

FOOD SAFETY CLIMATE AND KNOWLEDGE ABOUT FOOD SAFETY IN PORTUGUESE HIGHER EDUCATION FOOD SERVICE UNITS

AMBIENTE E CONHECIMENTO DE SEGURANÇA ALIMENTAR EM UNIDADES DE ALIMENTAÇÃO COLETIVA DO ENSINO SUPERIOR PORTUGUÊS

A.O.
ARTIGO ORIGINAL

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ABSTRACT

INTRODUCTION: Despite the increasing effort in food safety measures, food poisoning remains a reality. Employees' perception regarding food safety and hygiene at their workplace (food safety climate) can influence the microbiological status of the final product.

OBJECTIVES: To study the relationships between food safety climate, knowledge about food safety and personal and professional characteristics of workers of higher education institutions' food service units (canteens and bars).

METHODOLOGY: A convenience sample of 77 workers of 15 higher education institutions' canteens and bars in three Portuguese cities (Porto, Aveiro and Coimbra) was evaluated. The relationships of sociodemographic and workplace data with food safety climate (18 items divided into six components) and knowledge about food safety (20 items grouped in four themes) were assessed.

RESULTS: Food safety climate (median = 83.3%, P25 = 70.8%, P75 = 88.9%) was not significantly associated with food safety knowledge (median = 45.0%, P25 = 30.0, P75 = 55.0): $rs = -0.128$, $p = 0.262$. Food safety knowledge had a positive association with years of experience in current workplace ($rs = 0.247$, $p = 0.032$) and in food sector ($rs = 0.326$, $p = 0.004$). Workers who had attended training in their current workplace presented higher food safety knowledge (mean = 45.0% vs. 40.0%, $p = 0.021$). None of the relationships of workers' characteristics and food safety climate were statistically significant.

CONCLUSIONS: Workers of Portuguese higher education institutions' service units present low knowledge about food safety despite the positive perception of food safety climate. Experience and training are related with food safety knowledge but not with food safety climate.

KEYWORDS

Experience, Food safety, Food safety climate, Knowledge, Training

RESUMO

INTRODUÇÃO: Apesar do crescente esforço em medidas de segurança alimentar, as intoxicações alimentares continuam a ser uma realidade. A perceção dos colaboradores em relação à segurança alimentar e higiene no local de trabalho (ambiente de segurança alimentar) pode influenciar o estado microbiológico do produto final.

OBJETIVOS: Estudar as relações entre o ambiente de segurança alimentar, conhecimentos sobre segurança alimentar e características pessoais e profissionais de colaboradores de unidades de alimentação (cantinas e bares) em instituições do ensino superior.

METODOLOGIA: Avaliou-se uma amostra de conveniência de 77 trabalhadores de 15 cantinas e bares em instituições de ensino superior de três cidades portuguesas (Porto, Aveiro e Coimbra). Foram avaliadas as relações dos dados sociodemográficos e sobre o local de trabalho com o ambiente de segurança alimentar (18 itens divididos em seis componentes) e os conhecimentos sobre segurança alimentar (20 itens agrupados em quatro temas).

RESULTADOS: O ambiente de segurança alimentar (mediana = 83,3%; P25 = 70,8%; P75 = 88,9%) não se associou significativamente aos conhecimentos (mediana = 45,0%; P25 = 30,0; P75 = 55,0): $rs = -0,128$; $p = 0,262$. Os conhecimentos sobre segurança alimentar relacionaram-se positivamente com os anos de experiência no local de trabalho atual ($rs = 0,247$; $p = 0,032$) e no setor alimentar ($rs = 0,326$; $p = 0,004$). Os trabalhadores que tinham tido formação no local de trabalho atual apresentavam maiores conhecimentos sobre segurança alimentar (média = 45,0% vs. 40,0%; $p = 0,021$). Nenhuma das relações das características dos trabalhadores com o ambiente de segurança alimentar foi estatisticamente significativa.

