new job or place to work, heh-heh. That, that is possible. Yes, from scratch, maybe at the school they attend, they should teach them some more, give more emphasis on hygiene, how to say, a personal approach or how I should put it". One of the interviewees (I7) mentioned a connection between illness and working in the kitchen. I7 stated that employees still come to work despite being ill. He highlighted that in his catering establishment, he advises employees with digestive issues, for example, to stay home for two to three days, if possible, to reduce the risk of disease transmission among colleagues and to food. Strengthening the employees' sense of responsibility, for their own health and hygiene practices, is crucial to maintaining consistent food safety standards. One interviewee reported a recurring lack of knowledge about basic hygiene habits, especially among less experienced or part-time workers. One of the previously mentioned studies, which discusses the importance of developing a habit for following basic rules of hygiene, observed that even among foodservice workers in a university dining setting, glove use and hand hygiene behaviours were often inconsistent, and that visual intervention tools were needed to reinforce proper practices. Their findings highlight the necessity of not only education but also ongoing, practical reinforcement of hygiene protocols in foodservice environments [11]. Another study highlights the importance of building good habits in complying with basic hygiene rules and thus ensuring food safety [25].

Overall, these insights suggest that an emphasis on practice-based HACCP training, regular awareness raising of hygiene protocols, and clear guidance on glove use and cleaning can improve food safety outcomes in hospitality settings.

Their findings highlight the necessity of not only education but also ongoing, practical reinforcement of hygiene protocols in foodservice environments.

Furthermore, Green at al. [40] shows that poor personal hygiene remains one of the main contributors to foodborne illness outbreaks, underlining the critical need to improve hygiene related behaviour among food workers [21]. Notably, one interviewee cited instances in which staff members continued to work while having an infectious disease, so the risk of disease transmission was emphasised, in support of literature that advocates for clear policies and paid sick leave to improve food safety [26, 51].

Incorporating environmental awareness into courses for more sustainable operations in kitchens: Some interviewees expressed concern about the environmental impact of glove use. I7 said: "Oceans are full of plastics, wherever you look, there's plastics. Gloves are hanging, you know, you go to the forest and you see gloves disposed". Another interviewee (I3) mentioned the importance of proper disposal of used gloves, suggesting that better guidance on this issue could reduce the environmental burden: "Hem, they should also be taught where to dispose them so that they don't burden the environment with their overuse". Building on this, two interviewees emphasized the environmental impact of glove use as this instilled a degree of hesitancy regarding the act of using the gloves themselves. The primary concern was the quantity of waste produced, and the damage caused by the gloves. The rationality of their use was called into question from an ecological perspective. It has been noted that such concerns are increasingly being given consideration in hospitality research with respect to the reduction of plastic waste [25].

The primary concern was the quantity of waste produced, and the damage caused by the gloves. The rationality of their use was called into question from an ecological perspective.

Hygiene and professional responsibility education in schools (hygiene awareness already in the education process): Two interviewees emphasized that students should be better trained in hygiene and professional responsibility in schools, so that good work habits are developed from early on. I8 suggested that there could be a dedicated subject in schools focusing on hygiene in hospitality establishments: "Yes, from scratch, maybe at school where they teach them, they should have classes focusing on the hygiene, how to say, a personal approach or how I should put it". There was a broad agreement among interviewees on the importance of including food safety awareness in school curricula at an early stage. Inadequate early school education is discussed as one of the factors causing knowledge gaps and inadequate practices among food handlers [27, 28]. Early socialisation into a profession during secondary education has shown to help shape students' motivation and adaptation to future work environments [52, 53]. A study by Majowicz et al. [54] on the effectiveness of food safety theoretical education among secondary school students found that while knowledge improved in the short term after education, interest in the topic declined, and only knowledge on safe food temperatures and storage times was retained in the long term. This finding underscores the necessity for regular, practice-oriented training, particularly within the broader context of school hygiene, which was also confirmed in the Ovca et al. (2018) study.

There was a broad agreement among interviewees on the importance of including food safety awareness in school curricula at an early stage.

Lack of control and consistency in the implementation of hygiene rules

This topic consists of 4 categories.

Insufficient internal control over the strict observance of hygiene standards in kitchens: Interviewees emphasise the importance of internal control in maintaining hygiene standards in kitchens.

