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Comparison of official food control results in Finland between food establishments with and without a certified food safety management system

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ABSTRACT

Certified food safety management systems (FSMSs), such as ISO 22000 and BRC, along with official food control, focus on food safety. European Union regulation 2017/625 requires to take FSMSs and their audits into account in official food control. To assess the possibility to decrease official food control frequency due to certified FSMSs the association of certified FSMSs on food business operators' (FBO) compliance was examined. The results of 1484 official inspections of 110 Finnish food establishments representing slaughterhouses, other meat establishments, fish and milk establishments, and bakeries with ($n = 59$) and without ($n = 51$) certified FSMS were studied over the period of 2016–2018. Altogether, 14 356 scores were given to 87 different items during the inspections. The comparison of scores between food establishments with and without certified FSMS discovered minor differences: 98.3% and 98.0% of inspected items in food establishments with and without a certified FSMS, respectively, did not impair food safety. The association between certified FSMSs and food establishments' compliance was inconsistent in different establishment types and among inspected items. Therefore, the results do not support a decrease in the frequency of official food control inspections merely based on the existence of a certified FSMS. Instead, the results advocate for an individual assessment of the FBO's inspection frequency, based on the history of compliance.

1. Introduction

Food business operators (FBOs) are subjected to official food control such as inspections performed by the national food control authorities to ensure compliance with food safety legislation and thus food safety (CFIAA, 1997; EC 882/2004; EC 852/2004; FSMA, 2011; EU 2017/625). In addition, some FBOs have implemented voluntary food safety management systems (FSMSs) based on international food safety standards such as ISO 22000 or BRC (BRC, 2018; ISO, 2018). A third-party organization carry out certification audits to check whether the FSMS implemented by the FBO complies with the standard and issue a certificate when the requirements are fulfilled. Both certified FSMSs and official food control focus on food safety, which has led to discussions within the European Union (EU) and other countries about the utilization of certified FSMSs in official food control in order to decrease bureaucracy and costs (Turku, Lepistö, & Lundén, 2018; Wright, Palmer, Shahriyer, Williams, & Smith, 2018).

According to EU legislation, official food control should take into

account the results of quality assurance programmes when ascertaining compliance with food safety legislation (EU 2017/625 article 9). However, detailed instructions on how certified FSMSs should be taken into account in official food control, are not included in the EU legislation. In the Netherlands, Belgium and Denmark, FSMSs can decrease official food control inspection frequency (CFIA, 2016; Lepistö, Lundén, Turku, & Sukura, 2015; Räsänen & Vastamäki, 2016), whereas other countries like Finland contemplate how FSMSs could influence official food control (Lepistö et al., 2015; Räsänen & Vastamäki, 2016).

Previous studies in Finland have shown similarities and overlap in official food control inspections and FSMS audits (Lepistö et al., 2015; Turku, Lepistö, & Lundén, 2018), advocating for the utilization of certified FSMSs in official control. However, the results of official inspections and audits are not necessarily equivalent, as highlighted in an earlier study (Turku, Lepistö, & Lundén, 2018). Although the observed non-compliances in official food control inspections and non-conformities discovered in audits concerned the same areas, the number of them varied for example in cleaning, cross-contamination and

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hygienic methods, complicating the use of FSMSs in official food control (Turku, Lepistö, & Lundén, 2018). On the other hand, former studies have indicated food safety improvement due to the implementation of FSMSs (Dzwolak, 2017; Fernández-Segovia, Pérez-Llácer, Peidro, & Fuentes, 2014; Psomas & Kafetzopoulos, 2015; Qijun & Batt, 2016). However, there is a lack of information on whether FBOs with certified FSMSs show higher compliance with food safety legislation than FBOs without certified FSMSs.

In Finland, official food control is based on a disclosure system called 'Oiva'. Official food control inspects different items described in the Oiva guidelines (FFA, 2020). The items represent specific requirements, which are based on food safety legislation. During the inspection the inspector scores each inspected item from A to D (A = Excellent, B = Good, C = To be corrected, D = Poor) based on the observations and the evaluation guidelines (FFA, 2020). Items fully compliant with the legislation are scored A, and items with minor issues which do not impair food safety or mislead consumers are scored B. Items scored C impair food safety or mislead consumers, and lead to corrective actions, and score D illustrates jeopardized food safety or considerable misleading of consumers resulting in immediate corrective actions including administrative enforcement actions. In addition, the lowest score given to an inspected item defines the overall inspection score of the inspection.

