



Efficacy of disclosed food safety inspections in restaurants

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ABSTRACT

Noncompliances that decrease food safety are commonly detected in food safety inspections at restaurants, and challenges in correcting the noncompliances have been reported. Disclosure of inspection results has been used as a tool to decrease the rate of noncompliances by increasing motivation to attain and maintain compliance with regulations. However, the efficacy of disclosed inspection results is not well understood. In addition, pre-announcement of the inspection and inspection interval may have an impact on the efficacy of inspections. In this longitudinal retrospective study based on disclosed restaurant inspections in Finland from the years 2017–2018, we examined the stability of compliance, correction of noncompliances at the item level, association of pre-announcement with item-specific grades and association of inspection interval with compliance. The results show that compliance (inspection result Excellent) was maintained between two consecutive inspections in 60.5% of the restaurants. The inspection result To be corrected (C) improved in 72.3% and Poor (D) in 33.3% of the restaurants to an Excellent (A) or Good (B) result. Still, some noncompliances in items crucial to food safety were not corrected. This demonstrates that disclosure alone is not sufficient; other measures are also needed in food control. The inspection interval did not reveal any significant association with the stability of compliance. The proportions of C and D grades were at minimum twofold in unannounced compared to preannounced inspections in most inspected items. Unannounced inspections are therefore necessary to receive an accurate impression of the inspected items on the premises.

1. Introduction

The World Health Organization has estimated that 31 food safety hazards including pathogens and chemical agents caused the global burden of 33 million disability-adjusted life years in 2010 (Havelaar et al., 2015). Although foodborne illnesses are more prevalent in low-income countries, they are not uncommon in high-income countries (Havelaar et al., 2015; Scallan et al., 2011). Many of the recorded foodborne outbreaks have originated from restaurants (Centers for Disease Control and Prevention, 2017; European Food Safety Authority & European Centre for Disease Prevention, 2019). Foodborne outbreaks connected to restaurants have often been associated with improper food-handling practices (Angelo, Nisler, Hall, Brown, & Gould, 2017; Gould, Rosenblum, Nicholas, Phan, & Jones, 2013). Restaurant operations are regulated by the legislation to ensure food safety, and official inspections verify compliance of the restaurants (EC No 625/2017). Food safety inspectors have often detected noncompliances in operations relevant to food safety during restaurant inspections (Läikkö-Roto,

Mäkelä, Lundén, Heikkilä, & Nevas, 2015; Leinwand, Glanz, Keenan, & Branas, 2017). Despite inspector remarks and food safety risks caused by noncompliances, noncompliances have frequently been uncorrected, as observed during consecutive inspections in the restaurants (Läikkö-Roto et al., 2015).

Therefore, to improve food safety by improving the efficacy of restaurant inspections and to provide food safety information to consumers in support of their dining decisions, disclosure systems have been implemented particularly in the restaurant sector in many countries (Filion & Powell, 2009). In Finland, food control results of the restaurants have been disclosed since 2013 in the form of Oiva reports. In the Oiva report, the largest emoji symbol represents the result of the inspection and separate smaller smileys represent the grades given for subsections such as ‘Cleanliness of facilities, surfaces and equipment’, consisting of items such as ‘General order and cleanliness of facilities’ (Finnish Food Authority, 2020). Noncompliances affecting food safety or misleading consumers result in a grade represented with a straight-faced or a frowning symbol in the report and a reinspection

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(Finnish Food Authority, 2020). The inspection result grade is determined by the lowest grade of inspection. Following the same principle, the grades of subsections are determined by the lowest item-specific grades.

Disclosure systems have been demonstrated to improve inspection grades (Choi & Scharff, 2017; Wong et al., 2015), and food business operators have reported that disclosure of the inspection results enhances the correction of noncompliances (Kaskela, Vainio, Ollila, & Lundén, 2019). However, we do not know in detail how effectively the detected noncompliances are corrected and to what extent compliance is maintained over the time in the Oiva system or in other disclosure systems. According to our knowledge, there are no published studies comparing consecutive inspections and focusing on the stability of the compliance and the correction of noncompliances at the item level in the context of the disclosure system. This information is important to elucidate in order to not only assess potential shortcomings in the efficacy of the disclosure system but also to improve efficacy.

