



Contents lists available at ScienceDirect

Food Control

journal homepage: www.elsevier.com/locate/foodcont

The association between factors which affect the food safety practices of seafood distributors within the southern domestic distribution chains in Vietnam

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ARTICLE INFO

Article history:

Received 16 August 2015

Received in revised form

29 July 2016

Accepted 11 August 2016

Available online xxx

Keywords:

Food safety

Food safety practices

Seafood safety

Seafood handling

Fish contamination

ABSTRACT

In order to improve the safety of seafood in domestic distribution chains in Vietnam, a better understanding of factors affecting the practices of seafood distributors is necessary. The objective of this research was to identify the factors affecting the food safety practices among distributors in three major sites. A mixed methods design including qualitative and quantitative methods was used. Questionnaires were completed by 180 workers at various points of the seafood distribution chain. The survey revealed poor knowledge of food safety and hygiene amongst distributors and ineffective use of food safety management practices throughout the domestic seafood distribution chains. There was generally a low level of compliance with food safety regulations. One potentially positive outcome is that seafood distributors are concerned about critical feedbacks and complaints from consumers. Therefore, improving consumer knowledge may have a positive impact on food safety practices in the domestic seafood distribution chains.

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1. Introduction

Vietnam's prominence is increasing in regional and international markets for seafood products. Seafood exports have risen rapidly since the 1990s (Directorate of Fisheries, 2015). Despite the quality of exported seafood products, a considerable amount of unsafe raw seafood is still supplied to domestic markets (Gerber, Turner, & Milgram, 2014; Nguyen, 2011, 2012). Seafood was the second most common source of food poisoning events in Vietnam from 2010 to 2014 (Vietnam Food Administration, 2015). These reports have raised concerns for Vietnamese government about the food safety management system, the physical environments of fish distribution points and the quality of the fish distributors themselves within for the domestic distribution chains.

The domestic seafood distribution chains (DSDCs) in Vietnam contain complex processes involving many stages and traders. Once fish are unloaded from ships, they are sold to the first level traders and then proceed through a number of middle trading levels before

reaching retailers. 'Seafood distributors' include seafood handlers, intermediate traders and retailers. Seafood distributors have direct contact with seafood while undertaking various activities including unloading, sorting, washing, storing, and transporting seafood.

The government of Vietnam has recognised that ultimate responsibility for seafood safety lies with the distributors (Nguyen, Dalsgaard, Phung, & Mara, 2007; Vo, 2006). In 2009 national technical regulations (QCVN) were developed and issued by the Ministry of Agricultural and Rural Development (MARD, 2009a; MARD, 2009b). The regulations have a strong focus on the physical environment, personal hygiene and food safety training in an effort to protect food safety for consumers and to enhance the quality of Vietnamese seafood. However, less emphasis is placed on food handler behaviour. Food safety standards are more likely to be improved when all factors affecting seafood safety, including food handling practices, are controlled (Green & Selman, 2005).

Numerous studies have noted food handlers' knowledge and attitudes are important factors that influence food safety and hygiene behaviours (Aziz & Dahan, 2013; Ball, Wilcock, & Aung, 2009; Haileselassie, Taddele, Adhana, & Kalayou, 2013; Mendagudali, Akka, Swati, Shedole, & Bendigeri, 2016; Sharif, Obaidat, & Al-Dalalah, 2013). Accurate knowledge positively affects attitude

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formation which leads to desired behaviours (Ball et al., 2009; Haileselassie et al., 2013). Therefore, food handlers' food safety knowledge is critical when attempting to improve food safety and hygiene practices. However, it is noted that knowledge alone is not sufficient. Several studies have found food handlers fail to implement appropriate practices despite having the requisite food safety knowledge (Clayton, Griffin, Price, & Peter, 2002; Subratty, Beeharry, & Sun, 2004). Subratty et al. (2004) found that food vendors are quite aware of hygiene conditions; however, they do not translate their knowledge into practice. Clayton et al. (2002) reported that 63% of respondents admitted to failing to implement adequate handling practices that they knew were appropriate.

Food safety is also influenced by managers and worksite norms. For example, managers can emphasise the importance of food safety and ensure that staffing levels are appropriate to meet work demands (Green & Selman, 2005). Rennie (1995) identified worksite norms and rules, including social interactions and expectations of co-workers, influence food safety behaviours. Positive worksite norms facilitate safe food handling behaviours (Brough, Davies, & Johnstone, 2015; Mitchell, Fraser, & Bearon, 2007).

