

# Survey on food hygiene knowledge on board ships

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## ABSTRACT

**Background and aim:** The aim of the study was to evaluate the knowledge and attitudes on food hygiene in seafarers.

**Materials and methods:** The study was conducted using an anonymous questionnaire presented to the workers of 7 tankers of an Italian shipping company (Finaval S.p.A.). As a reference, the analysis was extended to office employees of the same firm. Data were divided according to the rank of seafarers to assess possible differences in perceiving the risk.

**Results:** Overall knowledge on food safety concept was not high among seafarers. In general, galley and catering workers group provided a lower percentage of correct answers than other crew members. Food services staff revealed little awareness of the risks linked with handling food and their perception of risk of disease transmission through food was low. Answers about risk related to specific food (eggs and fish) showed that knowledge about these problems was less than satisfactory. Moreover, the percentage of 'I don't know' answers was high. These findings suggest that this personnel is aware of the right steps of health protection in terms of food hygiene, but does not understand why it is necessary.

**Conclusions:** Galley and catering group workers were not the most informed about food hygiene problems. This highlights the need to hire qualified personnel of the food industry on board ships. All those working in the food service area should be properly trained on food hygiene. Seafarers should be the target of specific informative campaigns about health risks linked with aliments, possible consequences of it and also ones on how to minimise the exposure to potentially dangerous agents/behaviours during travel/life at sea.

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**Key words:** foodborne diseases, seafarers, risky behaviours, food handlers

## INTRODUCTION

Ships represent an environment in which communicable disease spread is favoured for several reasons. Outbreaks on board ships mainly involve passenger ships and are of public health importance — because of confined spaces, food and drinking water supply are shared by more and more people. This exposes to a high risk of diseases [1, 2]. Since 1970 more than 100 outbreaks associated with ships have been reported with approximately 40% of them being food-related. An underestimation of these events is possible as many of them may have not been reported and/or are undetected.

Diseases occurring on ships are mainly represented by gastrointestinal disorders [3, 4] caused by pathogenic bacteria such as *Salmonella spp.*, *Shigella spp.* and *Vibrio spp.*, and also enterotoxigenic *Escherichia coli* [1, 5]. The consumption of contaminated food or water on board cruise ships was responsible for most of gastrointestinal outbreaks detected. Moreover, acute gastroenteritis symptoms induced by Norwalk-like viruses infection were reported aboard passenger ships [3, 6, 7]. The spread of pathogens could be favoured by the characteristics of modern fleets, owned by international companies and carrying staff of several nationalities with different sensitivity/culture to hygiene



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and health protection [1, 8]. In general, gastrointestinal disorders are largely diffused among seafarers, being the first or second cause of requests for medical advice from sailing ships [9].

The incidence of transmittable diseases on cargo vessels was investigated only sparsely and the problem is probably underestimated. During the last decades outbreaks of Ciguatera fish poisoning associated with consumption of ciguatoxic seafood in tropical and subtropical areas were reported [10, 11]. Intoxication was caused by the exposure of seafarers to cockroach allergens present in infested food [12]. Health inspections on ships carried out in 2000 revealed in the 9.2% of vessels deficiencies in food and cookery hygiene [2, 3]. Hence, inadequate hygiene in the galley and catering areas may represent a relevant health problem for seafarers.

This paper summarises the results of a survey conducted on sailing ships in order to evaluate knowledge and awareness of food-related health risks. The target was represented by seafarers working on board of an Italian tankers fleet. As a reference, analysis was extended to office employees of the same firm. The survey is a part of the project called Health Protection and Safety on Board Ships (acronym: HEALTHY SHIP). It is a project of disease prevention and health protection on board sailing ships through information campaigns on the major health risks for seafarers and on their prevention [13].

## MATERIALS AND METHODS

The survey was proposed using an anonymous questionnaire on food hygiene, assessing behavior towards food, knowledge of diseases transmitted through food and awareness of risk represented by improper (incorrect) food handling and conservation.