CONCLUSÕES: Os colaboradores de unidades de alimentação em instituições do ensino superior em Portugal possuem baixos conhecimentos sobre segurança alimentar, apesar da perceção positiva sobre o clima de segurança alimentar. A experiência e formação relacionam-se com os conhecimentos sobre segurança alimentar mas não com o ambiente de segurança alimentar.

PALAVRAS-CHAVE

Experiência, Segurança alimentar, Ambiente de segurança alimentar, Conhecimentos, Formação

INTRODUCTION

In the last decades, Food Safety (FS), i.e. the assurance that food will not cause any harm if prepared and/or consumed in accordance with the use for which it is intended, (1) has received increasing attention. Despite the efforts to reduce food poisoning events, these still occur and may be lethal for more susceptible individuals. Food poisoning is often due to human errors, which leads to a change of focus to that human dimension. In that way, the notions of Food Safety Culture (FSCult) and Food Safety Climate (FSClim), which may be interpreted as the human dimension of FSCult, seem to be relevant, especially within food service settings (1, 2). Research suggests that a propitious FSClim combined with an adequate FS management system may lead to higher FS (3).

These concepts have been studied and evolved throughout the years; however, their definition is not unanimous (4). Within this study, FSCult was defined as “a long-term construct existing at the organizational level relating to the deeply rooted beliefs, behaviours and assumptions that are learned and shared by all employees which impact the food safety performance of the organisation” (4), and FSClim as “employees’ (shared) perception of leadership, communication, commitment, resources and risk awareness concerning FS and hygiene within their current work organization” (2). Indeed, FSClim comprises all these components, and their perception by the employees determines FS, as food handlers can only have the hygiene practices required, allowed and encouraged by the workplace and leadership, which in turn depend on the facilities and equipment’s conditions and on the management and culture systems (5).

In order to improve FS, the study of FSClim is, therefore, mandatory. To our best knowledge, there are no works studying FSClim in Portugal. Therefore, this study aimed to assess the relationships between FSClim, knowledge about FS and personal and professional characteristics of food service units workers. In particular, higher education institutions’ canteens and bars were chosen as target, since they supply a great number of meals but have received little attention in Portugal.

METHODOLOGY

This study was approved by the Ethics Committee of Instituto de Saúde Pública da Universidade do Porto (CE19114, 30-May-2019) and is part of the European project “Assessing the food safety knowledge and perception of food safety in the university canteens”. Data gathering took place between August 2019 and January 2020. Three Portuguese cities (Porto, Aveiro, Coimbra) were selected by convenience. All 25 food service units ruled by the social services of these cities’ public universities were invited and 15 (60.0%) agreed to participate (Porto: n = 6, Aveiro: n = 4, Coimbra: n = 5). From a total of 140 workers, 77 (55.0%) answered the questionnaire.

The questionnaire, constructed within the project, was of direct application (except for illiterate workers) and was divided into three parts. The first part examined the demographic characteristics of food handlers (sex, education, total and current work experience, training and role within the establishment).

The second part assessed FSClim using an instrument based on de Boeck *et al.* (2015) (2) and included 18 items divided into six components: communication between colleagues and with supervisors (“communication”; 3 items), commitment with FS and hygiene at the workplace (“commitment”; 4 items), resources and organization (“resources”; 3 items), perception of risks affecting food hygiene and FS (“risks”; 3 items), relevance of documentation and related practices (“documentation”; 3 items) and cleaning practices and barriers (“cleaning”; 2 items). In each item participants should select

their agreement with one sentence (disagree, partially agree or totally agree; recoded into 0, 50 or 100%), and each component’s score corresponded to the mean of its items.

Section three was adapted from Smigic *et al.* (2016) (6) and assessed knowledge about FS using 20 items, grouped in four themes: overall knowledge and cross-contamination (6 items), storage and cooling (4 items), handling and cooking (6 items) and hygiene (4 items). Each item consisted on a sentence which should be classified as true or false. The score of each theme corresponded to the percentage of correct answers.