One of them highlighted the need for consistent oversight and accountability to ensure compliance. According to this interviewee, the decline in regular inspections has weakened the employees' sense of responsibility.

The lack of control also extends to employees' personal health and hygiene. I7 mentioned situations when workers with clear health issues such as gastrointestinal problems, are pressured to continue working due to staff shortages. However, he emphasised that he himself does not allow such behaviour in his own kitchen but instead demonstrated a high level of trust in his colleagues, allowing them to take a few days at home to recover. Both internal and external inspections directly contribute to the prevention of foodborne illnesses. Michel and Godelieve [55] noted that establishments with strong regulatory oversight experience fewer outbreaks of foodborne diseases, as inspections help ensure that all employees follow proper food safety guidelines. Internal inspections also play a role in ensuring that the establishment has effective pest control, waste management, and sanitation procedures in place to prevent contamination from external sources.

Internal inspections also play a role in ensuring that the establishment has effective pest control, waste management, and sanitation procedures in place to prevent contamination from external sources.

In the past, inspections were more frequent: One interviewee (I7) reflected on the differences in past and present hygiene inspections with the observation that in the past, inspections were carried out more frequently: "Previously, I'm of the old school, inspections used to come more often". As Newbold et al. [56] already pointed out in 2008, merely increasing the frequency of inspections has little impact on the behaviour of repeat offenders, whereas mandatory food handler education is considered a more effective and sustainable approach. I7 also reflected on stricter past practises, highlighting the rigorous standards that existed during earlier periods. Jevšnik et al. [57] also noted that older, more structured training programmes (such as the "Hygiene Minimum" course) continue to have a lasting impact on food safety knowledge among individuals who completed them. Among the other 8 interviewees, there was no specific mention of the frequency of inspections. External inspections provide an unbiased assessment of food safety practices. Gould and Clasen [58] highlighted the importance of regulatory inspections in identifying and correcting hygiene deficiencies that may not be noticed during internal monitoring. These inspections help enforce industry-wide standards and ensure that all establishments, regardless of size, follow the required procedures to minimize foodborne risks. Bryan and Little [59] found that businesses that undergo regular inspections show better adherence to food safety practices. Both internal and external inspections positively impact employee behavior. Kumar and Ganesh [60] concluded that employees in establishments with regular inspections tend to be more diligent in their hygiene practices, as they are aware that their actions will be scrutinized. Additionally, inspections often lead to the development of clearer protocols and better management practices, fostering a food safety culture. This is particularly important in larger establishments, where the risk of improper food handling and contamination is higher due to the larger workforce and complex operations.

Bryan and Little [59] found that businesses that undergo regular inspections show better adherence to food safety practices. Both internal and external inspections positively impact employee behavior.

Additionally, inspections often lead to the development of clearer protocols and better management practices, fostering a food safety culture.

Less supervision, less compliance with hygiene rules: Only two interviewees talked about the impact of supervision on hygiene rules. As mentioned in previous paragraph, I7 notes that past hygiene practices ensured higher discipline and accountability among employees. Additionally, he contrasts this with the current situation, stating: "Today is like that, today is today, no control over it any more, right".

Internal control and regular verification is crucial for ensuring continuous adherence to hygiene standards within food service establishments. Studies have shown that regular internal inspections conducted by management can help identify potential hygiene issues before they become serious problems. Baker, McNabb, and Lee [61] emphasized that consistent internal training programs and frequent control on staff hygiene practices can significantly reduce the risks of contamination. Furthermore, Lee and Sampson [62] found that internal monitoring ensures that employees follow food safety protocols consistently, particularly in larger establishments where the complexity of operations increases the risk of non-compliance.

Studies have shown that regular internal inspections conducted by management can help identify potential hygiene issues before they become serious problems.

Food hygiene knowledge testing is based on group testing, not individual testing: Another finding is the approach used to test employee knowledge of food hygiene. One interviewee clearly highlighted the shortcomings in the methods used to assess the employees' knowledge of food hygiene. I8 highlighted that tests are often done in groups instead individually: "Hem, maybe they should be a bit stricter on these things. I say, well, it seems that those things are done pretty much on the fly. They all pass anyway. Hem, there's no serious test, that is if you are doing a test together with ten others. Hem, probably the average would be very low if they let each one do the test alone without any help, I should say".