The questionnaire was sent by express mail to the tankers ( $n = 7$ ) participating in the survey and to the company headquarters in Rome. Each worker received a sealed envelope containing a covering letter explaining the project and the questionnaire with the instructions on how to fill it in. The questionnaire was divided into 2 parts: the first one with questions about personal details (gender, age, nationality, educational level, work rank), the second with specific questions about food. Answers to the questionnaire were received, collected and transferred into Microsoft Excel sheets. This software was used for data storing and processing. Statistical analysis was performed by the X-Lstat software [14] using the  $\chi^2$  and Fisher tests. Statistical significance was established at  $p < 0.05$ .

## RESULTS

The total number of questionnaires filled in was 243, out of 280 distributed (response rate 86.8%). Compared

**Table 1.** Demographic characteristics and education (expressed in %) of the interviewed workers

	Ashore	Seafarers
<b>Gender</b>		
Male	55.0	100.0
Female	40.0	0.0
No answer	5.0	0.0
<b>Nationality</b>		
Italian	90.0	20.2
Indian	0.0	56.9
Filipino	0.0	15.70
Ukrainian	0.0	2.24
Romanian	0.0	0.45
No answer	10.0	4.48
<b>Education level</b>		
Diploma	60.0	29.6
High school	15.0	28.7
University degree	20.0	23.8
Professional diploma	0	11.7
Elementary diploma	0	1.3
No answer	5.0	4.9
<b>Mean age [years]</b>	37.4 ± 13.7 (range 20–58)	34.8 ± 12.8 (range 17–67)

to the previous surveys, the percentage of answers was higher (probably due to the increasing interest for the project HEALTHY SHIP) [15, 16]. Demographic characteristics and education levels of the respondents to the survey are summarised in Table 1.

Table 2 lists the questions proposed by the survey and the percentage of correct answers given by the interviewed people. Questions like 'Do you think that diseases can be transmitted through food?', 'Why is it important to wash your hands before touching food?', 'Foods most favourable to micro-organism multiplication are...', 'Vegetables should be stored in the refrigerator separately from meat, dairy products and cooked food. Why?' had the highest number of correct answers.

The last questions on food handling good practice have shown a variable level of knowledge of topics under analysis. The questions 'At what temperature should perishable foods made from milk, cream, whipping cream or eggs be kept?' and 'Is it appropriate to refreeze thawed food?' were those receiving the lowest percentage of correct answers (Table 2). The lack of knowledge on questions 12, 13, 14 and 15 of the interview is apparently more influenced by the geographical origin of the catering and galley staff than by the level of education achieved (Table 3).

**Table 2.** Questions of the questionnaire dedicated to knowledge and awareness of food-related health risks (data are expressed as the percentage of correct answers. For multiple answer questions figures represent the percentage resulting from the mean of right answers).