Official inspections are charged according to the municipal food control fees and high compliance benefits FBOs – repeated high compliance with food safety legislation leads to a decreased inspection frequency in the Finnish system (FFA, 2017). Therefore, as FSMSs may improve food safety and possibly also compliance, the FSMSs may indirectly decrease inspection frequency and costs induced by the inspections. However, this does not meet the expectations of a scheme where a FSMS automatically decreases the official inspection frequency.

This study aimed to compare the official food control scores between the FBOs with and without certified FSMSs in order to examine if certified FSMSs have an impact on FBOs' compliance with food safety regulations. The results can be used to assess whether the existence of a certified FSMS could lead to decreased official food control.

2. Materials and methods

2.1. Characteristics of the establishments and data collection

In total 110 food establishments including slaughterhouses, other meat, fish and milk establishments and bakeries (59 with a certified FSMS and 51 without a certified FSMS) were examined. Altogether 14 356 scores given to 87 different items in 1484 official inspections over the years 2016–2018 were examined. The three-year study period was chosen since according to Oiva guidelines (FFA, 2020), every item shall be inspected at least once in every three years. The results of the Oiva inspections were received from the Finnish Food Authority.

Certification status of the food establishment was confirmed via the internet if the certificate was disclosed at the establishment's homepage and, if necessary, by direct contact with the FBO as there are no complete registers of food establishments' certification status. Food establishments with certified FSMS (certified food establishments) were classified by the production type and similar non-certified counterparts to the certified food establishments were selected from the data by taking into account the food establishment type, production output and location.

Production output of 2017 was used to describe the size of the establishments, with the exception of slaughterhouses, where the number of official veterinarians was used due to production output confidentiality. The location of food establishments throughout the country was considered as far as possible to include food establishments located in the district of every Regional State Administrative Agency (RSAA). The number of establishments in the two groups (certified food establishments and non-certified food establishments) was equal with the

exception of slaughterhouses. All high-capacity slaughterhouses were included in the study for providing the majority of the inspected meat in Finland. As a result, the number of certified and non-certified slaughterhouses is unequal. Descriptive statistics of the food establishments in the study are presented in Table 1.

Establishments in this study represent 8.7% of the inspected food establishments in Finland during the study period. The set-up of the study limits the number of included food establishments since, the aim was to compare official food control results of the food establishments of the same type and as similar production output as possible, having the status of FSMS as the main disjunctive factor between the food establishments. Especially, the production output limits the number of suitable food establishments for this study as 79% of the manufacturing food businesses in Finland are micro-sized businesses (Statistics Finland, 2020), whereas most of the businesses with a certified FSMS are bigger in size. Consequently, a large number of establishments could not be included in the study as they did not have a corresponding counterpart.

2.2. Statistical analysis

Statistical analysis was performed using SPSS Version 25.0 (IBM, Armonk, NY, USA) and SAS 9.4 (SAS Institute Inc., Cary, NC, USA). Fig. 1 was created with R 4.0.0 (R Core Team, 2021). Scores of the inspected items were compared between certified food establishments and non-certified food establishments using Mann-Whitney *U* test. All of the scores of each item were first compared between certified and non-certified food establishments. Then, the same comparison was done separately by establishment type between the certified and non-certified food establishments (slaughterhouse, meat establishment, fish establishment, milk establishment and bakery).

In addition, the overall inspection score within food establishment types between certified and non-certified food establishments was examined. To account for confounding variables and non-independence caused by several inspections per establishment, generalized estimating equations (GEE) with identity link function and exchangeable working correlation structure was used in these analyses. Overall inspection score was converted into numerical variable (A = 4, B = 3, C = 2 and D = 1), which was used as a dependent variable. Independent variable was certification/non-certification and establishment was incorporated as repeated term. Production output, location of the establishment (RSAA) and preannouncement of the inspection were considered as possible confounding variables. Association of these variables to dependent and independent variables was assessed using Chi-squared or Fisher's exact test. If any of these variables was associated to both dependent and independent variable, it was included in the analysis as confounding variable. Because of the wide range in the production output, it was handled as grouped variable with four levels. Interactions between certification/non-certification and confounding variables were examined and if interaction was found, analyses were done separately on each class of confounding variable. Similar analyses were also performed between certified and non-certified food establishments with all inspected items pooled into same analysis among establishment type. Statistical difference was defined as *p*-value < 0.05. Multiple comparisons were not made because of the exploratory nature of the study (Rothman, 1990).