There are few studies on the Vietnamese DSDCs. No systematic research has been conducted regarding the factors that affect food safety practices among domestic seafood distributors. The aims of this research were to evaluate food safety practices of seafood distributors and investigate the associations between six interrelated factors including seafood distributor characteristics; training in food safety; knowledge of food safety; attitudes to food safety; concern of managers, co-workers, and consumers about food safety; and the working environment; on the food safety practices of seafood distributors in the DSDCs in Vietnam.

2. Materials and methods

Qualitative in-depth interviews were conducted with 11 participants including seafood handlers, retailers, and owners or traders in the DSDCs and food safety experts. Four focus group discussions were held, involving a total of 30 participants including seafood handlers, retailers, and owners or traders. In-depth interviews and focus group discussions were held to identify factors that would be most relevant for inclusion in the questionnaire and to explore how to use terminology/words in the survey questionnaire that are appropriate for fish distributors in Vietnam.

The questionnaires were developed using information from literature and the interview and focus group findings. The questionnaires were administered orally in-person, to 180 participants including 30 middlemen traders, 60 seafood handlers, and 70 retailers between May to June 2013. The participants were working in 6 fishing ports, 9 fish markets and 32 trading establishments in Khanh Hoa province, Ba Ria Vung Tau province, and Ben Tre in Vietnam (Fig. 1). The participants were randomly selected on each day of data collection and participation was voluntary. The visual aid were used to enhance participants' understanding of questions if necessary (e.g. all of five possible answers of multiple choice questions were printed out in big font, therefore, the participant could pointed directly to answer).

As recommended by Ary, Jacobs, and Sorensen (2006), the construct validity of the questionnaires was assessed by subject matter experts. Two PhD level food safety experts from Nha Trang University, a food safety law expert and two seafood traders reviewed the questionnaires. Their feedback was used to revise the questionnaire. Once finalised, the questionnaires were tested on 5 seafood handlers and retailers.

The questionnaires consisted of seven parts. Part one included questions about demographics (e.g. age, gender, income from their

current job, education level, type of settlement, and number of years in the seafood business) and whether the participant had experienced a fish-borne illness. Part two explored prior training and awareness of procedure manuals for food safety and hygiene in the DSDCs.

Part three assessed knowledge of microbiologic hazard development, identifying fish contamination and fish-borne illness, knowledge of safe temperatures, and personal hygiene. The thirteen questions in part three were all multiple choice with five possible answers including "do not know" for the purpose of minimizing the possibility of selecting the correct answer by chance. The food safety knowledge score was determined by adding all the correct answers together (correct answer = 2, incorrect answer or do not know = 1). Consequently, the lowest possible score was 13 and the highest possible score was 26. The scores of each section were classified as no knowledge (no correct answers), low knowledge (one correct answer), moderate knowledge (two correct answers), and good knowledge (three or four correct answers).

Part four of the questionnaire focused on the participants' attitude toward seafood safety and hygiene. This part was divided into four sections including attitude to seafood safety in job responsibility and training (e.g. question "safe fish handling is an important issues in my job responsibility"), risk of fish borne illness from personal hygiene and worker's health, risk of fish-borne illness from poor control of time and temperature, and risks of fish borne illness from unclean contact surfaces containers and tools. Responses to the ten questions were made using a likert-scale, from 1 = strongly disagree to 5 = strongly agree. Numeric responses to these questions were added to yield a range of possible scores from 10 to 50.

Part five of the questionnaire related to the concern was shown by managers, co-workers and consumers about food safety and hygiene. These questions used a Likert-scale ranging from one to five, with 1 = never and 5 = always.

Part six focused on satisfaction with working conditions and jobs including appropriate physical environment; cleanliness and sanitisation of structural environments; time pressure; and satisfaction with their job in terms of job character and organisational matters. Responses to the six questions were recorded using a Likert-scale of one to five, with 1 = strongly satisfied to 5 = strongly dissatisfied.

The final part of the questionnaires assessed participants' habits. The eighteen questions covered a range of practices including personal hygiene, cleaning contact surfaces, and time and temperature control. These questions used a Likert-scale ranging from one to five, with 1 = never and 5 = always. However, five questions were reverse scored (i.e. 5 = never and 1 = always) to ensure respondent attentiveness. Numeric responses were added to produce a score ranging from 18 (poor food safety and sanitation practices) to 90 (correct food safety and sanitation practices).

Parts three, four and seven were developed having regard to several published questionnaires (Annor & Baiden, 2011; Ansari-lari, Soodbacksh, & Lakzadeh, 2010; Baş, Ersun, & Kivanc, 2006, 2007; Gomes-Neves, Cardoso, Araujo, & Costad, 2011; Jevnsnik, Hlebec, & Raspor, 2008; Omemu & Aderoju, 2008; Sun, Wang, & Huang, 2012; Tokuc, Ekuklu, Berberoglu, Bilge, & Dedeler, 2009; Walker, Pritchard, & Forsythe, 2003), the qualitative interview and focus group findings and the relevant Vietnamese regulations.