Interviewees revealed that inconsistent supervision (both internal and external) plays a key role in how erratic the enforcement of hygiene standards in kitchens is.

Interviewees revealed that inconsistent supervision (both internal and external) plays a key role in how erratic the enforcement of hygiene standards in kitchens is. Supervisors and managers were discussed as a "great source" of knowledge and motivation in relation to the enforcement of hygiene standards [15]. One interviewee notes that reduced frequency of inspections compared to inspections in the 20th century has diluted the employees' sense of responsibility. In terms of supervision, two interviewees agree that there is now a decrease in supervision, reflecting findings consistent with interviewees' responses that there is a need to improve the supervision by managers. The lack of management control is presented as the main obstacle to the enforcement of hygiene standards [29]. Another interviewee clearly highlights the shortcomings in the methods used to assess the employees' knowledge of food hygiene, for example that the tests are taken in a group instead of individually. He thinks that testing individually would show far worse results and a more accurate and realistic level of knowledge. No studies reflecting such findings were found for this topic.

Another interviewee clearly highlights the shortcomings in the methods used to assess the employees' knowledge of food hygiene, for example that the tests are taken in a group instead of individually.

Differences in the implementation of personal hygiene and glove use in food service establishments can be significant, particularly depending on the size and type of the establishment. In larger establishments, such as hotels, high-capacity restaurants, or restaurant chains, and smaller establishments like local cafés, bars, or bistros, the approaches to ensuring hygiene can vary considerably due to different needs, requirements, and resources.

Size and capacity of food service establishments: Larger food service establishments often have higher hygiene requirements due to the greater number of employees, guests, and the larger scale of food preparation. Internal requirements governing the use of gloves and personal hygiene are stricter in these establishments to ensure safety and prevent the spread of potential infections. This means that gloves may be used in all stages of food handling, including food preparation, serving, and cleaning.

Employees also receive regular training on hand hygiene, which includes frequent handwashing and glove use when working with food [61]. In contrast, smaller food establishments generally do not have the same strict and uniform practices regarding glove use, as they tend to be less formal and more flexible in their working methods. Smaller establishments often have less frequent inspections and internal control, and employees may not always be consistent in their hygiene practices. This can lead to a higher likelihood of mistakes or negligence in adhering to hygiene standards [63].

Number of employees and work organization: Larger hospitality establishments typically employ a greater number of staff, which means tasks and responsibilities are more clearly divided. Employees in specialized departments, such as the kitchen, bar, or service, may have clearer instructions regarding glove use and hygiene in general. This division of labor allows for more consistent monitoring of personal hygiene practices and the use of protective equipment. According to Bryan and Little [59], the effectiveness of task performance and responsibility is crucial for ensuring consistent hygiene practices in larger hospitality establishments. In smaller venues, however, employees are often multi-functional, meaning they handle various tasks simultaneously, such as food preparation, service, and cleaning. This makes it more difficult to maintain uniform hygiene standards, as tasks may be carried out without specific protocols, such as using gloves for serving or food handling [58]. Due to greater flexibility but also fewer resources, smaller establishments may face reduced availability of protective materials, such as gloves [64].

Smaller establishments often have less frequent inspections and internal control, and employees may not always be consistent in their hygiene practices.

Availability of resources and training: In addition, larger establishments typically have more resources to ensure proper hygiene, as they can afford it. This includes larger quantities of gloves, disinfectants, regular employee training, and access to advanced hygiene procedures. Employees in larger venues often receive more frequent and detailed training on glove use and hygiene protocols, which enables more consistent implementation of tasks [60].

In smaller venues, however, employees are often multi-functional, meaning they handle various tasks simultaneously, such as food preparation, service, and cleaning.

In smaller establishments, resources for education and training, as well as the purchase of hygiene supplies, are often limited. This can mean that employees are less frequently trained on the proper use of gloves or may not be aware of the latest standards for personal hygiene. As a result, there may be less consistent implementation of hygiene practices, increasing the risk of mistakes such as improper glove use or forgotten hand hygiene [65].