3. Results

Certified food establishments had statistically significantly better scores than non-certified food establishments when the scores of every inspected item from all establishment types were considered together (Mann Whitney *U* test, *p*-value < 0.001) (Table 2). However, of the scores given to all inspected items, 98.3% and 98.0% consisted of scores A and B in certified and non-certified food establishments, respectively (Table 2). When examining differences in scores at the level of single inspected items, we found statistically significant difference (*p*-value

Table 1
Descriptive statistics of food establishments in the study.

Food establishment type	Number of certified establishments	Production output kg/year mean (min–max)	Number of non-certified establishments	Production output kg/year mean (min–max)
Slaughterhouse	11	3.1 (2–6) ^a	3	1.3 (1–2) ^a
Meat establishment	15	2 794 903 (200 000–9 000 000)	15	1 674 654 (150 000–11 122 000)
Fish establishment	14	1 141 350 (95 000–5 000 000)	14	1 262 782 (200 000–5 000 000)
Milk establishment	6	32 446 153 (680 000–11 7000 000)	6	46 129 191 (100 000–203 035 429)
Bakery	13	7 631 439 (500 000–27 377 531)	13	1 024 694 (400 000–3 450 000)
Total	59		51	

^a Production output of the slaughterhouses is classified information. The number of official veterinarians at the slaughterhouse is used as an indication of the size of the establishment. In Finland, the number of official veterinarians varies between 1 and 6, depending on the slaughterhouse’s production output.

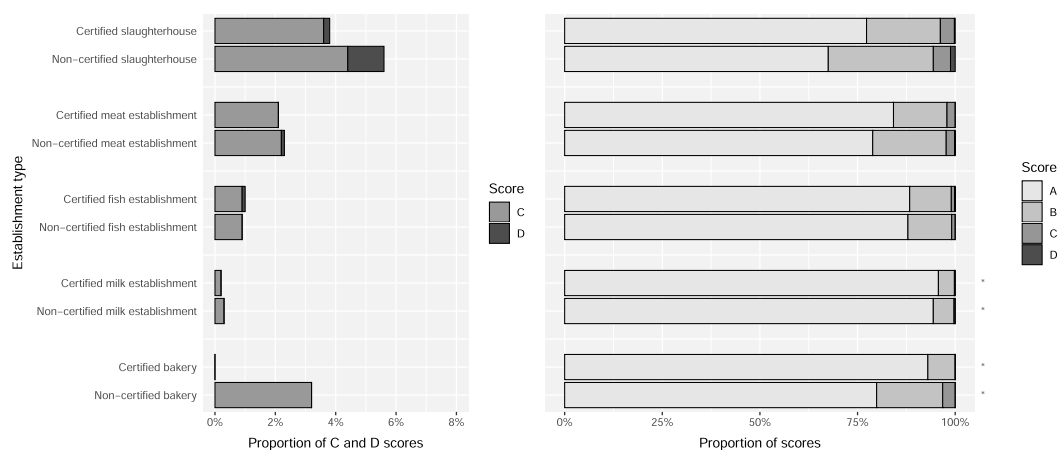


Fig. 1. Distribution of scores for all inspected items (n = 14 356) and distribution of C and D scores according to food establishment (n = 110) type and status of certification. The asterisk* indicates statistically significant difference in scores between certified and non-certified food establishment in generalized estimating equations analysis (GEE). In milk establishments statistically significant difference was found only in one Regional State Administrative Agency (RSAA).

<0.05) between certified and non-certified food establishments in 17 items out of the 87 items (19.5%). Certified food establishments had better scores in all of these items, with the exception of two items (items 4.1 Working hygiene of personnel and 5.1 General hygiene of food production) (Table 2).

Significant differences (Mann Whitney U test) were identified in the distribution of scores in 24 items within the establishment types (Table 3). However, the identified differences were not consistent between different establishment types (Table 3). In meat establishments and bakeries nine items showed a significant difference in the distribution of scores between certified and non-certified food establishments, whereas in milk establishments, only one item (3.2 Cleanliness of surfaces, fixtures, equipment and utensils) (Table 3). Most of the significant differences were in favour of certified food establishments (21/24 items), whereas three items showed significantly better scores in non-certified meat and fish establishments (4.1 Working hygiene of personnel, 5.1 General hygiene of food production and 5.3 Hygiene of water supply point and equipment using water) (Table 3). None of the items showed a significant difference in scores between certified and non-certified food establishments in all establishment types (Table 3).