2.1. Data analysis

Statistical analysis was performed using SPSS (version 21) for Windows for all variables. Identification of bivariate associations between food safety practices and factors utilised correlation

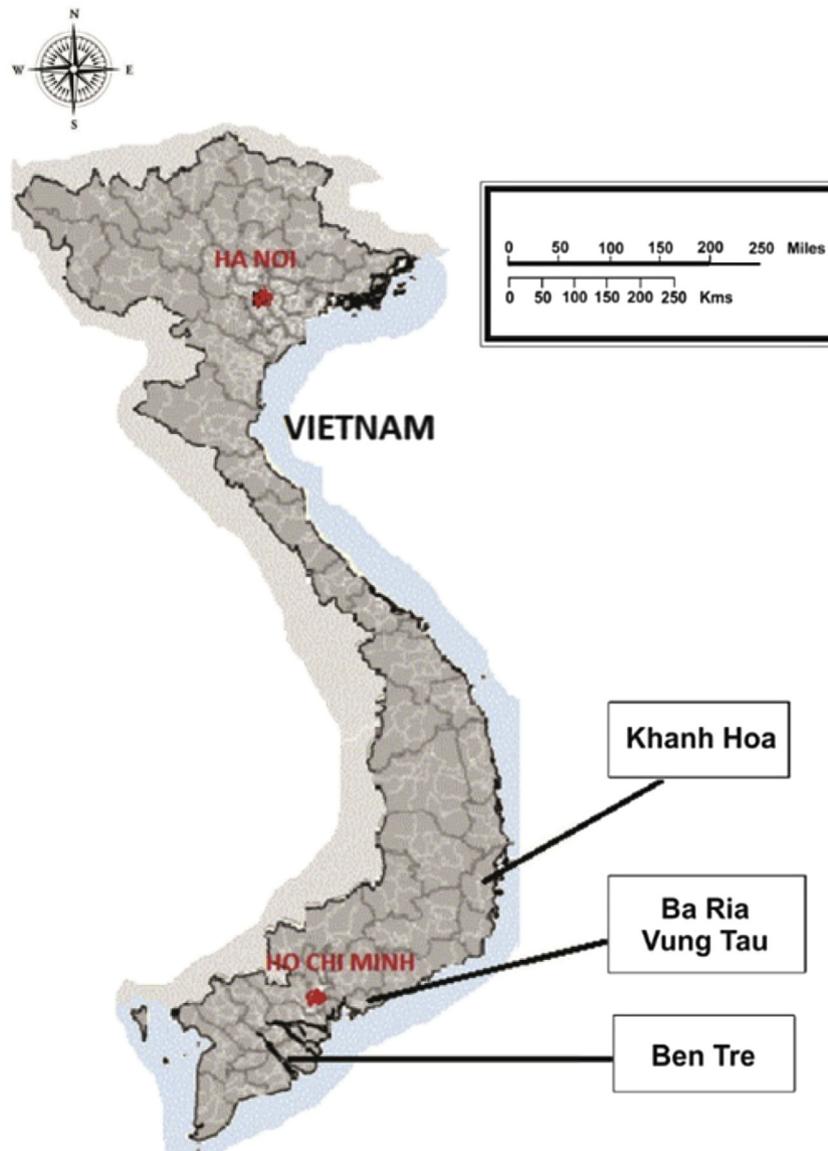


Fig. 1. Study areas in Vietnam.

analysis, with Pearson's r for continuous factors (such as food safety attitude, satisfaction of working environment and job), Point-bi-serial correlation coefficients were used for dichotomous factors (such as gender), and a Spearman correlation was used for categorical variables with more than two levels (such as food safety knowledge and "work as"), respectively.

3. Result

3.1. Characteristics of the sample

Of the 180 participants, 66.7% were female and 33.3% were male. The majority of participants (65.5%) were 18–40 years of age and 68.9% of them had attained a secondary school level of education. On average participants had worked in the seafood industry for 6.5 years (range 4–7 years). A large proportion of participants (95.6%) classified themselves as permanent workers. The personal income of 83.3% of participants is moderate compared to the average wage (in Vietnam Dong) for Vietnamese workers (as found the average wage for Vietnamese worker by Vu and Duong (2014)). Only 3

participants (1.7%) had experienced diagnosed fish-borne illness.

3.2. Food safety practices

The results of the questions regarding food safety and hygiene practices are shown in Table 1. The questions were divided into three main sections: personal hygiene practices; cleaning fish contact surfaces; and controlling time and temperature.