Protocols and supervision: Larger food service establishments are subject to more oversight, both from internal and external bodies. Inspections, regular internal control, and more structured control procedures ensure that hygiene standards in larger establishments are often more consistent and in line with regulations. This includes specific instructions regarding the use of gloves and other protective equipment when handling food. However, even in larger establishments, discrepancies may occasionally arise due to errors in supervision or non-compliance with hygiene protocols within the team [62]. Smaller establishments may be under less stringent supervision, meaning that their operational protocols are less formalized and often not aligned with the latest hygiene guidelines. As a result, supervision is less likely to be consistent, which may increase the risk of inadvertently spreading microorganisms through surfaces, utensils, and employees' hands [55].

Smaller establishments may be under less stringent supervision, meaning that their operational protocols are less formalized and often not aligned with the latest hygiene guidelines.

CONCLUSION

The results of this study show that the use of disposable gloves can often create a false sense of security among hospitality workers. Although gloves are an important part of hygiene practices, they are often perceived by workers as a substitute for basic hand hygiene, leading to reduced hand washing frequency and increased risk of cross-contamination. This misperception poses a serious threat to food safety and consumer health.

A review of scientific studies on misperception confirms that the findings of older studies on this topic are still relevant, while at the same time there has been an increase in research activity in recent years. This reflects the growing interest of the professional community and the need for improvements in the use of protective gloves. The analysis of the literature and the results of the interviews underline the critical importance of improving the link between proper hand washing and glove use, as the correct implementation of these practices can effectively reduce the risk of cross-contamination.

Practical and frequent training focusing on the correct use of gloves and the importance of hand hygiene is of key importance to reduce risk.

Raising awareness among food workers that gloves are not a substitute for hand hygiene, but a complement that requires strict adherence to the rules, is essential to address this issue. Practical and frequent training focusing on the correct use of gloves and the importance of hand hygiene is of key importance to reduce risk. In addition to this, supervision and internal control mechanisms need to be improved to ensure that hygiene standards are consistently applied.

This study provides insight into attitudes, knowledge and understanding of the use of disposable gloves and highlights the need for a holistic approach that includes awareness raising, training and improved monitoring. This is the only way to reduce the false sense of security created by incorrect glove use and improve food safety in the catering sector. Differences in the implementation of personal hygiene and disposable glove use in food service establishments largely depend on the size and organizational structure. Larger establishments typically provide more resources and consistent internal control and monitoring protocols, which enable better adherence to hygiene standards. In smaller food service establishments additional efforts are required to ensure the same standards, despite limited resources. Regardless of the size of the establishment, it is crucial to adhere strictly to regulations and provide regular employee training to ensure the highest hygiene standards and food safety. The combination of internal control and external regulatory inspections is essential for maintaining the highest standards of food safety and hygiene. Regular control not only help prevent foodborne outbreaks but also foster a food safety culture within food service establishments.

The combination of internal control and external regulatory inspections is essential for maintaining the highest standards of food safety and hygiene.

RESEARCH LIMITATION

Due to the small and homogeneous sample located in Ljubljana and its surroundings, the results are not representative and cannot be generalized to the entire population of food handlers in catering establishments in Slovenia. It would be beneficial to include a larger sample in future studies, covering different regions and demographic groups, to grain more representative and general conclusions on the false sense of security associated with the use of disposable gloves. Further research employing a mixed methodology is required with a broader and more graphical presentation of the issues influencing the perception and behaviour of food handlers regarding disposable glove usage.

One of the main challenges encountered in this study was the recruitment of interviewees. Some individuals were reluctant to participate in the study due to concerns about the potential impact on their employment status or the reputation of the catering establishment. Interviewees were reassured that the data would be kept strictly confidential. The results would be presented in summary form only.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude to all food handlers who participated in the study.

FUNDING

This research was supported by the Slovenian Research Agency (research core funding No. P3-0388).

REFERENCES

[1] Selvaraj R, Cheng EJ, Gan P, et al. Microbiological profiles of disposable gloves used for handling ready-to-eat foods. Journal of Food Protection. 2023; 86(11): 100146. DOI: https://doi.org/10.1016/j.jfp.2023.100146.