Questions	Per cent of correct answers
<b>1. Do you think that diseases can be transmitted through food?</b> <i>Yes; No. If Yes, can you indicate which foodborne diseases you are most familiar with?</i>	76.5
<b>2. What foods are most responsible for the disease?</b> <i>Eggs; meat; fish; I don't know</i>	93.4
<b>3. What do you think are the main risk factors for disease transmission through food?</b> <i>Improper storage temperature; improper cooking process; poor hygiene of the person preparing/distributing food; consumption of raw food; uncertain origin of food; excessive time between the preparation and consumption of food; contaminated utensils; contamination of cooked food by raw food; pathogen-carrying catering personnel (cooks, assistant cooks, waiters, etc.); I don't know</i>	55.6
<b>4. Which of the following activities favour the development of germs in food?</b> <i>Leaving the food at room temperature for a long time; refrigerating food in large pots; putting cooked food in contact with raw food; consuming food immediately after cooking it; heating food at high temperatures; I don't know</i>	51.4
<b>5. Food gets contaminated with microorganisms mainly through:</b> <i>Food containers; hands handling food; air; I don't know</i>	75.3
<b>6. How can food contamination be avoided?</b> <i>Personal hygiene; environmental hygiene; separating cooked from uncooked foods; separating meat from vegetables; cooking; refrigeration; freezing; I don't know</i>	57.2
<b>7. Why is it important to wash your hands before touching food?</b> <i>So that they are cleaner; because it is required by law; to reduce the risk that the germs present on hands contaminate the food; to avoid being contaminated by touching the food; I don't know</i>	89.3
<b>8. In your opinion, can food be stored for an unlimited amount of time?</b> <i>Yes, by storing it in the refrigerator; yes, by cooking it; no, all foods have a limited shelf life; I don't know</i>	78.6
<b>9. Does refrigeration kill all the pathogens that may be present in food?</b> <i>No, but it preserves the food so that germs cannot multiply; it just kills the germs that are vulnerable to low temperatures; yes, it kills all the germs; no, on the contrary, it facilitates their growth; I don't know</i>	55.9
<b>10. Foods most favourable to micro-organism multiplication are:</b> <i>Those with the highest water content such as milk, creams, broths; those with the lowest water content, such as biscuits and pasta; very salty foods, such as anchovies preserved in salt; I don't know</i>	81.5
<b>11. Are the most common pathogens (e.g. Salmonella) killed during the cooking process?</b> <i>False; true if cooked at a temperature of 30 °C; true only if the food reaches an internal temperature of 70 °C during the cooking process; true only if oven-baked; I don't know</i>	59.3
<b>12. At what temperature should perishable foods made from milk, cream, whipping cream or eggs be kept?</b> <i>Below 0 °C; not above +4 °C; between +4 to +8 °C; between 0 to +10 °C; I don't know</i>	24.3
<b>13. Raw food should be stored in the refrigerator or in the cold store separately from cooked food:</b> <i>True; False; true only for eggs; I don't know</i>	74.1
<b>14. Vegetables should be stored in the refrigerator separately from meat, dairy products and cooked food. Why?</b> <i>To avoid having the refrigerator too full so as not to be able to wash it well; to avoid having to open the refrigerator too often thereby raising the temperature; to prevent the germs on the surface of vegetables from contaminating other foods; I don't know</i>	82.3
<b>15. Is it appropriate to refreeze thawed food?</b> <i>Not more than once; not more than 3 times; no, never; yes, as many times as you'd like; I don't know</i>	44.1

Response rates to the questionnaire according to the rank of the interviewed people are detailed below. Our analysis was centered primarily on galley and catering personnel, as they represent the main players of food hygiene on board ships.

Table 4 summarises answers to the question 'Do you think that diseases can be transmitted through food?'

The lowest percentage of correct answers comes from the catering and galley group. Only 53.8% of these workers were aware that food may indeed be responsible for disease transmission, and more than 30% did not answer the question. The highest percentage of correct answers to this question was obtained from deck and engine officers category that apparently has a good awareness of food-related risks.

**Table 3.** Percentage of incorrect answers to questions 12, 13, 14 and 15 and geographical origin of the catering and galley staff interviewed

Questions	Italian origin	Indian origin	Philippine origin
<b>At what temperature should perishable foods made from milk, cream, whipping cream or eggs be kept?</b> <i>Below 0 °C; not above +4 °C; between +4 to +8 °C; between 0 to +10 °C; I don't know</i>	50.0	89.9	100.0
<b>Raw food should be stored in the refrigerator or in the cold store separately from cooked food:</b> <i>True; false; true only for eggs; I don't know</i>	0.0	5.6	75.0
<b>Vegetables should be stored in the refrigerator separately from meat, dairy products and cooked food. Why?</b> <i>To avoid having the refrigerator too full so as not to be able to wash it well; to avoid having to open the refrigerator too often thereby raising the temperature; to prevent the germs on the surface of vegetables from contaminating other foods; I don't know</i>	0.0	11.1	0.0
<b>Is it appropriate to refreeze thawed food?</b> <i>Not more than once; not more than 3 times; no, never; yes, as many times as you'd like; I don't know</i>	0.0	72.2	50.0