Overall 60.5% of participants 'rarely' implemented personal hygiene practices expected of food handlers. More than half of the respondents (58.6%) said they 'rarely' conducted activities that would prevent contamination of fish. Approximately half of the participants said they 'sometimes' controlled time and temperature during fish handling.

3.3. Food safety training

Nearly all participants (97.2%) received some job-related training when they commenced (Table 2). However, no participants (0%) had received training regarding food safety and hygiene.

Table 1
Responses to questions regarding food safety and hygiene practices.

Questions	Never (%)	Rarely (%)	Sometimes (%)	Often (%)	Always (%)
Personal hygiene	0.3	60.5	35.5	3.7	
Do you use clean gloves when you touch or distribute raw fish?		62.6	33.5	3.9	
Do you wash your hands before entering your work place?	0.6	85.0	14.4		
Do you use clean protective clothing when you touch or distribute raw fish?		76.7	23.3		
Do you use a mask and cap when you touch or distribute raw fish?	0.6	85.0	13.8	0.6	
Do you wash your hands or your gloves after touching contaminated objects (dirty objects)?		60.6	37.2	2.2	
Do you wash your hands after using the toilet?		41.1	51.1	7.8	
Do you wash your hands after rest time when you come back to work?	1.1	91.7	7.2		
Do you eat or drink in your working area?		1.1	27.2	71.1	0.6
Do you still work the same task (touching fish) when you have symptoms of sore throat with fever?		3.9	47.8	48.3	
Do you still work the same task (touching fish) when you have symptoms of diarrhoea or vomiting?		8.3	52.3	39.4	
Do you still work the same task (touching fish) when you have infected cuts and burns with pus on your hands and wrists?		14.4	39.4	46.2	
Cleaning contact surfaces	0.7	58.6	39.1	1.6	
Do you place raw fish on the floor?		3.9	51.1	45.0	
Do you wash fish containers, tools, and equipment when they are dirty?		62.2	33.9	3.9	
Do you wash fish containers, tools, and equipment with detergent/disinfectant/sanitizer when they are dirty?	0.6	60.6	38.9		
Do you clean working surfaces, tools, and equipment after working?	0.6	66.6	32.2	0.6	
Do you clean work surfaces and equipment with detergent/disinfectant/sanitizer after working?	2.3	58.3	39.4		
Controlling time and temperature	1.4	45.3	49.7	3.6	
Do you check the temperature of raw fish during storage or handling (not using thermometer)?		47.8	49.4	2.8	
Do you check the duration for which fish are exposed to ambient air temperatures during handling?	2.8	42.8	50.0	4.4	

Table 2
Responses to questions regarding training of food safety.

Question	Introduction to job (97.2%)			
	Yes (0%)	No (100%)		
	Not at all (%)	A little (%)	Quite a lot (%)	A lot (%)
Training for job				
Have you ever taken or are you currently taking any training (informal/formal/induction) in food hygiene and safety? (Yes; No)				
Do you know of any food safety procedure manuals?	92.2	7.8		
Do you know any regulations regarding food safety and hygiene relevant to your products?	91.7	8.3		
Do you know any regulations of regarding employee health and hygiene for food industry employees?	95.0	5.0		

Furthermore, almost all participants revealed that they did not know about any food safety and hygiene regulations or about food safety procedure manuals.

3.4. Knowledge of food safety

The results for the questions regarding food safety knowledge are presented in Table 3. The knowledge was evaluated in relation to microbiologic hazard development, identifying fish contamination and fish-borne illness, temperature regulations for food safety and personal hygiene and workers' health. Overall, the food safety and hygiene knowledge of seafood distributors was poor. The majority of participants selected the incorrect answer or identified that they did not know the answer for most of the food safety topics.

3.5. Attitudes to food safety risks and controls

The data relating to participants' attitudes to food safety risks and controls is presented in Table 4. It was found that only 18.3% of participants believed food safety was an important responsibility in their job, with the majority disagreeing with this statement (51.7%) or expressing uncertainty (30.0%). Similarly, only 21.1% of participants believed that it was important to learn more about food safety, with the majority disagreeing (50.5%) or expressing uncertainty (28.3%).

Most participants disagreed with or were uncertain about specific hygiene practices and health conditions associated with fish safety. However, a large proportion of participants (42.2%) agreed that time and temperature control could affect the risk of fish-borne illness.

The final questions in this section focused on the participants' attitudes to the cleanliness of contact surfaces, tools and equipment. It is noted that 31.4% of participants somewhat or strongly disagreed that cleaning fish contact surfaces, tools and containers reduced the risk of fish-borne illness and another 35% of participants were uncertain.