The original tools described in Boeck *et al.* (2015) (2) and Smigic *et al.* (2016) (6) were adapted to better suit the knowledge and practices of food handlers in canteens and bars.

Statistical analysis was performed using IBM SPSS version 25.0 for Windows. Descriptive statistics consisted on absolute (n) and relative (%) frequencies and medians and percentiles (P25; P75). Normality was assessed using Kolmogorov-Smirnov’s test. Spearman’s correlation coefficient (rs) was used to measure the association of FSClim and knowledge about FS with sociodemographic and workplace characteristics. Mann-Whitney’s and Kruskal-Wallis’ tests were used to compare FSClim and knowledge about FS between participants with different characteristics, and Friedman’s test was used to compare the components of FSClim and to compare the themes of knowledge about food safety. When applicable, post-hoc tests were performed with Bonferroni’s correction. The null hypothesis was rejected when $p < 0.05$. The analysis was performed for the total sample (n = 77) except in case of missing data in the first part of the questionnaire.

RESULTS

Table 1 presents the sample’s sociodemographic and professional characterization. Participants were aged 21 to 66 years (median = 50, P25 = 42, P75 = 59, n = 67). Most had attended only primary (50.6%) or secondary education (41.6%) and have worked in the food sector (68.8%) and in the current workplace (50.7%) for more than 8 years. About two thirds of the sample had attended training courses (68.4%) and had training at the workplace (67.1%). Most participants (93.3%) were operators responsible for preparation and/or cooking. Due to the low proportion of males (7.8%), we did not compare FSClim or FS knowledge between sexes.

Regarding FSClim, the median score was 83.3% (P25 = 70.8%; P75 = 88.9%), with a minimum of 44.4% and a maximum of 100%. Table 2 presents the median score for each component of FSClim. There were significant differences between components ($p < 0.001$), with those about commitment and risks presenting the highest scores, whereas cleaning presented the lowest.

As for knowledge about FS, the median score was 45.0% (P25 = 30.0; P75 = 55.0). The minimum score was 0% and the maximum 75.0%. There were significant differences between themes ($p = 0.021$). Overall knowledge and cross-contamination presented the lowest scores (Table 3).

FSClim and knowledge about FS did not present a significant association ($r_s = -0.128$, $p = 0.262$). Higher scores in FSClim regarding cleaning were associated with lower total knowledge ($r_s = -0.236$, $p = 0.039$) and lower knowledge about handling and cooking ($r_s = -0.239$, $p = 0.036$). Knowledge about hygiene was associated with higher scores in FSClim related to documentation ($r_s = 0.306$, $p = 0.007$) and with lower scores in FSClim related to commitment ($r_s = -0.266$, $p = 0.019$) and cleaning ($r_s = -0.255$, $p = 0.025$).

There were no significant differences between cities regarding FSClim (medians: Porto = 84.7%, Aveiro = 86.1%, Coimbra = 73.6%, $p =$

Table 1

Sociodemographic and professional characterization of 77 workers of 15 higher education institutions' canteens and bars

	n	%
City		
Porto	32	41.6
Aveiro	29	37.7
Coimbra	16	20.8
Sex		
Female	71	92.2
Male	6	7.8
Education		
Primary education (≤ 4 years)	39	50.6
Secondary education (5 to 12 years)	32	41.6
Post-secondary education	4	5.2
Higher education	2	2.6
Total work experience in food sector		
Less than 2 years	12	15.6
2 to 8 years	12	15.6
8 to 16 years	16	20.8
16 to 25 years	37	48.1
Work experience at current workplace [n = 75]		
Less than 2 years	21	28.0
2 to 8 years	16	21.3
8 to 16 years	16	21.3
16 to 25 years	22	29.3
Attendance of training courses [n = 76]		
Yes, organized officially	47	61.8
Yes, organized privately	5	6.6
No	24	31.6
Training at workplace [n = 73]		
Yes, internally	39	53.4
Yes, externally	10	13.7
No	24	32.9
Function [n = 75]		
In charge	1	1.3
Operator (preparation/ cooking)	70	93.3
Distribution	4	5.3