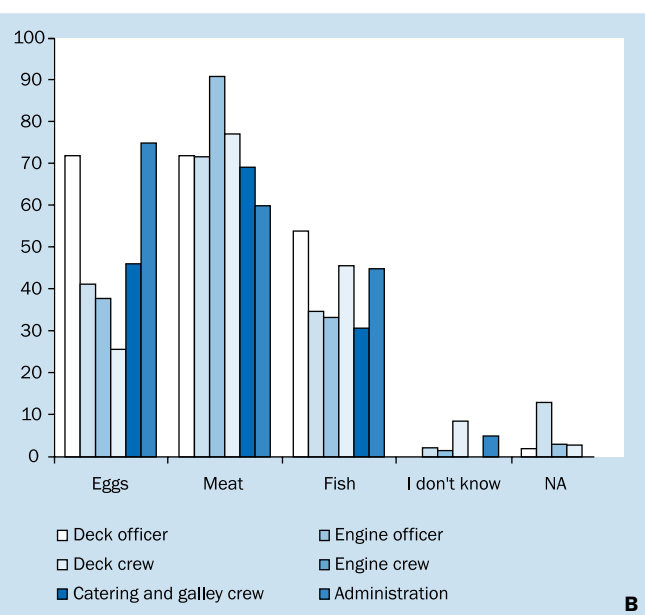
**Table 4.** Percentage of answers to the question 'Do you think that diseases can be transmitted through food?' for the rank of respondents

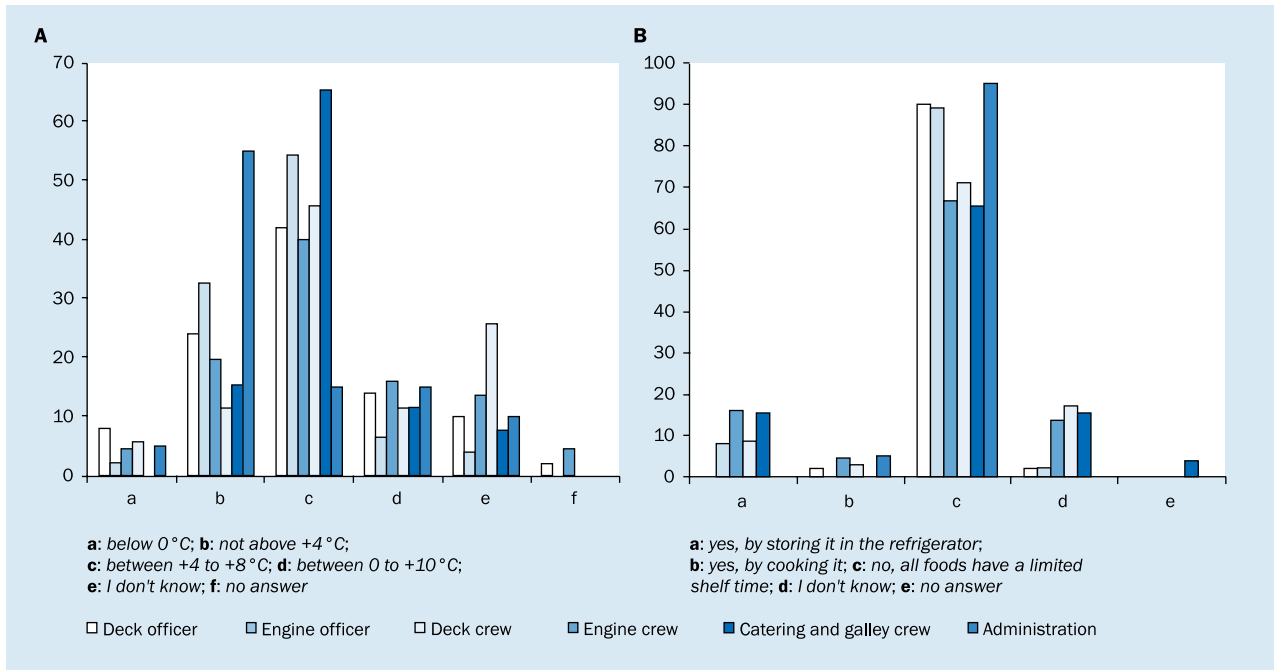
	Yes	No	No answer
Deck officers	82.0%	16.0%	2.0%
Engine officers	87.0%	6.5%	6.5%
Deck crew	71.2%	25.8%	3.0%
Engine crew	74.3%	25.7%	0.0%
Catering and galley crew	53.8%	15.4%	30.8%
Administration	90.0%	10.0%	0.0%
TOTAL	76.5%	17.7%	5.8%