3.6. Concern of managers, co-workers, and consumer about food safety

As can be seen in the data on manager commitment to food safety in Table 5, most of respondents were "never" and "rarely" told or encouraged to implement safe food handling practices by managers/authorities, co-workers, or consumers. Indeed, no respondents said they were "often" or "always" reminded to employ food safety practices.

3.7. Participants' satisfaction of with their working conditions, work pace and job

The participants reported satisfaction with their working

Table 3
Responses to questions regarding food safety and hygiene knowledge.

Questions	Respondents (%)		
	Correct	Not correct	Don't know
Microbiologic hazards development			
Pathogen microorganisms that are on/in ice for fish preservation can: (a) Grow very slow; b) Do not grow but are still alive; c) Some die, some alive; d) All die; e) Do not know.	5.6	82.7	11.7
Some pathogenic microorganisms that are on/in fish preserved by ice adequately can: a) Grow very slowly; b) Grow quite fast; c) Do not grow; d) All die; e) Do not know.	68.9	24.4	6.7
After being eaten what will food poisoning microorganisms do?: a) Die; b) Do not grow; c) Grow quickly; d) Grow slowly; e) Do not know.	47.7	46.7	5.6
Identifying fish contamination and fish-borne illness			
Which of the following identify contaminated fish?: a) Smell bad; b) The eyes are glazed or dull; c) The blood along the backbone is not brightly coloured; d) That cannot be established solely by appearance; e) Do not know.	28.9	53.9	17.2
Can pathogenic microorganism contamination occurred by: a) Not using clean- gloves during work; b) Eating and drinking in the working area; c) Improper cleaning and handling of instrument; d) All of the above; e) Do not know.	4.4	73.4	22.2
Which of the following can be transmitted by raw fish?: a) Typhoid; b) Jaundice; c) Diarrhoea; d) All of the above; e) Do not know.	1.7	26.1	72.2
Which of the following are food-borne pathogens?: a) <i>Salmonella</i> ; b) <i>Staphylococcus</i> ; c) <i>Listeria monocitogenes</i> ; d) All of the above; e) Do not know.	0.0	3.9	96.1
Temperature knowledge about food safety			
Which of the following is the correct temperature of fish preserved in ice: a) 7 °C or above; b) 4.5 °C to 7 °C; c) – 1 °C to 4 °C; d) 0 °C or less; e) Do not know.	10.6	70.0	19.4
If the fish is displayed too long at environmental temperature (22 °C–27 °C) germs that are on/in raw fish will: a) Grow slowly; b) Grow quite fast; c) Grow very fast; d) Do not grow; e) Do not know.	20.0	68.3	11.7
Which of the following temperatures do bacteria pathogenic to humans most readily to multiply at: a) 10° C; b) 35° C; c) 50° C; d) 75° C; e) Do not know.	33.9	59.4	6.7
Personal hygiene knowledge			
When should you wash your hand in order to minimize the risk of microbiological contamination of fish: a) Upon entering a fish handling or working area; b) Immediately after using the toilet; c) After eating, drinking or smoking; d) All of the above; e) Do not know.	6.7	72.7	20.6
What would you do while you are at work if you were infected with a skin disease?: a) I would not do anything; b) I would consider what to do and find the best possible solution by myself; c) I would consult with my supervisor; d) I would consult with my co-workers; e) I do not know.	1.7	93.9	4.4
What would you do if you had symptoms of a sore throat and fever while you are at work?: a) I would not do anything; b) I would consider what to do and find the best possible solution by myself; c) I would consult with my supervisor; d) I would consult with my co-workers; e) I do not know.	0.6	92.7	6.7

Table 4
Responses to questions concerning attitudes to food safety risks and controls.

Questions	Strongly disagree (%)	Disagree somewhat (%)	Uncertain (%)	Agree somewhat (%)	Strongly agree (%)
Attitude to fish safety responsibility and training					
Safe food handling is an important issue in my job responsibility	4.6	41.5	35.6	18.3	–
Fish-borne illness can cause disease in consumers	5.6	46.1	30.0	18.3	–
It is important to learn more about food safety	1.1	35.0	48.3	15.6	–
Attitude to risks of fish borne-illness from personal hygiene					
To reduce the risks of fish contamination, I should use cap, mask, adequate clothing and clean protective gloves?	7.2	43.3	28.3	21.1	–
To reduce the risks of fish contamination I should not touch fish if I have typhoid, jaundice, or diarrhoea	18.1	40.4	38.7	2.8	–
Evaluation of health status of the workers before employment is necessary to prevent the risk of food-borne illness	42.8	35.5	21.7	–	–
Attitude to risks of fish-borne illness from time/temperature control					
When fish is placed in ice, measuring the temperature (from –1° C to + 4° C) of fish regularly is necessary to reduce the risk of fish-borne illness.	1.7	30.0	62.8	5.5	–
When fish are exposed to ambient air temperature during handling, to limit the duration of handling can reduce the growth of pathogen microorganisms.	10.0	55.6	31.7	2.7	–
Attitude to risks of fish-borne illness from contact surfaces, tools and equipment					
To reduce the risk of fish-borne illness I should clean containers, tools, and contact surfaces	1.4	11.2	41.3	43.4	2.7
To reduce the risk of fish-borne illness I should clean containers, tools and equipment with detergent/sanitiser	2.8	11.7	43.3	42.2	–
		10.6	39.4	46.7	3.3
Attitude to risks of fish-borne illness from contact surfaces, tools and equipment					
To reduce the risk of fish-borne illness I should clean containers, tools, and contact surfaces	0.3	31.1	35.0	30.8	2.8
To reduce the risk of fish-borne illness I should clean containers, tools and equipment with detergent/sanitiser	0.6	19.4	31.7	42.8	5.5
		42.8	38.3	18.9	–