The proportion of scores C and D was highest in non-certified (5.6%) and certified slaughterhouses (3.8%), whereas no C or D scores were detected in certified bakeries (Fig. 1). In addition, non-certified slaughterhouses had the lowest proportion of A scores (Fig. 1). The GEE analysis revealed that, the association between the scores and the certification status differed between establishment types. The analysis

including all scores revealed a significant difference in the compliance between certified and non-certified bakeries (adjusted mean score 3.94 and 3.69, respectively, p = 0.002) (Fig. 1). An interaction was found between certification status and RSAA districts in milk establishments, which means that effect of certification differed between RSAA districts; significant differences were observed within the district of one RSAA, although the differences were small (adjusted mean score 3.95 and 3.90, respectively, p < 0.001) (Fig. 1).

The GEE analysis of the overall score of the inspections also revealed significant differences between certified and non-certified bakeries (adjusted mean score 3.74 and 3.26, respectively, p = 0.01) and within one RSAA district between certified and non-certified milk establishments (adjusted mean score 3.68 and 3.38, respectively, p < 0.0001) (Table 4). No significant differences were observed within slaughterhouses, other meat establishments or fish establishments (Table 4).

4. Discussion

The analysis of all of the scores given to the inspected items suggest that the certified FSMSs may have some positive impact on food safety compliance. This finding was not a surprise since several studies have shown improvement in different areas of food safety due to FSMSs (Dzwolak, 2017; Escanciano & Santos-Vijande, 2014; Fernández-Segovia et al., 2014; Osés et al., 2012; Psomas & Kafetzopoulos, 2015; Qijun & Batt, 2016; Rajkovic et al., 2017; Sampers, Jacxsens, Luning, Marcelis, & Dumoulin, 2010; Tsola, Drosinos, & Zoioopoulos, 2008).

Table 2
Distribution of scores in inspected items with statistical difference between certified and non-certified food establishments.

Inspected items	Certified food establishments						Non-certified food establishments						p-value Mann-Whitney
	Number of inspected establishments	Number of scores of inspected items	Scores (%)				Number of inspected establishments	Number of scores of inspected items	Scores (%)				
			A	B	C	D			A	B	C	D	
1.2 Approval of activities	52	111	97.3	2.7	0	0	46	94	89.4	8.5	2.1	0	*
1.6 General compliance of own-check requirements	41	126	93.7	5.6	0.8	0	34	130	74.6	20.8	4.6	0	***
3.3 Cleanliness of cleaning equipment storage and cleaning equipment	12	35	94.3	5.7	0	0	13	39	71.8	23.1	5.1	0	*
4.1 Working hygiene of personnel	58	457	80.1	16.6	3.3	0	50	316	89.2	9.5	1.3	0	**
4.2 Hand hygiene	14	46	100	0	0	0	13	38	86.8	13.2	0	0	*
4.4 Monitoring of employees' health status	50	101	98.0	2.0	0	0	42	87	87.4	11.5	1.1	0	**
4.5 Instruction, guidance and training of personnel	54	121	94.2	5.8	0	0	42	104	85.6	12.5	1.9	0	*
5.1 General hygiene of food production	54	245	83.7	13.5	2.7	0	39	135	91.3	8.0	0.7	0	*
6.2 Temperature management in chilled facilities	55	200	96.0	3.5	0.5	0	50	258	90.7	7.0	1.9	0.4	*
6.7 Temperature management of dispatched carcasses	4	8	100	0	0	0	2	5	20.0	40.0	40.0	0	*
6.8 Temperature management of water used in disinfection of working utensils	19	66	87.9	10.6	1.5	0	10	29	48.3	48.3	3.4	0	***
13.2 Nutrition labelling	47	79	93.7	6.3	0	0	37	80	71.3	21.3	7.5	0	***
15.4 Dispatch of foodstuffs, commercial documents and transport conditions	23	35	100	0	0	0	20	45	86.7	13.3	0	0	*
17.1 Sampling and own-check tests	58	216	93.1	5.6	1.4	0	44	148	84.5	14.9	0.7	0	*
17.4 National salmonella control in meat sector	16	52	96.2	3.8	0	0	8	22	72.7	27.3	0	0	**
17.5 Own-check of EHEC ^a	4	12	100	0	0	0	3	7	28.6	71.4	0	0	*
18.1 Display of the Oiva report	54	219	96.8	3.2	0	0	45	231	91.3	8.2	0.4	0	*
Total		7974	86.1	12.2	1.7	0.1		6382	83.1	14.9	1.8	0.1	***

p < 0.05*.

p < 0.01**.

p < 0.001***.

