

THE ROLE OF FOOD SAFETY CULTURE ON FOOD HANDLER'S RISK PERCEPTIONS

UNGKU FATIMAH, U. Z. A.^{1*} – MOHD NOOR, N. N.¹

¹ Faculty of Food Science and Technology, Universiti Putra Malaysia, Selangor, Malaysia.

*Corresponding author
e-mail: [ungkufatimah\[at\]upm.edu.my](mailto:ungkufatimah[at]upm.edu.my)

(Received 05th March 2025; revised 12th May 2025; accepted 20th May 2025)

Abstract. Food safety culture is a growing concept that focuses on the behavioural and organizational aspects influencing food safety performance. Although its role in improving food safety practices has been increasingly recognized, limited research has examined its influence on food handlers' risk perception. This study aimed to: (1) determine the level of food safety culture across micro-, small-, and medium-sized foodservice operations and (2) evaluate the influence of food safety culture on food handlers' risk perceptions. A cross-sectional survey was conducted among 200 food handlers in the Klang Valley using a structured questionnaire. Data were analysed using descriptive statistics, mean comparison, and multiple regression. Findings indicated that the level of food safety culture did not significantly differ across enterprise sizes ($p > 0.05$), with customer perception rated highest and work pressure rated lowest. Multiple regression analysis revealed that personalization factors ($\beta = 0.38$; $p = 0.001$), organizational factors ($\beta = 0.20$; $p = 0.044$), and surrounding support ($\beta = -0.255$; $p = 0.007$) significantly influenced food handlers' risk perception. These results highlight the importance of fostering a positive food safety culture to strengthen risk awareness among food handlers and reduce the likelihood of unsafe food handling practices.

Keywords: *food safety culture, risk perception, small-medium enterprise, food handler*

Introduction

Foodborne illnesses remain a critical public health issue globally, with profound implications for the food industry. In Malaysia, illnesses such as food poisoning, dysentery, typhoid, cholera, and viral hepatitis A are linked to the consumption of contaminated food and water. Between 2015 and 2019, reported cases of food and water-borne diseases rose by 11.8%, with food poisoning accounting for the majority, 16,583 cases in 2019 alone. Although the incidence of food poisoning saw a decrease in 2020 (MOHM, 2021; 2020), it continues to surpass other foodborne illnesses in both incidence and mortality rates (MOHM, 2021; 2020). Improper food handling and temperature abuse remain significant contributors to foodborne outbreaks (Argudin et al., 2010), aligning with the WHO (2006) identification of unsafe food sources, poor hygiene, and cross-contamination as critical risk factors. These risks are further amplified by the rapid growth of the food and beverage (F&B) industry in Malaysia, particularly in urban centers like Selangor and Kuala Lumpur, where food expenditure ranks among the highest (DOSM, 2021). The expansion of this sector has been accompanied by a rise in food premises, which are frequently implicated in foodborne outbreaks (Mun, 2020). Food handlers are central to food safety management, as their behaviors are influenced by their attitudes and the prevailing organizational culture (Todd et al., 2007; Yiannas, 2007). Despite the existence of food safety management systems (FSMS) such as HACCP, GMP, HALAL certification, MeSTI, BeSS, and Trust My Catering, compliance remains inconsistent among food handlers in restaurants and retail food services (Brown et al., 2016; Arendt et al., 2015; Carpenter et al., 2013;

Lubran et al., 2010; Allwood et al., 2004). While knowledge-attitude-practice (KAP) training remains common, it often lacks the behavioral depth associated with effective, sustainable change (Da Cunha and Diogo, 2021; Escrig et al., 2018).

Malaysia's strategies to reduce foodborne illness include regulatory surveillance, preventive training, and FSMS adoption (Nik et al., 2016). However, empirical evidence indicates that food safety training alone does not always translate into improved hygiene practices or behavioral compliance (Young et al., 2019; Da Cunha et al., 2014; Ehiri et al., 1997). In many cases, risk perception acts as a barrier to compliance, especially when food handlers do not perceive the risks as relevant or serious (Fatimah et al., 2014; Griffith et al., 2010; Sandman, 1993). Risk perception is shaped not only by knowledge but also by cultural, emotional, and psychological factors, which may lead to cognitive biases and misjudgment of objective risks (Zanin et al., 2015; Da Cunha et al., 2012; Schmitt et al., 1993; Slovic, 1987). Despite growing interest in behavioral approaches, there is a lack of methodological depth in studies addressing food handlers' risk perception in foodservice settings. This issue is particularly pronounced in micro, small, and medium-sized foodservice operations, which constitute the majority of food establishments in Malaysia. These enterprises often face limitations in resources and infrastructure, hindering the effective implementation of FSMS (Bolton et al., 2007). The size of the enterprise has been shown to influence FSMS implementation, suggesting that food safety culture may vary significantly across differently sized operations. Nevertheless, limited research exists in the Malaysian context examining the interplay between enterprise size, food safety culture, and risk perception. In addressing this research gap, the present study aims to: (1) Determine the level of food safety culture across micro-, small-, and medium-sized foodservice operations; and (2) Evaluate the influence of food safety culture on food handlers' risk perceptions.