A more detailed analysis of answers to the question on the main risk factors of food-related disease transmission (mean of right answers 55.56%) revealed that the highest percentage of total sample responded 'the poor hygiene of the person preparing/distributing food' and 'the improper storage temperature' (Fig. 1A).

Kitchen staff considered improper food storage temperature (96.1%) and the poor hygiene of the person responsible for food preparation and distribution (themselves) (88.5%) as the main risk factors of food-related disease transmission. Correct answers to the other questions on risk factors (improper cooking process, consumption of raw food, uncertain origin of food, contaminated utensils,

Answer	Total	Per cent
Improper storage temperature	196	80.7
Improper cooking process	146	60.1
Poor hygiene of the person preparing/distributing food	206	84.8
Consumption of raw food	143	58.8
Uncertain origin of food	91	37.4
Excessive time between preparation and consumption	104	42.8
Contaminated utensils	123	50.6
Contamination of cooked food by raw food	113	46.5
Pathogen-carrying catering personnel (cooks, assistants, ...)	97	39.9
I don't know	4	1.6

**Figure 1.** Answers to the questions: **A.** 'What do you think are the main risk factors for diseases transmission through food?'. Percentage of answers given by all interviewed people. **B.** 'What foods are most responsible for the disease?'. Percentage of answers by interviewed divided by rank; NA – no answer



**Figure 2.** Answers to the questions: **A.** 'At what temperature should perishables food made from milk, cream, eggs, etc. be kept?'. **B.** 'Can food be stored for an unlimited time?'

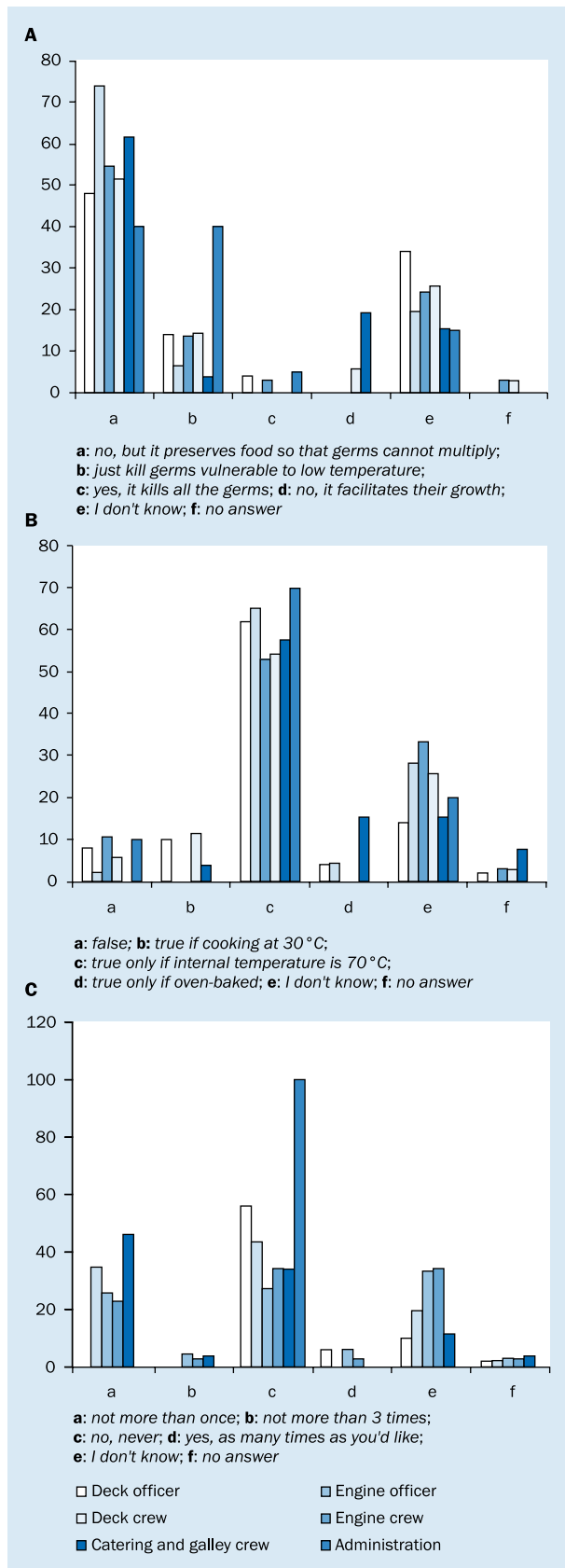
contamination of cooked food by raw food) given by catering and galley staff varied between 42% and 54%, documenting a limited perception of the risk of contracting diseases from food. The possibility that food operators may be carriers of pathogens is perceived by themselves as the lowest risk factor (34.6%). The perception of cross-contamination risk for kitchen staff is also low, as documented by the percentage of answers 'contamination of cooked food by raw food' (46.1%) and 'contaminated utensils' (42.3%). Figure 1B summarises answers to the question 'What foods are most responsible for disease?', divided by rank. Interviewed people considered meat as the main origin of food-borne diseases, whereas eggs and fish were considered a less relevant cause of food-related pathologies. Galley and catering personnel that should be the most informed about hygiene of food, apparently underestimate the risks linked to these foods.