^a Enterohaemorrhagic *Escherichia coli*

However, the official inspections consist of the inspection of 87 items (FFA, 2020) and our study revealed that certified food establishments had significantly better scores in 15 items. Hence, in most of the inspected items the compliance did not differ significantly between certified and non-certified food establishments.

The analysis of the distribution of the scores in different food establishment types did not reveal any items where certified food establishments would have had better scores in every establishment type. For instance, certified meat establishments showed significantly better scores in eight items (for example cleanliness and general compliance of own-check requirements), but in the item concerning personnel's working hygiene the scores were significantly better in non-certified meat establishments. In addition, non-compliances impairing food safety were discovered in both certified and non-certified meat

establishments. Expectedly, this was also discovered in the slaughterhouses, since non-compliances are common in Finnish slaughterhouses (Luukkanen & Lundén, 2016). Inevitably, a certified FSMS may not guarantee full compliance with food safety regulations as situations where compliance is not met can occur for various reasons in any establishment. Even though various studies have indicated food safety improvement due to the implementation of FSMSs (Dzwolak, 2017; Fernández-Segovia et al., 2014; Psomas & Kafetzopoulos, 2015; Qijun & Batt, 2016) the implementation of FSMS may be challenging since employee resistance to change, high costs, lack of awareness of requirements, lack of technical knowledge and skills of the employees are common reasons behind inadequate implementation of FSMS (Mensah & Julien, 2011). In addition, official food control inspections and third-party audits are carried out at different time and the criteria used

Table 3
Inspected items of certified and non-certified food establishments with statistical difference in distribution of scores.

Inspected items	Number of inspected items	Slaughterhouse	Meat establishment	Fish establishment	Milk establishment	Bakery
1.2 Approval of activities	205	–	–	–	–	X
1.6 General compliance of own-check requirements	256	–	X	–	–	–
2.2 Maintenance of facilities and structures	577	X	–	–	–	–
2.3 Maintenance of fixtures, equipment, water equipment and utensils	509	X	–	–	–	–
3.1 Cleanliness and order of facilities and structures	941	–	–	–	–	X
3.2 Cleanliness of surfaces, fixtures, equipment and utensils	862	–	X	–	X	–
3.3 Cleanliness of cleaning equipment storage and cleaning equipment	74	–	–	–	–	X
3.5 Pest control	311	–	X	–	–	X
4.1 Working hygiene of personnel	773	–	A	–	–	–
4.2 Hand hygiene	84	–	–	–	–	X
4.3 Working clothes and protective clothing of personnel	741	–	–	–	–	X
4.4 Monitoring of employees' health status	188	–	X	–	–	–
4.5 Instruction, guidance and training of personnel	225	–	X	–	–	–
5.1 General hygiene of food production	383	–	–	A	–	–
5.3 Hygiene of water supply point and equipment using water	401	–	–	A	–	–
5.5 Hygiene in wrapping and packing	368	–	–	X	–	–
5.6 Hygiene in storage and warehousing of foodstuffs	448	–	X	–	–	–
6.2 Temperature management in chilled facilities	458	–	X	–	–	X
6.7 Temperature management of dispatched carcasses	13	X	–	–	–	–
6.8 Temperature management of water used in disinfection of working utensils	95	X	X	–	–	–
13.1 General labelling	286	–	–	–	–	X
13.2 Nutrition labelling	159	–	–	–	–	X
17.1 Sampling and own-check tests	364	X	–	–	–	–
17.5 Own-check of EHEC ^a	19	X	–	–	–	–

X Scores of certified food establishments were better.

A Scores of non-certified food establishments were better.

^a *Enterohaemorrhagic Escherichia coli*.

Table 4

Distribution of the overall scores of inspections for food establishments 2016–2018. Grades were converted to numbers (A = 4, B = 3, C = 2, D = 1) and adjusted means were calculated using generalized estimating equations to account for correlation caused by non-independence of observations. If covariate was associated to certification status and to overall score, it was included in the analysis as confounder.