Literature review

Food safety culture

Food safety culture, a subset of organisational culture, has emerged as a critical concept in understanding the behavioural dimensions of food safety. It encompasses the shared values, beliefs, and attitudes within an organisation that influence food safety practices and decision-making (Griffith et al., 2010; Yiannas, 2007). This culture is reflected in how employees behave and engage with food safety protocols, often shaped by leadership, training, and communication within the organisation. As personnel internalise these values, food safety behaviour becomes embedded within daily operations, reinforcing a collective responsibility towards consumer protection (Yiannas, 2007). Despite advances in food safety management systems (FSMS), persistent foodborne outbreaks suggest underlying deficiencies in food safety culture. Scholars have argued that compliance alone is insufficient, as food safety culture also depends on individual attitudes, perceptions, and commitment to food hygiene (Jespersen et al., 2017; Nyarugwe et al., 2016; Griffith et al., 2010). Without a strong food safety culture, FSMS may fail to translate into consistent and effective practices. Therefore, fostering this culture requires leadership engagement, employee involvement, clear communication, and a supportive environment that encourages accountability and risk awareness (Powell et al., 2011). The development of food safety culture is particularly challenging in smaller food service establishments, which often lack the infrastructure, resources, and formal management systems of larger operations.

Nonetheless, studies suggest that these challenges can be mitigated through targeted efforts in training, behaviour reinforcement, and cultivating shared goals (Nyarugwe et al., 2016; Yiannas, 2007). Elements such as leadership, employee competence, communication, and national cultural context all play a role in shaping food safety culture, and should be tailored to each organisation's specific risks and structure. When these elements are matured and aligned, food safety culture can significantly improve regulatory compliance and public health outcomes (Jespersen et al., 2017; Powell et al., 2011).

Food handler's risk perception

Risk perception, defined as the subjective assessment of the likelihood and severity of harm (WHO, 2015), plays a critical role in influencing food handlers' compliance with food safety practices. Although food safety hazards may be well-documented, how seriously individuals perceive these threats can vary based on cognitive, emotional, and experiential factors (Slovic, 1987). Research shows that food handlers often underestimate the risks associated with improper handling, even when managing high-risk foods. These misperceptions may arise from overconfidence, lack of risk awareness, or desensitization due to repeated exposure to unsafe practices, which ultimately diminishes motivation to adhere to safety guidelines (Byrd-Bredbenner et al., 2013; Redmond and Griffith, 2004). Studies further reveal that despite possessing adequate knowledge, food handlers may not apply it in practice due to poor risk perception. For example, behaviors such as using leftovers, neglecting proper cooking temperatures, and failing to prevent cross-contamination are often perceived as low-risk actions, despite their association with foodborne illnesses. These gaps highlight the influence of social, cultural, and psychological dimensions on risk perception (Slovic, 2000). Consequently, enhancing food safety in the foodservice sector requires more than technical training; it demands strategies that address behavioral biases and improve the way risks are internalized by food handlers. Thus, evaluating how food safety culture influences risk perception is crucial for promoting compliance and preventing contamination in real-world foodservice environments.

Personalization factors, Organizational Factors and Surrounding Supports

Understanding the behavioral dimensions that shape food handlers' risk perception requires an exploration of both individual and contextual determinants. Drawing on the framework by Namian et al. (2016), these determinants can be classified into three overarching components: personalization factors, organizational factors, and surrounding supports. Personalization factors refer to individual-level attributes, including workers' attitudes, safety values, and personal motivations, all of which influence how hazards are recognized and responded to in the workplace. According to Namian et al. (2016), individuals who prioritize safety tend to demonstrate stronger hazard recognition and compliance with safety protocols, reflecting their internalized safety attitudes. Organizational factors encompass broader structural and cultural elements within the workplace, including leadership engagement, communication systems, and safety-oriented practices (Namian et al., 2016). Supervisors and managers play a pivotal role in cultivating a safety-oriented culture by reinforcing expectations, modeling appropriate behavior, and ensuring that food safety remains a core operational value. Leadership involvement has been identified as a key sub-factor, as the safety

values upheld by supervisors are often mirrored by their subordinates (Namian et al., 2016). Complementing this, Fujisaki and Akamatsu (2020) highlighted the importance of organizational communication in aligning values, inspiring staff, and reinforcing consistent food safety practices through shared missions and people-focused systems.