conditions, work pace and the job in general with a mean from 4.93 to 5.32 (Table 6). In comparison to the maximum possible score of 10, the scores for satisfaction with working conditions, work pace, and job in general were close to the neutral point of these items. This may indicate that fish distributors are uncertain about satisfaction with their job.

3.8. Bivariate associations

Results from the statistical analysis regarding factors that may be related to food safety practices among seafood distributors have been examined widely. Most variables examined had no statistical significant relationship with total scores for food safety and hygiene practices with the exceptions being consumers who returned

Table 5
Respondents' opinions about their managers, co-workers, and consumers' attitudes toward food safety and hygiene.

Questions	Never (%)	Rarely (%)	Sometimes (%)	Often (%)	Always (%)
How often are you checked by managers/authorities to ensure the implementation of the regulations of employee health?	93.3	6.7	–	–	–
Do you receive any encouragement to report illness to management?	88.3	11.7			
Do your managers/authorities talk about/encourage safe food handling practices?	78.9	21.1			
Do your managers/authorities pay attention to food safety?	83.9	16.1			
Do the food safety inspectors visit your workplace?	78.3	21.7			
Do your co-workers talk/show concern about food safety and hygiene?	77.2	22.8			
Do your consumers show concern about food safety and hygiene of your products?	60.0	28.9	11.1		
Do your consumers return your products because they believe it is unsafe food?	58.9	37.2	3.9		

Table 6
Means of scores of respondents' opinions about working conditions, work pace (time pressure), and their job.

Questions	n	Mean (SDs)	Possible score min-max
Satisfaction with working conditions	180	4.93(1.05)	2–10
Satisfaction with work pace	180	5.32(1.27)	2–10
Satisfaction with job	180	4.93(1.05)	2–10

Note: Score of 2: Strongly not satisfied; Score of 10: Strongly satisfied.

products due to food safety, which resulted in significant differences ($P < 0.05$); gender of seafood distributors ($P < 0.05$); duration of work (employment) ($P < 0.05$), and job position ($P < 0.01$).

4. Discussion

The questionnaire designed for the present study has allowed the detection of food safety practices and factors affecting food safety practices. Each factor has also been analysed to determine whether or not it is relevant to the practices of distributors.

4.1. Food safety practices

Most of the participants in this study exhibited poor fish handling practices. The majority of respondents 'rarely' or only 'sometimes' implemented food safety practices that are compliant with the government regulations.

Fish can be contaminated during handling as a result of poor hygiene practices from infected handlers. Consequently, government regulations require seafood distributors to implement personal hygiene practices such as wearing clean protective clothing, a cap and mask; washing hands before entering the work place, after a rest period, after touching contaminated objects, and after going to the toilet; and not eating or drinking in the workplaces. However, this study found that the majority of seafood distributors 'rarely' or only 'sometimes' implemented personal hygiene practices. Failing to wash hands or ineffective hand washing after going to the toilet or touching contaminated objects is of significant concern because of the increased risk of fish being contaminated by pathogens. Many studies have demonstrated that pathogens can be transferred from hands of food handlers to food (Andargie, Kassu, Moges, Tiruneh, & Huruy, 2008; Fendler, Dolan, & Williams, 2002; Harrison, Griffith, Ayers, & Michaels, 2003).

The study also revealed that most of the seafood handlers disregarded illnesses, such as sore throats with fever, diarrhoea, or skin infections, and continued to work. Infected food handlers are well known sources for the transfer of enterotoxigenic pathogens (e.g. enterotoxigenic *E. coli* (ETEC)), and harmful viruses (e.g. Hepatitis A) to food (World Health Organization, 1999). By disregarding

illnesses, seafood distributors increase the risk of food-borne illnesses to their consumers from their products.