Food establishment type	Certified food establishments					Non-certified food establishments					Adjusted mean (95% CL)		p-value
	Number of inspections	Overall score (%)				Number of inspections	Overall score (%)				Certified	Non-certified	
		A	B	C	D		A	B	C	D			
Slaughterhouse	334	39.5	44.6	15.0	0.9	84	36.9	52.4	8.3	2.4	3.12 (2.86–3.38)	3.10 (2.62–3.58)	0.95
Meat establishment	274	41.2	46.0	12.8	0	208	39.9	47.6	12.0	0.5	3.52 (3.31–3.74)	3.47 (3.30–3.63)	0.73
Fish establishment	174	54.0	37.9	7.5	0.6	176	44.9	48.9	6.3	0	3.44 (3.22–3.66)	3.40 (3.25–3.54)	0.77
Milk establishment ^a	82	72.0	26.8	1.2	0	48	62.5	33.3	4.2	0			
RSAA Southern Finland	42	73.8	26.2	0	0	33	48.5	45.5	6.1	0	3.68 (3.60–3.75)	3.38 (3.33–3.43)	<0.0001
RSAA West and Inner Finland	32	78.1	21.9	0	0	15	93.3	6.7	0	0	3.77 (3.54–4.01)	3.91 (3.75–4.07)	0.36
RSAA North Finland	8	37.5	50.0	13	0	0	–	–	–	–			
Bakery	54	61.1	38.9	0	0	50	28.0	50.0	22.0	0	3.74 (3.57–3.91)	3.26 (2.99–3.53)	0.01

^a Interaction between certification/non-certification and Regional State Administrative Agencies (RSAA) statistically significant, analyses performed separately on each Regional State Administrative Agency.

for evaluating compliance with food safety regulations and FSMSs is different, further complicating the straightforward utilization of FSMSs in official food control.

The GEE analyses revealed a significant difference in compliance between the certified and non-certified bakeries; certified bakeries had only minor non-compliances whereas non-certified bakeries had also non-compliances impairing food safety. This suggests that the FSMS may have influenced the compliance positively. Though, it is noteworthy that due to challenges to find establishments with similar output, the production output of the certified bakeries in this study was clearly higher

than in non-certified bakeries. However, the production output was included in the analysis as confounding variable to minimize the effect of the production output to the results.

Increased safety and quality of milk products as well as increased employees' working discipline due to FSMSs have been discovered for example in Serbia (Tomašević et al., 2016). In this study milk establishments, both certified and non-certified, showed high compliance. An interaction was found between certification/non-certification and RSAA district, meaning that the effect of certification differed regarding the location of the food establishments. When looking at the RSAA districts

separately, a statistically significant difference was only found in one RSAA district in favour of certified milk establishments. This highlights that the associations between the presence of FSMSs and official food control results are not consistent throughout the country. Reasons behind this inconsistency were not investigated in this study. However, food safety culture and maturity of the certified FSMSs may differ between FBOs and some FBOs may have challenges in the implementation of FSMSs (Mensah & Julien, 2011). It is also possible that there are differences in the official food control assessments leading to inconsistencies.

The results of this study introduce an intriguing dilemma to be decided by the authorities; can official food control frequency be categorically decreased in certified food establishments or not? The analyses suggest a positive association between the FSMSs and compliance in bakeries, however, for the other food establishment types the results do not suggest this. These results support the present policy in Finland, which allows to decrease the inspection frequency due to repeated high compliance in official inspections regardless of the status of certification (FFA, 2017). Consequently, the FBO's individual inspection frequency should rather be considered by the local food control authorities than by general guidelines related to the presence of FSMS. An important question is also how infrequently food establishments could be inspected. This is a question that this study has not investigated but which should be addressed both from a food safety and food control credibility point of view.

The number of some establishment types in this study is relatively small. However, as described in the materials and methods section, the aim was to compare food establishments of the same type and production output, which limited the number of establishments. However, the total number of establishments and inspections is substantial, giving a good basis for drawing conclusions. It is also important to acknowledge that several inspectors have performed these inspections possibly assessing the findings at inspections differently. However, during the inspections the findings are assessed according to official Oiva guidelines (FFA, 2020), which has a unifying effect on the assessment. Further, it can be argued that the four-point scale does not discriminate compliance enough because the majority of the scores were A and B. Despite of this, the whole four-point scale was used and both C and D scores were also given during inspections, suggesting official food control being able to discriminate establishments based on different compliance. In addition, official food control assessment is based on the 4-point scale and possible changes in the inspection frequency is based on the results drawn from that scale. In addition, the maturity of the certified FSMS or the food safety culture of the FBOs were not assessed in this study although they can influence food safety and possible compliance.