Surrounding support further reinforces food safety culture through mechanisms embedded in organizational structures and interpersonal interactions. As conceptualized by Jespersen et al. (2017), surrounding supports operate through education and mentoring of new staff, promotion of peer-to-peer risk awareness, and visible leadership commitment to food safety values. These supports not only facilitate knowledge transfer but also foster a collaborative safety climate where individuals are encouraged to actively recognize and manage risks. Based on this framework, the present study posits that the interplay between these three factors, personalization, organizational, and surrounding supports, collectively shapes food handlers' perceptions of risk and ultimately influences food safety behavior in foodservice settings. Accordingly, the following hypotheses are proposed to guide the conceptual framework of this study (Figure 1):

Hypothesis 1 (H1): Organizational factors of food safety culture significantly influence food handlers' risk perceptions.

Hypothesis 2 (H2): Personalization factors of food safety culture significantly influence food handlers' risk perceptions.

Hypothesis 3 (H3): Surrounding supports of food safety culture significantly influence food handlers' risk perceptions.

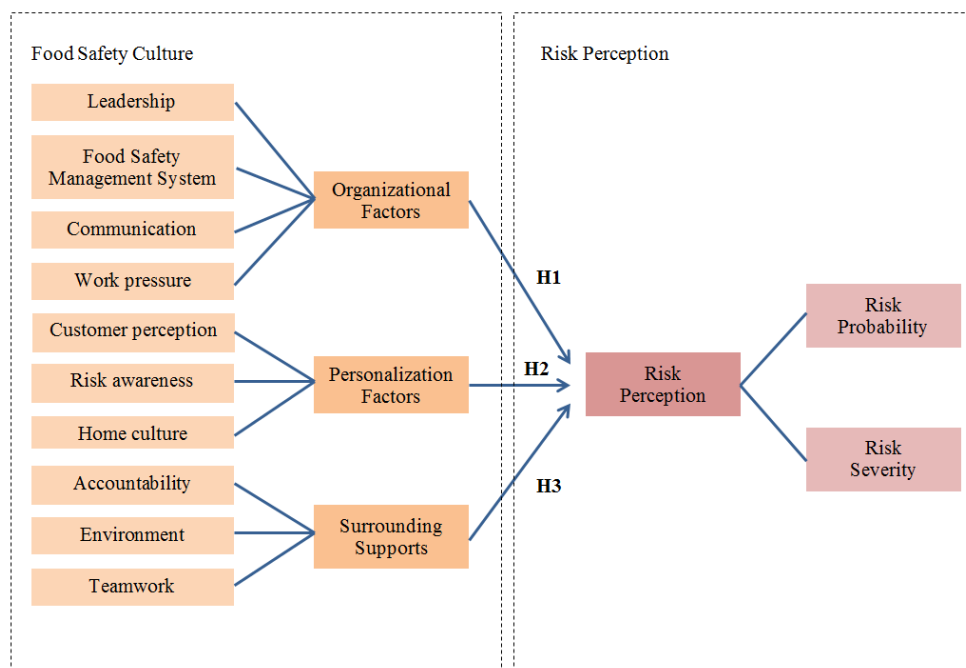


Figure 1. Conceptual model on food safety culture and food handlers' risk perception.

Materials and Methods

Research design

This study adopted a quantitative research, cross-sectional research design to investigate the relationship between food safety culture and food handlers' risk perception across micro-, small-, and medium-sized foodservice establishments. A self-administered survey questionnaire was developed to collect standardized data efficiently from a diverse sample. The design enabled systematic measurement of variables and supported statistical analysis to test the proposed hypotheses.

Sample and sampling

The target population comprised food operation supervisors and their staff who were directly involved in food preparation tasks, including handling food, utensils, food equipment, and contact surfaces. These individuals are responsible for adhering to food hygiene standards as defined. The selection of these areas was based on data from the DOSM (2021), which reported Selangor and W.P. Kuala Lumpur as the most frequented destinations by domestic tourists, recording 10.2 million and 9.1 million visitors, respectively. Notably, food and beverage expenditure was identified as the second highest spending component among these visitors (DOSM, 2021), highlighting the critical importance of food safety in high-traffic, tourism-oriented regions. To ensure the inclusion of relevant participants, a non-random, convenience sampling technique was employed. This approach was deemed suitable as the study required direct access to specific food handlers involved in food preparation, storage, or service roles such as supervisors, chefs, cook assistants, bartenders, and servers. The selection was guided by the practical availability of food establishments in the Klang Valley area. Eligibility criteria required participants to be at least 18 years old, actively involved in food handling, and possess a minimum of six months' experience at their current restaurant. This requirement ensured that responses reflected perceptions rooted in the existing food safety culture of their workplace. A minimum sample size of 200 food handlers was targeted to provide a sufficient data set for meaningful analysis related to food safety culture and risk perception.