The percentage of right answers ('all foods have a limited preservation time') to the question 'In your opinion, can the food be stored for an unlimited amount of time?' given by galley and catering group did not exceed the 65%. Galley and catering personnel were also one of the groups that attributed the lowest value of this answer, whereas the highest value was given by administration staff and ship officers (Fig. 2B).

Answers to the questions like 'Does refrigeration kill all the pathogens that may be present in food?' and 'Are the

most common pathogens (e.g. *Salmonella*) killed during the cooking process?' show that galley and catering personnel gave the correct answer by 61.5% and 57.7% respectively (Fig. 3A, B). From the personnel working in the kitchen 46.1% deem appropriate to refreeze defrosted food only once. 11.5% of the respondents reported that they do not know how to behave, and 3.8% did not answer the question. Comparatively, administration personnel provided more correct answers to this group of questions (Fig. 3C). Hence, people living ashore have apparently more knowledge on some topics, although a relatively discrete percentage of them gave wrong answers.

Questions like 'What are the food characteristics most suitable to micro-organisms multiplication?', 'What are the more important pathways of food contamination?', 'Should raw food be stored in the refrigerator or in the cold store separately from cooked food?' received more than 90% of correct answers primarily by deck officers. Catering and galley staff gave about 80% of correct answers, whereas administration personnel apparently underestimates the importance to separate raw and cooked food in the refrigerator (50% of correct answers). Right answers averaged in all ranks 80% to the question 'Vegetables should be stored in the refrigerator separately from meat, dairy products and cooked food. Why?'. Catering and galley staff are the most familiar with the common rules of hygiene that need to be met while cooking (96% of correct answers).



**Figure 3.** Answers to the questions: **A.** 'Does refrigeration kill all the pathogens that may be present in food?'. **B.** 'Are the most common pathogens (e.g. *Salmonella*) killed during the cooking process?'. **C.** 'Is it appropriate to refreeze thawed food?'

Other answers suggest that they have little knowledge about more technical issues. For instance, 84% of the galley staff know that leaving food at room temperature for a long time facilitates the growth of bacteria (a concept widely known by the public), whereas only 20% of them know that the same is true when hot food is refrigerated in large pots (more specific notion) (Fig. 4A). Responses to the question 'How can food contamination be avoided?' show that the majority of interviewed people consider important personal and environmental hygiene, assigning less importance to the separation of food (cooked and raw food, meat and vegetables), the type of cooking and refrigeration. In particular, food handlers know the importance of the environmental hygiene (92%) and 84% of them consider relevant personal hygiene. The majority of seafarers, irrespective of their rank, assign less importance to the separation of food, type of cooking, and refrigeration, with the main response rates not exceeding 56% (Fig. 4B).