5. Conclusions

Since official food control and FSMSs both focus on food safety and both incur costs, interest in exploitation of FSMSs in food control has increased. The results of this study indicated an inconsistent influence of certified FSMSs to compliance among different food establishment types and inspected items. Therefore, the results do not support a decrease in official food control merely based on the existence of a certified FSMS. Instead, the results advocate for an individual assessment of the FBO's inspection frequency, based on the history of compliance.

Data availability

The Oiva inspection records that support the findings of this study can be requested from the Finnish Food Authority. The researchers do not have permission to share the inspection results.

CRedit authorship contribution statement

N. Piira: Formal analysis, Writing – original draft, Writing – review & editing. **M. Kosola:** Formal analysis, Writing – original draft, Writing – review & editing. **C. Hellsten:** Writing – review & editing, Writing – original draft. **A. Fagerlund:** Writing – review & editing, Writing – original draft. All authors reviewed the manuscript. **J. Lundén:** Conceptualization, Methodology, Writing – review & editing, Supervision, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

- BRC. (2018). Global standard. *Food Safety*. https://www.scsglobalservices.com/files/program_documents/brc_food_standard_8.pdf. (Accessed 17 December 2020).
- CFIA. (2016). *Canadian food inspection agency. Private certification policy (food safety)*. <http://www.inspection.gc.ca/about-the-cfia/accountability/consultations-andengagement/regulatory-risk-based-oversight/private-certificationpolicy/eng/1452808755126/1452808821799>. (Accessed 17 December 2020).
- CFIAA. (1997). *Canadian food inspection agency act*. Government of Canada. <https://laws-lois.justice.gc.ca/PDF/C-16.5.pdf>. (Accessed 31 March 2021).
- Dzvolak, W. (2017). Assessment of food allergen management in small food facilities. *Food Control*, 73, 323–331. <https://doi.org/10.1016/j.foodcont.2016.08.019>
- EC 852/2004. (2004). Regulation (EC) No 852/2004 of the European parliament and of the council of 29 April 2004 on the hygiene of foodstuffs. *Official Journal of the European Union*, L226, 3.
- EC 882/2004. (2004). Regulation (EC) No 882/2004 of the European Parliament and of the Council of 29 April 2004 on official controls performed to ensure the verification of compliance with food and feed law, animal health and animal welfare rules. *Official Journal of the European Communities*, L165, 1.
- Escanciano, C., & Santos-Vijande, M. L. (2014). Reasons and constraints to implementing an ISO 22000 food safety management system: Evidence from Spain. *Food Control*, 40, 50–57. <https://doi.org/10.1016/j.foodcont.2013.11.032>
- EU 2017/625. (2017). Article 9. Regulation (EU) 2017/625 of the European Parliament and of the Council of 15 March 2017 on official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products, amending Regulations (EC) No 999/2001, (EC) No 396/2005, (EC) No 1069/2009, (EC) No 1107/2009, (EU) No 1151/2012, (EU) No 652/2014, (EU) 2016/429 and (EU) 2016/2031 of the European Parliament and of the Council, Council Regulations (EC) No 1/2005 and (EC) No 1099/2009 and Council Directives 98/58/EC, 1999/74/EC, 2007/43/EC, 2008/119/EC and 2008/120/EC, and repealing Regulations (EC) No 854/2004 and (EC) No 882/2004 of the European Parliament and of the Council, Council Directives 89/608/EEC, 89/662/EEC, 90/425/EEC, 91/496/EEC, 96/23/EC, 96/93/EC and 97/78/EC and Council Decision 92/438/EEC (Official Controls Regulation). *Official Journal of the European Union*, L95, 1.
- Fernández-Segovia, I., Pérez-Llácer, A., Peidro, B., & Fuentes, A. (2014). Implementation of a food safety management system according to ISO 22 000 in the food supplement industry: A case study. *Food Control*, 43, 28–34. <https://doi.org/10.1016/j.foodcont.2014.02.042>
- FFA. Finnish Food Authority. (2017). *Risk classification of food premises and determination of inspection frequency*. [eviran_ohje_10503_2.fi_huoneiston-riskiluokitusta.pdf](http://www.eviran_ohje_10503_2.fi_huoneiston-riskiluokitusta.pdf) (ruokavirasto.fi). (Accessed 18 December 2020).
- FFA. Finnish Food authority. (2020). Oiva evaluation guidelines for approved food establishments. <https://www.oivahymy.fi/wp-content/uploads/2019/01/heh-2019-eng-kooste-7.1.2019.pdf>. (Accessed 17 December 2020).
- FSMA. (2011). *Food safety modernization act*. US Food & Drug Administration. <https://www.govinfo.gov/content/pkg/PLAW-111publ353/pdf/PLAW-111publ353.pdf>. (Accessed 31 March 2021).
- ISO 22000. (2018). *Food safety management systems — requirements for any organization in the food chain*. <https://www.iso.org/obp/ui/#iso:std:iso:22000:ed-2:v1>. (Accessed 17 December 2020).
- Lepistö, O., Lundén, J., Turku, M., & Sukura, O. (2015). *Utilization of food safety standards in the official food control in Finland* (only in Finnish) <http://www.laatusertifikaatit.fi/wp-content/uploads/2015/11/Laatusertifointien-hy%C3%B6dynt%C3%A4mine>