Data collection

Data were collected through a face-to-face survey using a structured questionnaire, administered to food handlers in selected restaurants across Klang Valley. Restaurant selection was guided by TripAdvisor Malaysia, a widely used platform with over 795 million user-generated reviews on 8.4 million restaurants and accommodations globally. Although the reliability of individual reviews may vary, TripAdvisor employs fraud-detection software and forensic analysts to monitor suspicious patterns and enhance review authenticity. Furthermore, the platform requires reviewers to describe first-hand experiences using standardized formatting. For this study, restaurants with favorable reviews, across micro-, small-, and medium-sized foodservice operations, were prioritized to ensure diverse representation and enhance the relevance of the sample to the tourism-influenced food sector. The data collection process involved several stages. First, a list of eligible restaurants in Cyberjaya, Shah Alam, and W.P. Kuala Lumpur, identified via TripAdvisor, was compiled in Microsoft Excel to facilitate tracking and coordination. Restaurant representatives were then contacted via email or telephone to request permission for participation. Upon obtaining consent and setting appointments, the validated questionnaires were administered on-site to supervisors and their food handlers. Each survey session lasted between 30 to 45 minutes, with an average of four

to seven food handlers participating per restaurant. The estimated time to complete each questionnaire ranged from 8 to 10 minutes, ensuring minimal disruption to the respondents' daily operations while allowing for efficient and comprehensive data collection.

Research instrument

The research instrument consisted of a structured questionnaire divided into three sections: Section A, Section B, and Section C. Section A collected demographic information, including respondents' nationality, gender, age, educational background, years of experience in the current company and the foodservice industry, job position, employment status, and food handling certification. This section was essential to examine the influence of workforce diversity on food safety culture, particularly concerning variables such as employment status and the presence of foreign staff. These demographic factors allowed for a deeper understanding of how individual backgrounds may shape food safety practices and perceptions in foodservice operations.

Section B focused on assessing food safety culture through ten key elements, measured using a seven-point Likert scale (1=very strongly disagree to 7=very strongly agree). The ten elements included: (1) Leadership (7 items), (2) Food Safety Management System (6 items), (3) Communication (5 items), (4) Accountability (4 items), (5) Environmental Factors (4 items), (6) Teamwork (3 items), (7) Customer Perception (3 items), (8) Risk Awareness (3 items), (9) Work Pressure (3 items), and (10) Home Culture (3 items). Each construct was designed to evaluate a specific dimension of food safety behavior. For example, leadership assessed managerial commitment to food safety, while communication evaluated how effectively safety information is conveyed to food handlers. Section C examined risk perception, specifically the perceived probability and severity of food safety incidents, using two separate seven-point Likert scales. The scale for perceived probability ranged from "Very unlikely" (1) to "Very likely" (7), while the perceived severity scale ranged from "Very mild" (1) to "Very severe" (7). Respondents took approximately 8 to 10 minutes to complete the full questionnaire.

Pre-testing of questionnaire

Prior to the actual data collection, the survey questionnaire was pre-tested with a small group of food handlers (n=9) to assess its surface validity and to identify any ambiguities or unclear items. The pre-test participants were asked to evaluate the clarity and relevance of the questions, particularly in Section A (demographic profile) and Section C (risk perception). Feedback obtained from the pre-test indicated that certain items, such as Questions 9 and 10 in Section A, were redundant. Additionally, several respondents found elements of Section C unclear, prompting revisions to ensure that the instrument was comprehensible and contextually appropriate for the target population. This iterative process allowed for refinement of the questionnaire to enhance reliability and user engagement. In addition to respondent feedback, the draft questionnaire was reviewed by subject matter experts to evaluate the appropriateness and alignment of the items with the study objectives. Based on expert input and pre-test responses, several revisions were made. Question 10 in Section A was removed due to its similarity to the preceding question and the limited familiarity of food handlers with non-mandatory food safety training. In Section C, amendments were made to the section header to

explicitly distinguish between "risk probability" and "risk severity," with bracketed labels added for clarity. Further instructions were incorporated, such as "Please use the scale below to answer the questions," to prevent confusion regarding the Likert scales. Items related to probability and severity were also separated into distinct parts to improve readability. Minor adjustments to vocabulary and phrasing were made throughout the questionnaire to enhance comprehension and ensure alignment with the study's scope and terminology.