Table 2

Scores in each component of food safety climate instrument (adapted from Boeck *et al.*, 2015)

COMPONENTS	MEDIAN (P ₂₅ ; P ₇₅)	POST-HOC TESTS *
Communication between colleagues and with supervisors	83.3% (66.7; 100)	b
Commitment with food safety and hygiene at the workplace	100% (75.0; 100)	a
Resources and organization	83.3% (66.7; 100)	b
Perception of risks affecting food hygiene and food safety	100% (83.3; 100)	a
Relevance of documentation and related practices	83.3% (66.7; 100)	b
Cleaning practices and barriers	50.0% (50.0; 100)	c

Friedman's test: $p < 0.001$

* The presence of the same letter indicates the absence of significant differences between components in the post-hoc tests (Wilcoxon's test with Bonferroni's correction).

Table 3

Scores in each theme of knowledge about food safety (adapted from Smigic *et al.*, 2016)

THEMES	MEDIAN (P ₂₅ ; P ₇₅)	POST-HOC TESTS *
Overall knowledge and cross-contamination	33.3% (17.7; 50.0)	a
Storage and cooling	50.0% (25.0; 75.0)	b
Handling and cooking	50.0% (16.7; 66.7)	a, c
Hygiene	50.0% (25.0; 75.0)	a, b

Friedman's test: $p = 0.021$

* The presence of the same letter indicates the absence of significant differences between themes in the post-hoc tests (Wilcoxon's test with Bonferroni's correction).

0.406) or knowledge about FS (medians: Porto = 45.0%, Aveiro = 40.0%, Coimbra = 50.0%, $p = 0.092$). FSCLim was not associated with age ($r_s = 0.059$, $p = 0.636$), education ($r_s = 0.058$, $p = 0.614$), total work experience in food sector ($r_s = -0.120$, $p = 0.310$) or experience at current workplace ($r_s = -0.088$, $p = 0.451$). Knowledge about FS did not present association with age ($r_s = -0.029$, $p = 0.815$) or education ($r_s = 0.125$, $p = 0.279$). Higher knowledge was associated to longer experience, both in food sector ($r_s = 0.326$, $p = 0.004$) and at current workplace ($r_s = 0.247$, $p = 0.032$). FSCLim did not differ between participants with or without training at current workplace (median = 83.3% vs. 86.1%, $p = 0.628$), or between participants with or without overall attendance of training courses (median = 83.3% vs. 86.1%, $p = 0.831$). Knowledge about FS also did not differ between participants who overall had or had not attended training courses (median = 47.5% vs. 40.0%, $p = 0.066$), but was higher among those with training at current workplace (median = 45.0% vs. 40.0%, $p = 0.021$).

DISCUSSION OF THE RESULTS

The high proportion of female participants reflects the reality of this area, and is in line with previous studies (6, 7). Participants' education is overall low, which may contribute to the poor results found for FS knowledge. Despite education was not significantly associated to knowledge, that relationship has been previously reported in Portugal (7).

Despite most participants had more than eight years of experience and have attended training, the median knowledge about FS was low. Since longer experience and training at current workplace were related with higher knowledge, this result may be due to specific training features, such as contents and language not adapted to workers' characteristics or their own lack of motivation or fatigue (8, 9).

The association between knowledge about FS and years of experience was higher for the overall experience than for experience at the current workplace. The precarious contracts in this area lead to a high turnover of employees, but, the fact that establishments have similar and standardized operating modes and identical contents covered in training means that knowledge is applicable transversally in the sector, thus justifying this result (8-10).