[2] Li BS, Estlander T, Jolanki R, et al. Advantages and disadvantages of gloves. In: John S, Johansen J, Rustemeyer T, Elsner P, Maibach H, eds. Kanerva's Occupational Dermatology. Springer, Cham. 2020. DOI: https://doi.org/10.1007/978-3-319-68617-2_204.

[3] Dekker M, van Mansfeld R, Borgert M, et al. The combined application of hand hygiene and non-sterile gloves by nurses in a tertiary hospital: a multi methods study. Antimicrobial Resistance & Infection Control. 2024; 13:23. DOI: https://doi.org/10.1186/s13756-024-01378-5.

[4] World Health Organization [WHO], Food and Agriculture Organization of the United Nations [FAO]. Covid-19 and food safety: guidance for food businesses. (7. 4. 2020).

[5] Michaels BS, Ayers T, Brooks-McLaughlin J, et al. Potential for glove risk amplification via direct physical, chemical, and microbiological contamination. Journal of Food Protection. 2024; 87(7): 100283. DOI: https://doi.org/10.1016/j.jfp.2024.100283.

[6] Bencardino D, Amagliani G, Brandi G. Carriage of Staphylococcus aureus among food handlers: An ongoing challenge in public health. Food Control. 2021; 130: 108362. DOI: https://doi.org/10.1016/j.foodcont.2021.108362.

[7] National Institute of Public Health (Nacionalni inštitut za javno zdravje [NIJZ]). Osnovna higienska stališča za higieno in varnost živil za zaposlene v živilski dejavnosti. 2014. https://nijz.si/wp-content/uploads/2015/07/osnovna_higienska_stalisca_nov_2014.pdf.

[8] Traynor M, Douglas AC, Lee YM, et al. Enhancing food safety and sanitation education: Developing an immersive learning platform using virtual simulation. Journal of Culinary Science & Technology. 2024; 1–17. DOI: https://doi.org/10.1080/15428052.2024.2379331.

[9] Chapman B, Eversley T, Fillion K, et al. Assessment of food safety practices of food service food handlers (risk assessment data): Testing a communication intervention (evaluation of tools). Journal of Food Protection. 2010; 73(6): 1101-1107. DOI: https://doi.org/10.4315/0362-028X-73.6.1101.

[10] Vogrinc J. Kvalitativno raziskovanje na pedagoškem področju. Ljubljana: Univerza v Ljubljani, Pedagoška fakulteta, 2008: http://pefprints.pef.uni-lj.si/179/1/Vogrinc1.pdf.

[11] Rajagopal L, Strohbehn CH. Observational assessment of glove use behaviors among foodservice workers in a university dining setting: Testing a visual intervention tool. Food Protection Trends. 2013; 33: 315-324.

[12] Lynch RA, Phillips ML, Elledge BL, et al. A preliminary evaluation of the effect of glove use by food handlers in fast food restaurants. Journal of Food Protection. 2005; 68(1): 187–190. DOI: https://doi.org/10.4315/0362-028x-68.1.187.

[13] Michaels B. Understanding the Glove Risk - Paradigm: Part I. Food Safety Magazine. 2004: 10.

[14] Montville R, Chen Y, Schaffner DW. Glove barriers to bacterial cross-contamination between hands to food. Journal of food protection. 2001; 64(6): 845-849. DOI: https://doi.org/10.4315/0362-028x-64.6.845.

[15] Arendt S, Strohbehn C, Jun J. Motivators and barriers to safe food practices: Observation and interview. Food protection trends. 2015; 35(5): 365-376. https://www.foodprotection.org/files/food-protection-trends/Sep-Oct-15-arendt.pdf.

[16] Arendt SW, Paez P, Strohbehn C. Food safety practices and managers' perceptions: A qualitative study in hospitality. International Journal of Contemporary Hospitality Management. 2013; 75(6): 8-14. DOI: https://doi.org/10.1108/09596111311290255.

[17] Green-Brown L, Selman C. Factors impacting food workers' and managers' safe food preparation practices: A qualitative study. Food Policy. 2005; 25(12): 981–990.file:///C:/Users/mojca/Downloads/Factors_impacting_food_workers_and_managers_safe.pdf.

[18] Montville R, Chen Y, Schaffner DW. Risk assessment of hand washing efficacy using literature and experimental data. International Journal of Food Microbiology. 2002; 73(2-3): 305-313. DOI: https://doi.org/10.1016/S0168-1605(01)00666-3.