Data analysis

The data collected were analyzed by using the Statistics Package for Social Sciences (SPSS) Version 27. The descriptive analysis was conducted to provide frequency and mean scores which were important to interpret data. Descriptive analysis was conducted to measure the level of food safety culture among micro-, small-, and medium-sized food service operations. Next, multiple linear regression was applied in order to evaluate the significant relationship between food safety culture and food handlers' risk perceptions.

Results and Discussion

Respondents' profile

The demographic characteristics of the respondents are summarized in Table 1. A total of 200 food handlers from foodservice establishments of varying sizes, micro, small, and medium, in the Klang Valley participated in this study. The sample comprised 55.0% male and 45.0% female respondents. In terms of work experience, 42.5% of respondents had less than two years of experience in the foodservice industry, followed by 29.5% with three to four years, and only 11.5% with over ten years of experience. Regarding job roles, the majority (74.5%) were classified as crew members, while 25.5% held supervisory positions. The employment status data revealed that 83.5% of the respondents were full-time employees, whereas the remaining 16.5% worked on a part-time basis. In terms of educational background, 35.5% of the respondents had completed SPM/STPM, followed by 31.5% holding certifications or diplomas. Only a small proportion reported having a bachelor's degree (11.0%) or postgraduate qualifications (1.0%). Notably, 18.0% of respondents reported not possessing food handler certification, despite regulatory requirements. The sample included 15.5% non-Malaysian workers, with Malaysians making up the remaining 84.5%. Respondents were also categorized according to the size of the foodservice enterprise in which they worked, with 30.0% from micro-sized operations, 33.5% from small-sized, and 36.5% from medium-sized establishments. This distribution ensured the inclusion of diverse perspectives across organizational structures, facilitating meaningful comparison in subsequent analyses.

Table 1. Summary of the respondents' profile (n=200).

Category	Frequency (N)	Percentage (%)
Gender		
Male	110	55.0
Female	90	45.0
Years in foodservice industry		
< 2 years	85	42.5

3 – 4 years	59	29.5
5 – 10 years	33	16.5
> 10	23	11.5
<hr/>		
Job position		
Supervisor	51	25.5
Crew	149	74.5
<hr/>		
Employee status		
Full-time	167	83.5
Part-time	33	16.5
<hr/>		
Education level		
UPSR/PMR	11	5.5
SPM/SPTM	71	35.5
Certification/Diploma	63	31.5
Bachelor's degree	22	11.0
Masters	2	1.0
Others	31	15.5
<hr/>		
Food Safety Training Certification		
Yes	164	82.0
No	36	18.0
<hr/>		
Nationality		
Malaysian	169	84.5
Non-Malaysian	31	15.5
<hr/>		
Category Industry		
Micro	60	30.0
Small	67	33.5
Medium	73	36.5
<hr/>		

Level of food safety culture across micro-, small-, and medium-sized foodservice operations

The level of food safety culture was examined across micro-, small-, and medium-sized foodservice operations based on the mean scores for ten key elements (*Figure 2*). These elements included leadership, food safety management systems, communication, accountability, environmental factors, teamwork, customer perception, risk awareness, work pressure, and home culture. As shown in *Figure 2*, although there were no statistically significant differences among the three categories in any of the food safety culture dimensions-leadership ($F=1.28$, $p=0.28$), food safety management system ($F=0.43$, $p=0.65$), communication ($F=0.39$, $p=0.68$), accountability ($F=0.20$, $p=0.82$), environmental factors ($F=0.78$, $p=0.46$), teamwork ($F=0.63$, $p=0.54$), customer perception ($F=0.25$, $p=0.78$), risk awareness ($F=0.72$, $p=0.49$), work pressure ($F=1.64$, $p=0.20$), and home culture ($F=0.77$, $p=0.47$)-there were meaningful patterns observed across the enterprise sizes. Medium-sized operations generally recorded higher mean scores in several elements, suggesting stronger food safety structures and organizational practices. Notably, the highest overall mean was observed in customer perception ($M=6.40$, $SD=0.81$), indicating that food handlers were strongly aware of how consumer expectations influence food safety practices. Conversely, work pressure recorded the lowest overall mean ($M=5.92$, $SD=1.14$), particularly within small-sized establishments ($M=5.96$, $SD=1.15$), suggesting that workload remains a critical barrier to consistent food safety behavior. These results align with previous findings by Fatimah et al. (2014), who noted that work overload often reduces food handlers' ability to maintain safety standards effectively. Micro-and small-sized operations demonstrated

closely aligned scores in elements such as environmental factors, teamwork, customer perception, and risk awareness. These similarities may be attributed to comparable structural limitations, including limited financial resources, informal management systems, and insufficient training infrastructure, as highlighted by Bolton et al. (2007). These challenges may hinder the development of formal food safety programs in smaller enterprises and increase the risk of non-compliance. While medium-sized enterprises fared slightly better across most elements, the findings suggest that enterprise size alone does not guarantee a high-performing food safety culture. Instead, the data point toward the need for targeted interventions, especially in micro and small operations, to strengthen cultural elements such as leadership support, teamwork, and workload management for improving food safety outcomes across the sector.