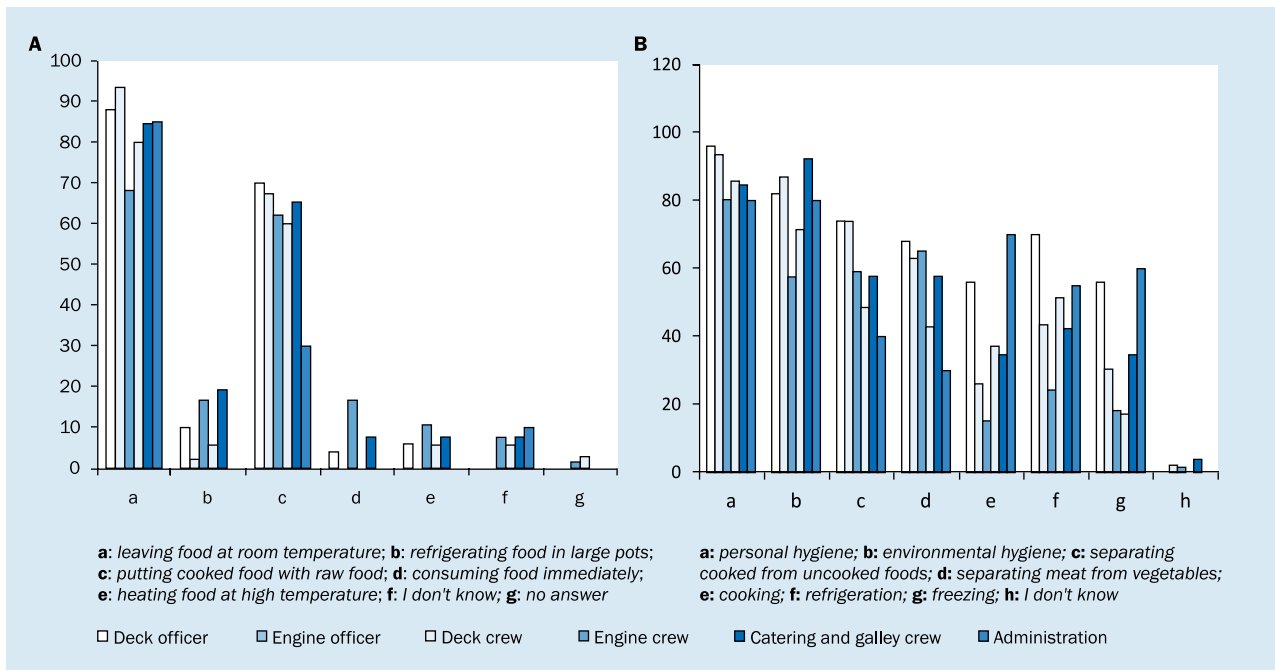
Personal hygiene is considered important by 84% of the galley and catering group, but only 48% of them know that it is necessary to wash your hands after smoking, and only 76% know that it is necessary to reduce the risk of contamination. More than 90% of deck officers properly answered to this last question. Finally, in the opinion of 28% of galley and catering group, it is necessary to wash their hands to avoid being contaminated by food they touch.

## DISCUSSION

World Health Organisation (WHO) identifies 5 principal components facilitating food contaminations on board ships:

- the source of food coming into the ports;
- transfer of food to storage points on board ship;
- storage and general distribution of food on board ship;
- preparation and serving of food, including cooking and mixing by food handlers;
- handling and storage of food for personal consumption by passengers or crew, including taking food away and storing it in private areas for subsequent consumption [5].