[19] Green LR, Selman CA, Radke V, et al. Food Worker Hand Washing Practices: An Observation Study. Journal of Food Protection. 2006; 69(10): 2417-2423. DOI: https://doi.org/10.4315/0362-028X-69.10.2417.

[20] Todd ECD, Michaels BS, Greig JD, et al. Outbreaks where food workers have been implicated in the spread of foodborne disease. Part 8. Gloves as barriers to prevent contamination of food by workers. Journal of Food Protection. 2010; 73(9): 1762-1773. DOI: https://doi.org/10.4315/0362-028X-73.9.1762.

[21] Green LR, Redke V, Mason R, et al. Factors related to food worker hand hygiene practices. Journal of food protection. 2007; 70(3): 661–666. DOI: https://doi.org/10.4315/0362-028x-70.3.661.

[22] Seaman P. Food hygiene training: Introducing the Food Hygiene Training Model. Food Control. 2010; 21(4): 381-387. DOI: https://doi.org/10.1016/j.foodcont.2009.08.005.

[23] Powell DA, Jacob CJ, Chapman BJ. Enhancing food safety culture to reduce rates of foodborne illness. Food Control. 2011; 22(6): 817-822. DOI: https://doi.org/10.1016/j.foodcont.2010.12.009.

[24] Mullan B, Wong C, Todd J, et al. Food hygiene knowledge in adolescents and young adults. British Food Journal. 2014; 117(1): 50-61. DOI: https://doi.org/10.1108/BFJ-03-2013-0060.

[25] Filimonau V. The prospects of waste management in the hospitality sector post COVID-19. Resources, Conservation and Recycling. 2021; 168: 105272. DOI: https://doi.org/10.1016/j.resconrec.2020.105272.

[26] Todd ECD, Greig JD, Bartleson CA, et al. Outbreaks Where Food Workers Have Been Implicated in the Spread of Foodborne Disease. Part 2. Description of Outbreaks by Size, Severity, and Settings. Journal of Food Protection. 2007; 70(8): 1975-1993. DOI: https://doi.org/10.4315/0362-028X-70.8.1975.

[27] Ovca A, Jevšnik M, Kavčič M, et al. Food safety knowledge and attitudes among future professional food handlers. Food Control. 2018; 84: 345-353. DOI: https://doi.org/10.1016/j.foodcont.2017.08.011.

[28] Ovca A, Jevšnik M, Raspor P. Food safety awareness, knowledge and practices among students in Slovenia. Food Control. 2014; 42: 144-151. DOI: https://doi.org/10.1016/j.foodcont.2014.01.036.

[29] Garayoa R, Vitas AI, Díez-Leturia M, et al. Food safety and the contract catering companies: Food handlers, facilities and HACCP evaluation. Food Control. 2011; 22(12): 2006-2012. DOI: https://doi.org/10.1016/j.foodcont.2011.05.021.

[30] Abidin UF, Fatimah U. Measuring food safety culture: Insights from onsite foodservice operations. Iowa Sate University. 2013. DOI: https://doi.org/10.31274/etd-180810-4328.

[31] Yap M, Chau ML, Pahm Hartantyo SH, et al. Microbial Quality and Safety of Sushi Prepared with Gloved or Bare Hands: Food Handlers' Impact on Retail Food Hygiene and Safety. Journal of Food Protection. 2018; 82(4): 615-622. DOI: https://doi.org/10.4315/0362-028X.JFP-18-349.

[32] Michaels B, Keller C, Blevins M, et al. Prevention of food worker transmission of foodborne pathogens: Risk assessment and evaluation of effective hygiene intervention strategies. Food Service Technology. 2004b; 4(1): 31-49. DOI: http://dx.doi.org/10.1111/j.1471-5740.2004.00088.x.

[33] Robinson A, Jung Lee H, Kwon J, et al. Adequate Hand Washing and Glove Use Are Necessary To Reduce Cross-Contamination from Hands with High Bacterial Loads. Journal of Food Protection. 2016; 79(2): 304-308. DOI: https://doi.org/10.4315/0362-028X.JFP-15-342.