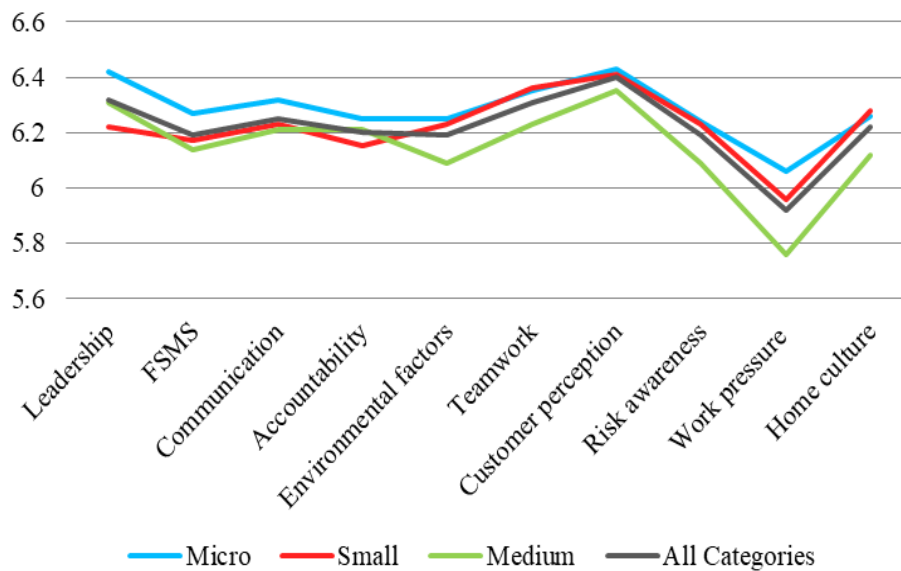


Figure 2. The mean score level of food safety culture across micro-, small-, and medium-sized foodservice operations.

The influence of food safety culture on food handlers' risk perceptions

To examine the relationship between food safety culture and food handlers' risk perceptions, a multiple regression analysis was performed (Table 2). Food safety culture construct was categorized into three core dimensions-organizational factors, personalization factors, and surrounding support-based on theoretical frameworks from Jespersen et al. (2017) as well as Namian et al. (2016). The model produced a significant result, explaining 26.7% of the variance in risk perception ($R^2=0.267$, $F[3,198]=18.872$, $p<0.05$), thereby confirming the predictive power of food safety culture on food handlers' perceptions of risk. Each hypothesis was supported by statistically significant beta coefficients. Organizational factors, comprising leadership, food safety management systems, communication, and work pressure, positively influenced risk perception ($\beta=0.20$, $t=2.026$, $p=0.044$), confirming H1. This suggests that structured systems and managerial commitment shape food handlers' awareness and response to risk, consistent with findings by Griffith et al. (2010). Personalization factors, encompassing customer perception, risk awareness, and home culture, demonstrated the strongest effect ($\beta=0.38$, $t=4.469$, $p=0.001$), supporting H2. These

findings reinforce earlier research by Redmond and Griffith (2004), which emphasized that individual beliefs and personal experiences significantly shape food safety behavior. Interestingly, surrounding support, which includes accountability, environmental conditions, and teamwork, had a negative but significant association with risk perception ($\beta=-0.255$, $t=-2.698$, $p=0.007$), supporting H3. While counterintuitive, this result may reflect an overreliance on external support systems, potentially leading to complacency among food handlers. Overall, these findings affirm that both internalized values and structural support mechanisms play vital roles in shaping how food handlers perceive risk. Enhancing food safety culture, therefore, not only requires procedural improvements but must also address the behavioral and perceptual dimensions of food handler engagement. These insights are crucial in advancing targeted interventions aimed at reducing unsafe practices and improving compliance within the foodservice sector (Fatimah et al., 2014; Da Cunha et al., 2012; Slovic, 2000).

Table 2. The hypothesis testing results.

Hypothesis	Regression Weights ^{a,b}	β value	t value	p value	Hypothesis support
H1	OF \rightarrow RP	0.2	2.026	0.044	R = 0.525 R ² = 0.267 F = 18.872 $p < 0.05$ \therefore Supported
H2	PF \rightarrow RP	0.38	4.469	0.001	R = 0.525 R ² = 0.267 F = 18.872 $p < 0.05$ \therefore Supported
H3	SS \rightarrow RP	-0.255	-2.698	0.007	R = 0.525 R ² = 0.267 F = 18.872 $p < 0.05$ \therefore Supported

Note: ^aPredictors: Organizational factor (OR), Personalization factor (PF), Surrounding support (SS); ^bDependent Variable: Food handlers' risk perceptions.