Our results show that, overall, knowledge about FS is low, especially regarding overall knowledge and cross-contamination. The analysis of individual items (data not presented) showed that participants had higher knowledge regarding practical issues (how to proceed) compared to more theoretical and technical ones, which include the nomenclature and technical designations concerning contamination and corrective actions. A Portuguese study on FS knowledge among workers from a catering company that prepares meals for school canteens, kindergartens and nursing homes reported a mean of 56.5% of correct answers, which is close to the result in our sample. The same study also found limited knowledge about temperature control and pathogens (29.7% to 71.3% correct answers), which highlights the need for improvement in these themes among Portuguese workers in this sector (7).

A European study reported knowledge levels (mean = 72.6%) among Portuguese food handlers higher than those in our sample, and that knowledge about FS was similar when compared to other countries (Serbia: 71.3%; Greece: 69.1%) (6). However, both the samples' characteristics and the instruments used were different in the two studies, which may at least partially explain these differences.

Results regarding FSCLim and knowledge were very different (median = 83.3% vs. 45.0%). Low knowledge about FS may lead to lower critical analysis and to a more favorable perception on FSCLim. Despite the overall scores did not present a significant association, the correlations

between FSCLim components and FS knowledge themes were mostly negative. On the other hand, FSCLim components with lower scores (i.e. cleaning) are mainly those which imply financial costs, which may be explained by the lack of funds previously identified in a similar sample (11).

A work assessing FSCLim in butcher shops also found high mean scores, ranging from 76.1 to 91.0% (4). Another research, carried out in more than 500 industries in ten European countries describes mean FSCLim results higher than 80%, with leadership (85.4%) and risk perception (84.6%) presenting higher mean scores and resources (81.0%) the lowest (12). These results are similar to those found in the current work, despite the perception about FSCLim related to cleaning is lower in our sample.

Several other works have studied FSCLim, however using different methodologies and components, thus making it difficult the comparison of results, as already referred for FS knowledge. As such, a recommendation for future projects is the standardization of definitions and assessment methods in order to favor comparisons. Also, current evidence suggests that education and theoretical interventions are not good predictors of attitudes and practices in food service units (12-15). Therefore, such practices and attitudes should be assessed and related with both microbiologic results and sociodemographic and professional characteristics, in order to tailor future interventions and research projects.

Some limitations should be considered. First, the use of a small convenience sample with low geographic dispersion limits their generalization. Also, the participants' low level of education caused difficulties in understanding and answering some questions; this was in part overcome by an indirect application with some workers. The low response rate (55%) is also a limitation of our study. The length of the questionnaire may have reduced the participation, and we cannot rule out a participation bias. The leadership component of FSCLim was excluded, as it was not applicable to most of the food service units analysed; however, this difference should also be taken into account. On the other hand, as main strength of our study we highlight being the first one assessing and relating FSCLim and different dimensions of knowledge about FS in a sample of workers of higher education institutions' food service units.

Overall, our results suggest that low FS knowledge may lead to a more favorable perception on FSCLim. The fact that employees may consider that practices related to FS and hygiene are more adequate than they really are due to their low knowledge reveals the need to rethink training strategies, changing the focus from specific functions to the institutional FSCLim. Training courses should aim not only to increase knowledge about FS, but also to raise awareness about its overall impact on the organization.

CONCLUSIONS

Workers of Portuguese higher education institutions' service units present low knowledge about FS despite a high FSCLim. Overall FS knowledge and FSCLim scores did not significantly correlate, although some negative correlations were found between specific FS knowledge themes and FSCLim components: higher FSCLim regarding cleaning was associated with lower total knowledge and with lower knowledge about handling and cooking; higher knowledge about hygiene was associated with lower FSCLim related to commitment and to cleaning. Higher knowledge about FS is related with higher experience and training, but FSCLim was not related with personal or professional characteristics.

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CONFLICTS OF INTEREST

None of the authors reported a conflict of interest.

AUTHORS' CONTRIBUTIONS

JL, RP, AR: Conceptualization, methodology and writing; RP, AR: Validation; CL, BO, JV, BA: Formal analysis and investigation. All authors have read and agreed with the final version of the manuscript.

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