- n-suomalaisessa-elintarvikevalvonnassa.-Loppuraportti-03112015.pdf. (Accessed 17 December 2020).
- Luukkanen, J., & Lundén, J. (2016). Compliance in slaughterhouses and control measures applied by official veterinarians. *Food Control*, 68, 133–138. <https://doi.org/10.1016/j.foodcont.2016.03.033>
- Mensah, L. D., & Julien, D. (2011). Implementation of food safety management systems in the UK. *Food Control*, 22, 1216–1225. <https://doi.org/10.1016/j.foodcont.2011.01.021>
- Osés, S. M., et al. (2012). Food safety management system performance in the lamb chain. *Food Control*, 25, 493–500. <https://doi.org/10.1016/j.foodcont.2011.11.018>
- Psomas, E. L., & Kafetzopoulos, D. P. (2015). HACCP effectiveness between ISO 22000 certified and non-certified dairy companies. *Food Control*, 53, 134–139. <https://doi.org/10.1016/j.foodcont.2015.01.023>
- Qijun, J., & Batt, P. J. (2016). Barriers and benefits to the adoption of a third party certified food safety management system in the food processing sector in Shanghai, China. *Food Control*, 62, 89–96. <https://doi.org/10.1016/j.foodcont.2015.10.020>
- R Core Team. (2021). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. <https://www.R-project.org/>.
- Rajkovic, A., et al. (2017). The performance of food safety systems in the raspberries chain. *Food Control*, 80, 151–161. <https://doi.org/10.1016/j.foodcont.2017.04.048>
- Räsänen, L., & Vastamäki, P. (2016). Exploitation of certified food safety management systems. *Elintarvike- ja Terveys*, 3, 12–15 (only in Finnish).
- Rothman, K. J. (1990). No adjustments are needed for multiple comparisons. *Epidemiology*, 1, 43–46.
- Sampers, I., Jacxsens, L., Luning, P. A., Marcelis, W. J., & Dumoulin, F. H. J. N. (2010). Performance of food safety management systems in poultry meat preparation processing plants in relation to *Campylobacter* spp. contamination. *Journal of Food Protection*, 73(8), 1447–1457. <https://doi.org/10.4315/0362-028X-73.8.1447>
- Statistics Finland. (2020). *Enterprises by industry and size class in personnel 2018 (Manufacture of food products)*. ISSN=2342-6217. Helsinki: Tilastokeskus. <http://www.stat.fi/til/yrti/index.html>. (Accessed 17 December 2020).
- Tomašević, I., et al. (2016). Evaluation of food safety management systems in Serbian dairy industry. *Mljekarstvo*, 66(1), 48–58. <https://doi.org/10.15567/mljekarstvo.2016.0105>
- Tsola, E., Drosinos, E. H., & Zoiopoulos, P. (2008). Impact of poultry slaughter house modernisation and updating of food safety management systems on the microbiological quality and safety of products. *Food Control*, 19(4), 423–431. <https://doi.org/10.1016/j.foodcont.2007.05.003>
- Turku, M., Lepistö, O., & Lundén, J. (2018). Differences between official inspections and third-party audits of food establishments. *Food Control*, 85, 459–465. <https://doi.org/10.1016/j.foodcont.2017.10.031>
- Wright, M., Palmer, G., Shahriyer, A., Williams, R., & Smith, R. (2018). *Assessment and comparison of third party assurance schemes in the food sector: Towards a common framework. Final report for the Food Standards Agency CR2435 R2 V8. Microsoft Word - GSB CR2435 3rd Party Assurance Scheme R2 V8 FCA (food.gov.UK)*. . (Accessed 18 December 2020).