Conclusion

This study investigated the level of food safety culture across micro-, small-, and medium-sized foodservice operations and examined how elements of food safety culture influence food handlers' risk perceptions. Although no statistically significant differences were found across enterprise sizes, meaningful variations emerged in the mean scores of several food safety culture elements. Micro- and small-sized establishments demonstrated similar patterns, particularly in environmental factors, teamwork, and home culture, likely reflecting comparable operational limitations. Conversely, medium-sized establishments exhibited comparatively higher scores in certain structured aspects, though they also showed lower means in pressure-related and perception-based elements. These findings highlight the importance of tailoring food safety interventions to the operational realities of different foodservice sizes, particularly in refining training modules to address specific cultural gaps. The

regression analysis confirmed that all three dimensions of food safety culture: organizational factors, personalization factors, and surrounding support; significantly influence food handlers' risk perceptions. Personalization factors showed the strongest relationship, suggesting that individual attitudes and values are critical drivers of safe food practices. Organizational factors, including leadership and communication, also play a crucial role in shaping safety awareness, while the effect of surrounding support, though significant, indicated the potential for overreliance on external cues. These insights emphasize the need for targeted interventions that not only enhance infrastructure and procedures but also foster internal motivation and accountability among food handlers to support a sustainable food safety culture. Despite its contributions, this study is not without limitations. The focus on restaurants and cafes in Klang Valley restricts the generalizability of findings to other foodservice sectors such as hospitals, hotels, or institutional catering. The cross-sectional design offers a snapshot in time, lacking insights into the evolution of food safety behavior. Additionally, the classification of food safety culture elements into broader categories due to software constraints may have overlooked more nuanced relationships. Future studies are recommended to adopt longitudinal and mixed-method approaches, expand the sample to diverse foodservice types, and explore factors affecting long-term behavioral consistency. By addressing these gaps, researchers and practitioners can design more effective strategies to strengthen food safety practices across Malaysia's foodservice industry.

Acknowledgement

This research is self-funded.

Conflict of interest

The authors declare that no conflicts of interest exist with any individuals or entities concerning this research study.

REFERENCES

- [1] Allwood, P.B., Jenkins, T., Paulus, C., Johnson, L., Hedberg, C.W. (2004). Surveillance for foodborne-disease outbreaks-United States, 1993-1997. – *Journal of Food Protection* 67(7): 1480-1486.
- [2] Arendt, S.W., Strohbehn, C.H., Jun, J. (2015): Manager behaviors, food safety attitudes, and performance. – *Food Control* 50: 236-243.
- [3] Argudin, M.A., Mendoza, M.C., Rodicio, M.R. (2010): Food poisoning and *Staphylococcus aureus* enterotoxins. – *Toxins* 2(7): 1751-1773.
- [4] Bolton, D.J., Meally, A., Blair, I.S., McDowell, D.A., Cowan, C. (2007): Food safety knowledge of head chefs and catering managers in Ireland. – *Food Control* 19(3): 291-300.
- [5] Brown, L.G., Le, B., Wong, M.R., Reimann, D., Nicholas, D., Faw, B., Davis, E. (2016): Restaurant food cooling practices: intervention and impact. – *Journal of Food Protection* 79(1): 89-96.
- [6] Byrd-Bredbenner, C., Berning, J., Martin-Biggers, J., Quick, V. (2013): Food safety in home kitchens: A synthesis of the literature. – *International Journal of Environmental Research and Public Health* 10(9): 4060-4085.