In addition to poor personal hygiene, many seafood distributors also disclosed poor practices of cleaning and preventing fish contamination. For example, 45.0% of respondents 'often' place fish on the floor where people walk (Table 1). Furthermore, more than half of the seafood distributors reported that they 'rarely' washed fish containers, working surfaces, tools and equipment with detergent/disinfectant/sanitiser, even though these tasks must be implemented according to the regulations (MARD, 2009b). Extensive research has shown that poor cleaning practices result in accumulated bacteria which may pose risks if transferred to the food during storage or handling (Harrison et al., 2003; Kassa, Harrington, Bisesi, & Khuder, 2001).

Time and temperature control are critical for limiting the growth of bacteria and therefore in ensuring raw seafood safety. The results of this study indicate many seafood distributors are not controlling time and temperature. Only 2.8% of participants 'often' check the temperature of fish, with the remainder 'rarely' or only 'sometimes' checking the temperature. The time fish are exposed to ambient air temperatures were 'often' checked by 4.4% of participants, with the remainder 'never', 'rarely' or only 'sometimes' monitoring time.

4.2. Food safety knowledge and attitudes

Previous studies have shown that a food handlers' practice is influenced by his or her knowledge and attitude (Ehiri, Morris, & Mcwen, 1997; Rennie, 1995). This study found that seafood distributors have a low level of knowledge of relevant food safety regulations and procedures (Table 2). A small proportion of seafood distributors had 'a little' knowledge of the procedures used to minimise fish contamination, the regulations regarding food safety and the regulations regarding the health and hygiene of food industry workers.

The findings of this study suggest that the food safety knowledge of seafood distributors is also very poor (Table 3). In particular, most of the seafood distributors had little knowledge about personal hygiene and 95.6% of distributors could not correctly identify (i.e. answered incorrectly or did not know) how pathogenic

microorganism contamination of fish can occur. The participants' knowledge of microbiological hazards and temperature control was a little better than their knowledge of personal hygiene and fish contamination; however, the participants were evaluated as having a low level of knowledge in all topics assessed. The lack of participants' knowledge on critical topics such as personal health and hygiene may be why the food safety practices discussed in the previous section are so inadequate.

These results are not particularly surprising given no seafood distributors had participated in any food safety training courses. The majority of participants had completed other training relevant to their job, which may indicate business owners and managers place greater importance on other aspects of the business (e.g. worker safety, efficiency) than they do food safety. This issue could be the subject of future research.

In addition to food safety knowledge, attitudes toward food safety and hygiene are also important factors leading to changes in food safety practices. The score for attitude toward fish safety responsibility and fish-borne illness causing disease seems to indicate negative attitudes in this area (Table 4). This might explain the inadequate food safety practice of seafood distributors; that they take their health for granted and they view themselves as not at risk or threatened by potential fish-borne disease. A generally negative attitude toward correct food safety practices leads to incorrect food safety practices (Buccheri et al., 2007; Tokuc et al., 2009). In this study, the food safety practices of seafood distributors were poor; however, the scores for attitudes to risks of fish borne-illness were little more positives. The discrepancy between food safety and hygiene attitudes and food safety and hygiene practices found in this study, was also in agreement with the findings of other studies about food hygiene knowledge, attitudes, and practices in hospitals in Iran, Italy, and Turkey (Askarian, Kabir, Aminbaig, Memish, & Jafari, 2004; Baş et al., 2006; Buccheri et al., 2007; Tokuc et al., 2009). The results of this study may explain that the lack of food safety training may lead to the seafood distributors adopting the knowledge, attitudes, and practices or behaviours empirically based on their skills and experiences in daily working. Therefore they implement food safety practice as their own knowledge and experiences.

4.3. Attitude of managers regarding food safety

The findings of this study revealed that no information was given to workers by managers or authorities, which demonstrated concern for food safety or hygienic handling by seafood distributors. The results (Table 5) showed that responses to all questions regarding managers' or authorities' concern about food safety and the hygiene of seafood distributors, was in the "never" or "rarely" category. None of the remaining categories covering implementation of a food safety management system; communication of positive messages about food safety; or provision of an organizational framework to support food safety and hygiene from managers and authorities to seafood distributors, resulted in food safety training for the seafood distributors or in education about poor food safety and hygiene knowledge. This situation explains the findings' that almost all seafood distributors did not know anything about regulations relating to food hygiene and safety or employees' health and hygiene and that 100% of seafood distributors did not attend any food safety training. Therefore, although food safety regulations have been developed by the Vietnamese government to reduce the risks of fish-borne illness (MARD, 2009b), it may be more difficult for these regulations to be applied to seafood distributors due to the low food safety commitment of managers and authorities in the DSDCs.