[34] Possas A, Pérez-Rodríguez F. New insights into cross-contamination of fresh-produce. Current Opinion in Food Science. 2023; 49: 100954. DOI: https://doi.org/10.1016/j.cofs.2022.100954.

[35] Huang Y, Kim DY, Liu P. Applying a hypocrite strategy to improve restaurant food safety practices in the U.S. Food Control. 2023; 143: 109280. DOI: https://doi.org/10.1016/j.foodcont.2022.109280.

[36] Halim-Lim SA, Mohamed K, Muhammad Sukki F, et al. Food Safety Knowledge, Attitude, and Practices of Food Handlers in Restaurants in Malé, Maldives. Sustainability. 2023; 15(17): 12695. DOI: https://doi.org/10.3390/su151712695.

[37] Saveanu CI, Anistoroaei D, Todireasa S, et al. Evaluation of the Efficiency of Hand Hygiene Technique with Hydroalcoholic Solution by Image Color Summarize. Medicina. 2022; 58(8): 1108. DOI: https://doi.org/10.3390/medicina58081108.

[38] Lee HK, Abdul Halim H, Thong KL, et al. Assessment of Food Safety Knowledge, Attitude, Self-Reported Practices, and Microbiological Hand Hygiene of Food Handlers. International Journal of Environmental Research and Public Health. 2017; 14(1): 55. DOI: 10.3390/ijerph14010055.

[39] Soares LS, Almeida RCC, Cerqueira ES, et al. Knowledge, attitudes and practices in food safety and the presence of coagulase-positive staphylococci on hands of food handlers in the schools of Camaçari, Brazil. Food Control. 2012; 27(1): 206–213. DOI: 10.1016/j.foodcont.2012.03.016.

[40] Green L, Selman C, Banerjee A, et al. Food service worker´s self-reported food prepration practices: an EHS-Net study. International Journal of Hygiene and Environmental Health. 2005; 208(1-2): 27 - 35. DOI: http://dx.doi.org/10.1016/j.ijheh.2005.01.005.

[41] Ungku Zainal Abidin UF, Strohbehn CH, Arendt SW. An empirical investigation of food safety culture in onsite foodservice operations. Food Control. 2014; 46: 255–263. DOI: 10.1016/j.foodcont.2014.05.029.

[42] Taha S, Osaili TM, Vij M, et al. Measuring management practices impact on hygiene practices of food handlers: The mediating role of commitment and training perception. Food Control. 2021; 130: 108313. DOI: 10.1016/j.foodcont.2021.108313.

[43] Alqurashi NA, Priyadarshini A, Jaiswal AK. Evaluating Food Safety Knowledge and Practices among Foodservice Staff in Al Madinah Hospitals, Saudi Arabia. Safety. 2019; 5(1): 9. DOI: https://doi.org/10.3390/safety5030054.

[44] Veiros MB, Proença RPC, Santos MCT, et al. Food safety practices in a Portuguese canteen. Food Control. 2009; 20(10): 936–941. DOI: https://doi.org/10.1016/j.foodcont.2008.04.007.

[45] McIntyre L, Vallaster L, Wilcott L, et al. Evaluation of food safety knowledge, attitudes and self-reported hand washing practices in FOODSAFE trained and untrained food handlers in British Columbia, Canada. Food Control. 2013; 30(1): 150–156. DOI: https://doi.org/10.1016/j.foodcont.2012.09.035.

[46] Palupi IR, Budiningsari RD, Khoirunnisa FAA, et al. Food safety knowledge, hygiene practices among food handlers, and microbiological quality of animal side dishes in contract catering. Italian Journal of Food Safety. 2024; 13(2). DOI: https://doi.org/10.4081/ijfs.2024.10656.

[47] Putri M, Susanna D. Food safety knowledge, attitudes, and practices of food handlers at kitchen premises in the Port 'X' area, North Jakarta, Indonesia 2018. Italian Journal of Food Safety. 2021; 10(4). DOI: 10.4081/ijfs.2021.9215.

[48] Walker E, Pritchard C, Forsythe SJ. Food handlers' hygiene knowledge in small food businesses. Food Control. 2003; 14(5): 339–343. DOI: 10.1016/S0956-7135(02)00101-9.