- [7] Carpenter, L.R., Green, A.L., Norton, D.M., Frick, R., Tobin-D'Angelo, M., Reimann, D.W., Blade, H., Nicholas, D.C., Egan, J.S., Everstine, K., Brown, L.G. (2013): Food worker experiences with and beliefs about working while ill. – *Journal of Food Protection* 76(11): 2146-2154.
- [8] Da Cunha, D.T., Diogo, C.A. (2021): Improving food safety practices in the foodservice industry. – *Current Opinion in Food Science* 42: 127-133.
- [9] Da Cunha, D.T., Stedefeldt, E., de Rosso, V.V. (2014): The role of theoretical food safety training on Brazilian food handlers' knowledge, attitude and practice. – *Food Control* 43: 167-174.
- [10] Da Cunha, D.T., Stedefeldt, E., de Rosso, V.V. (2012): Perceived risk of foodborne disease by school food handlers and principals: The influence of frequent training. – *Journal of Food Safety* 32: 219-225.
- [11] Department of Statistics Malaysia (DOSM) (2021): Domestic tourism survey report 2020. – Putrajaya, Malaysia: DOSM 5p.
- [12] Ehiri, J.E., Morris, G.P., McEwen, J. (1997): Implementation of HACCP in food businesses: The way ahead. – *Food Control* 8(6): 325-328.
- [13] Escrig, A., de-Juan-Vigaray, M.D., Galiana, L. (2018): The role of human values in understanding the attitude toward food safety and the importance of sustainable consumption. – *British Food Journal* 120(10): 2357-2371.
- [14] Fatimah, U.Z.A., Arendt, S.W., Strohbehn, C.H. (2014): Food safety culture in onsite foodservices: Development and validation of a measurement scale. – *Apparel, Events and Hospitality Management Publications* 8(1): 10p.
- [15] Fujisaki, K., Akamatsu, R. (2020): Food safety culture assessment scale development and validation for use in school foodservice. – *British Food Journal* 122(3): 737-752.
- [16] Griffith, C.J., Livesey, K.M., Clayton, D.A. (2010): Food safety culture: The evolution of an emerging risk factor? – *British Food Journal* 112(4): 426-438.
- [17] Jespersen, L., Griffiths, M., Wallace, C.A. (2017): Comparative analysis of existing food safety culture evaluation systems. – *Food Control* 79: 371-379.
- [18] Lubran, M.B., Pouillot, R., Bohm, S., Calvey, E.M., Meng, J., Dennis, S. (2010): Observational study of food safety practices in retail deli departments. – *Journal of Food Protection* 73(10): 1849-1857.
- [19] Ministry of Health Malaysia (MOHM) (2021): Health facts 2021. – Planning Division, Health Informatics Centre, MOHM 19p.
- [20] Ministry of Health Malaysia (MOHM) (2020): Health facts 2020. – Planning Division, Health Informatics Centre, MOHM 19p.
- [21] Mun, W.H. (2020): Food premises and foodborne illness in Malaysia. – *Food Safety Bulletin* 11: 24-29.
- [22] Namian, M., Zuluaga, C.M., Albert, A. (2016): Critical factors that impact construction workers' hazard recognition performance. – *Construction Research Congress* 11p.
- [23] Nik Husain, N., Wan Muda, W., Noor Jamil, N., Nik Hanafi, N., Abdul Rahman, R. (2016): Effect of food safety training on food handlers' knowledge and practices: A randomized controlled trial. – *British Food Journal* 118(4): 795-808.
- [24] Nyarugwe, S.P., Linnemann, A.R., Hofstede, G.J., Fogliano, V., Luning, P.A. (2016): Determinants for conducting food safety culture research. – *Trends in Food Science & Technology* 56: 77-87.
- [25] Powell, D.A., Jacob, C.J., Chapman, B.J. (2011): Enhancing food safety culture to reduce rates of foodborne illness. – *Food Control* 22(6): 817-822.
- [26] Redmond, E.C., Griffith, C.J. (2004): Consumer perceptions of food safety risk, control and responsibility. – *Appetite* 43(3): 309-313.
- [27] Sandman, P.M. (1993): Responding to community outrage: Strategies for effective risk communication. – *American Industrial Hygiene Association* 113p.

- [28] Schmitt, N., Oswald, F.L., Friede, A., Imus, A., Merritt, S. (1993): Perceived risks and risk behaviors: The role of personality and perceived control. – *Journal of Applied Psychology* 78(3): 438-444.
- [29] Slovic, P. (2000): The perception of risk. – Earthscan Publications 512p.
- [30] Slovic, P. (1987): Perception of risk. – *Science* 236(4799): 280-285.
- [31] Todd, E.C.D., Greig, J.D., Bartleson, C.A., Michaels, B.S. (2007): Outbreaks where food workers have been implicated in the spread of foodborne disease. Part 3. – *Journal of Food Protection* 70(9): 2199-2217.
- [32] World Health Organization (WHO) (2015): Estimates of the global burden of foodborne diseases. – Geneva: WHO 268p.
- [33] World Health Organization (WHO) (2006): Five keys to safer food manual. – Geneva: WHO 28p.
- [34] Yiannas, F. (2007): Food safety culture: Creating a behavior-based food safety management system. – Springer Science & Business Media 97p.
- [35] Young, I., Thaivalappil, A., Waddell, L., Meldrum, R., Greig, J. (2019): Psychosocial and organizational determinants of safe food handling at retail and food service establishments. – *International Journal of Environmental Health Research* 29(5): 531-556.
- [36] Zanin, L.M., da Cunha, D.T., Stedefeldt, E., Capriles, V.D. (2015): Seafood safety: Knowledge, attitudes, self-reported practices and risk perceptions of seafood workers. – *Food Research International* 67: 19-24.