4.4. Participants' satisfaction with working conditions, work pace and their job

In this research, satisfaction was evaluated by determining whether or not it affected food safety practices. However, the findings showed that this factor seemed to have no bearing on food safety practice. The average scores for satisfaction in terms of working conditions, work pace, and job were neutral. Seafood distributors did not give clear positive or negative responses. According to the study and reports (Gerber et al., 2014; Nguyen, 2011, 2012), the physical environment and facilities of the DSDCs had inadequate conditions compared to government regulations. However, most of the seafood distributors in this self-report research gave as "uncertain", answers for adequate and hygienic working conditions. This may be because there is a lack of understanding about food safety regulations leading to seafood distributors viewing themselves as accepting of their surrounding physical environment. Furthermore, without having attended food safety training, the seafood distributors defined the working conditions as in accordance with their personal needs; and based on these, they judged working conditions as "uncertain". Therefore, the 'satisfaction with working conditions' response was a very personal matter. Opinions of participants in this study depended more on general parameters such as their tradition or socio-economic situation.

In addition to satisfaction with working conditions, satisfaction with work pace (time pressure) and job was not directly related to safe food handling practices. This could explain why there was no enforcement of food safety and hygiene practices from managers or consumers. Moreover, lack of knowledge about food safety and hygiene meant seafood distributors felt no pressure from safe food and hygiene practices. Therefore, the findings of this study could not compare how this factor affected food safety and hygiene practices as to be replaced by like many previous studies which have shown that time pressure was consistently mentioned as a negative factor (Clayton et al., 2002; Green & Selman, 2005; Kharbanda & Ritchie, 2005).

4.5. Factor affecting the food safety practices

In the factor related to consumers, the more frequently consumers returned fish products to seafood distributors because of food safety matters, the higher the scores for food safety and hygiene practice that were gained by seafood distributors. The association between food safety and hygiene practice and consumers returning products could suggest that consumers were the main factors that could affect the practices of seafood distributors. In the context of seafood distribution chains, effective trading, or profits, is the only concern for seafood distributors. Therefore, consumers are the main targets for their business. Implementation of the food safety and hygiene practices of seafood distributors may affect the willingness of consumers to buy, and seafood distributors, therefore, try to achieve better food safety practices in this context. This revealed that the increased awareness of consumers about food safety may be an important point to promote food safety and hygiene practices of seafood distributors, one that may lead to the motivation of seafood distributors to learn about food safety practices and enhance their food safety attitude.

Another significant difference between food safety and hygiene practice and duration work (employment) was also found in this study. Better practice associated with length of time in the seafood industry, may suggest that experience counts, or that practical experiences accumulate over the period of working. The longer the duration of working in seafood industry that seafood distributors had, the more positively it affected the food safety practices seafood

distributors gained.

The last significant factor associated with food safety practice was job position. Retailers seemed to achieve a higher practice score compared to seafood handlers. This may be explained by the fact that retailers were always directly in contact with consumers at retail markets, and thus, they needed to be aware of better food safety practices. On the other hand, the seafood handlers always worked at handling the seafood at fishing ports and indirectly traded with consumers; therefore, their awareness of food safety and hygiene practice may be less attention than that of retailers.

5. Conclusion

The findings of this study clearly indicate that general knowledge and attitudes to food safety and hygiene were at low level in most of the seafood distributors. The poor food safety and hygiene practices of seafood distributors have been affected directly by their low levels of knowledge of food safety and hygiene and by the lack of commitment to food safety from managers and authorities within the DSDCs. Other factors such as working conditions and education levels seemed not to affect food safety and hygiene practices of seafood distributors greatly. However, these factors may lead to high risks of microbiological contamination of fish and of food-borne diseases. Developing and implementing training in food safety for seafood distributors and having effective management commitments, are the first steps in building effective food safety management systems for the DSDCs. Fish distributors mostly have never been trained in even basic food hygiene and safety; Training should therefore be provided which integrates basic hygiene and new food safety programs conforming to national regulations. Training should be more practical (i.e. demonstrations) rather than theoretical. The provision of guidance and information in the form of manuals, short booklets, or videos may be valuable for raising awareness of seafood safety for fish distributors. In addition to training knowledge and practice, education for food safety responsibility and regulation obligations of food distributors is necessary. One significant factor affecting food safety and hygiene practice, the consumer, should be emphasised in the strategies for improving food safety among seafood distributors in the DSDCs.

Conflict of interest

The authors declare that they have no conflict of interest.

Acknowledgements

This research project was financially supported by the Queensland University of Technology, Australia. Our special thanks are due to the various seafood establishments and personnel, industry organisations, and government agencies for contributing to this project.

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