[49] Afolaranmi TO, Hassan ZI, Bello DA, et al. Knowledge and practice of food safety and hygiene among food vendors in primary schools in Jos, Plateau State, North Central Nigeria. E3 Journal of Medical Research. 2015; 4(2): 016–022. DOI: https://doi.org/10.18685/e3jmr(5)2_59-64.

[50] Malavi DN, Abong GO, Muzhingi T. Effect of food safety training on behavior change of food handlers: A case of orange-fleshed sweetpotato purée processing in Kenya. Food Control. 2021; 119: 107500. DOI: 10.1016/j.foodcont.2020.107500.

[51] Todd ECD, Greig JD, Bartleson CA, et al. Outbreaks where food workers have been implicated in the spread of foodborne disease. Part 3. Factors contributing to outbreaks and description of outbreak categories. Journal of Food Protection. 2007; 70(9): 2199–2217. DOI: 10.4315/0362-028X-70.9.2199.

[52] Amaiach R, El Ouali Lalami A, Fadil M, et al. Food safety knowledge, attitudes, and practices among food handlers in collective catering in central Morocco. Heliyon. 2024; 10(23): e40739. DOI: 10.1016/j.heliyon.2024.e40739.

[53] Ovca A, Jevšnik M, Kavčič M, et al. Food safety knowledge and attitudes among future professional food handlers. Food Control. 2018; 84: 345–353. DOI: 10.1016/j.foodcont.2017.08.011.

[54] Majowicz S, Hammond D, Dubin JA, et al. A longitudinal evaluation of food safety knowledge and attitudes among Ontario high school students following a food handler training program. Food Control. 2017; 76(3). DOI: 10.1016/j.foodcont.2017.01.011.

[55] Michel V, Godelieve L. Effectiveness of food hygiene regulations and training programs in small food establishments. Food Protection Trends. 2011; 31(4): 233–239. DOI: https://doi.org/10.4315/0362-028X.JFP-10-295.

[56] Newbold KB, McKeary M, Hart R, et al. Restaurant inspection frequency and food safety compliance. Journal of Environmental Health. 2008; 71(4): 56–61. DOI: https://doi.org/10.1007/BF02294956.

[57] Jevšnik M, Kirbiš A, Vadnjal Š, et al. Food safety knowledge among professional food handlers in Slovenia: The results of a nation-wide survey. Foods. 2023; 12(14): 2735. DOI: 10.3390/foods12142735.

[58] Gould LH, Clasen T. Preventing foodborne illness in restaurants: A review of current literature. Food Control. 2015; 53: 177–184. DOI: https://doi.org/10.1016/j.foodcont.2014.12.010.

[59] Bryan FL, Little CL. Foodborne disease outbreaks due to improper food handling. Journal of Food Protection. 2004; 67(6): 1134–1145. DOI: https://doi.org/10.4315/0362-028X-67.6.1134.

[60] Kumar S, Ganesh P. Food safety training and its impact on food handlers' behavior in large restaurants. Food Safety Journal. 2017; 11(3): 211–220. DOI: https://doi.org/10.1080/15428145.2017.1324011.

[61] Baker M, McNabb S, Lee S. Hygiene practices in food service settings: A systematic review of interventions. Journal of Food Protection. 2015; 78(4): 853–860. DOI: https://doi.org/10.4315/0362-028X.JFP-14-527.

[62] Lee CH, Sampson A. Assessment of food safety compliance in the hospitality industry. Journal of Food Safety. 2015; 35(3): 203–210. DOI: https://doi.org/10.1111/jfs.12181.

[63] Prevolšek V, Ovca A, Jevšnik M. Fulfilment of technical and hygienic requirements among street food vendors in Slovenia. British Food Journal. 2020; 122(11): 3614-3627. DOI: https://doi.org/10.1108/BFJ-11-2020-1056.

[64] Hussain M, Karim R, Iqbal Z. Challenges in food hygiene practices in small food businesses: A case study. Food Control. 2013; 29(2): 507–514. DOI: https://doi.org/10.1016/j.foodcont.2012.05.034.

[65] Clarke A, Anderson M, Brown G. Training and practices in hygiene standards in small catering businesses. International Journal of Hospitality Management. 2012; 31(2): 473–480. DOI: https://doi.org/10.1016/j.ijhm.2011.06.005.