In general, foodborne outbreaks on board passenger ships are linked to inadequate food temperature control, infected food handlers, contaminated raw ingredients, cross-contamination, and not enough heat treatment [17]. However, the correlation between outbreaks of the diseases on merchant (cargo) ships and food hygiene received a limited attention. This paper has summarised the results of a survey on knowledge and awareness of food safety conducted on board ships while at sea, and hence without external influences. Therefore the results of our questionnaire probably reflect the awareness/knowledge of problems assessed on board ships.



**Figure 4.** Answers to the questions: **A.** 'Which of the following activities favour the development of germs in food?'. **B.** 'How can food contamination be avoided?'

Our study showed that the overall knowledge of food handlers on food safety concept is not satisfactory. In general, catering and galley workers provided a lower percentage of correct answers compared to other crew members. Their answers give the impression that food service staff is not fully aware that diseases can be transmitted by contaminated food and does not know the reason why a particular behavior must be adopted during food preparation. Food handlers must be aware of the correct procedures of safe storage and cooking food to avoid contaminations. For such a reason, the questionnaire presented a sequence of questions on storage times, storage temperatures and also cooking temperatures. The answers of catering and galley people revealed an unsatisfactory training. This is indirectly confirmed by the high percentage of the 'I don't know' answer to questions on temperature and time of safe storage of food.

In agreement with data of studies analysing food safety knowledge among food workers in restaurants, the galley staff on board ships has a good knowledge of basic elements of 'personal hygiene'. They also know that food operators not practising good personal hygiene may represent a relevant risk factor, but they have poor to fair knowledge of the importance for food operators of being pathogen carriers, on 'foodborne pathogens', 'safe storage, cooking, thawing and refreezing the food' [18]. Questions investigating the possibility of contamination between raw and cooked food or between utensils and food show a very low percentage of correct answers by catering and galley

staff. The percentage of 'I don't know' answers was high and suggested that the connection between poor personal hygiene, sanitation, presence of pathogens and spread of diseases is not obvious. This means that the personnel is aware of the right steps to be taken, as being clean, but does not understand why this is necessary. Answers about the risk related to specific foods show a low level of knowledge on eggs and fish. Some authors estimated that approximately 30% of the outbreaks investigated by the Center for Disease Control and Prevention (CDC) in Atlanta (USA) in the period 1986–1993 could have been prevented by cooking of shellfish and the use of pasteurised eggs [19].

## CONCLUSIONS

This investigation provided data on knowledge and awareness of the main concepts of food safety among ship workers, with particular attention to catering and galley personnel working in cargo ships (tankers). The limited studies on the culture of food among seafarers, and the results of this investigation indicate the necessity of further investigations and interventions to highlight the problem of proper hygienic approach in the kitchens and in handling food for protecting health of seafarers [20]. Overall, the results of our survey revealed that 'catering and galley' workers are often the least informed about the subject matter for the majority of questions. We can therefore conclude that the group of main food handlers has little knowledge of the problem and their perception of risk of contracting diseases through food is low. This highlights the need to hire qualified

personnel of the food industry on board ships. They should be those in possession of a health card, having successfully attended courses on food hygiene, and demonstrating their knowledge and familiarity with the subject. In view of the delicacy of the role of catering services staff on board ships, experience is not enough and proper knowledge of the topic is required. It is important that all those who work in food services are adequately trained on food hygiene and specific knowledge on food safety should be verified. The attendance to short vocational courses and periodical refreshing of this training would be appropriate. The Codex Alimentarius Commission and the FAO/WHO require Food Safety Plans (FSPs) to manage the process of providing safe food on board ships. The FSP could be based on the Hazard Analysis and Critical Control Point (HACCP) method and must include training of chefs and food handlers. Kitchen/catering operators and staff must know the risks associated with food chain and the importance of managing these risks for avoiding/reducing foodborne diseases [5]. The outbreaks of foodborne diseases are dangerous on board of passenger ships because they involve a large number of people, but are also important on board of cargo ships. These carry particularly isolated communities spending long times at sea, sometimes in remote regions of the world and without adequate medical care [19]. In our opinion, it is necessary to increase and maintain a food safety culture on merchant/cargo ships. This will be possible only through using easy instruments considering the different nationalities, cultures and languages of the seafarers [21].

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