The true situation in the food premises may be unrevealed if the inspection time is announced in advance, as observed in previous studies (Makofske, 2019; Nwako, 2017; Waters et al., 2013), because noncompliances may be corrected before the inspection. If noncompliances are corrected just for the inspection visit, noncompliances may reoccur after the preannounced inspection, decreasing food safety. However, preannounced inspections can also be beneficial; on preannounced inspections, the inspector might better succeed at giving guidance to the food business operator, when needed, since the food business operator would have the opportunity to organise time to attend the inspection. Thus, preannounced inspections may increase the impact through guidance given on inspections (Reske, Jenkins, Fernandez, Vanamber, & Hedberg, 2007). Consequently, an inspection programme combining unannounced inspections with preannounced guidance-focused inspections could be more effective than using only unannounced inspections. If some inspections are preannounced, the inspector needs to be aware of how the preannouncement can affect the compliance on an item level. However, the studies on the association of preannounced inspections with the noncompliances in different items are sparse.

Furthermore, inspection frequency has been suggested to affect compliance of the food business operators, but the results of the studies are contradictory (Allwood, Lee, & Borden-Glass, 1999; Leinwand et al., 2017; Liggans, Boyer, Williams, Destromp, & Hoang, 2019; Medu et al., 2016; Newbold, McKeary, Hart, & Hall, 2008). In addition, only few studies have focused on the association of inspection frequencies less than once per year with compliance. Yet, many of the restaurants are inspected less than once per year (Leinwand et al., 2017).

The aims of this study were: 1) to investigate the efficacy of disclosed Oiva inspections by analysing the correction of noncompliances and the stability of compliance in different inspected items in restaurants, 2) to investigate the association of preannounced inspections on the noncompliance detection rate in different inspected items and, 3) to examine the association of inspection interval on compliance. The results can be used to develop food control systems.

2. Materials and methods

2.1. Oiva system and inspections

Routine food safety inspections and reinspections of all restaurants in Finland (excluding the autonomous region of Åland Islands) are conducted according to the Oiva system and are therefore called Oiva inspections. The Oiva system, launched in 2013, introduced the grading of the inspected items into food control together with detailed grading guidelines (Finnish Food Authority, 2020) and uniform inspection reports. The inspection reports include detailed, item-specific information of noncompliances, while disclosed Oiva reports include information of noncompliances only at the level of subsections that consist of several items. Inspection reports are delivered to food business operators and

recorded to the database of Finnish Food Authority.

2.2. Inspection report data and data subsets

Routine and reinspection reports of all restaurants inspected according to Oiva system in Finland from the years 2017 and 2018 were requested from the Finnish Food Authority for use in this study. Inspection reports include information about the inspection result and item-specific grades of each inspection. The grading scale includes the grades Excellent (no noncompliances detected, A), Good (only minor noncompliances detected, B), To be corrected (noncompliances decreasing food safety or misleading consumers or repeated minor noncompliances detected, C) and Poor (noncompliances endangering food safety or misleading consumers or repeated C noncompliances, D). Reinspection should follow inspections with grades C and D. In addition, the inspection date, regional administrative agency and preannouncement status of the inspections were included in the reports.

The inspection report of the first routine inspection of the study period for each restaurant ($n = 8139$) was included in the analyses of the association of preannouncement with C and D grades (Table 1). Only routine inspections were included to eliminate the effect of an initiated reinspection process. Further, the association of the preannouncement of the preceding inspection with correction of noncompliances was examined by using the second unannounced inspections ($n = 3013$) (Table 1).

In addition to the first routine inspection report, the second inspection report for the restaurant ($n = 3664$) was included in the analyses on the change in grades between consecutive inspections: all inspection reports were included in item-specific analyses ($n = 3664$) and only unannounced first routine and unannounced second inspections were used in inspection result change analyses ($n = 2652$) (Table 1). Those restaurants that received an inspection result C in the first unannounced routine inspection and improved the inspection result in the second unannounced inspection, as well as the grades of the third unannounced inspection ($n = 189$), were examined to study the stability of improvement. The same subset of unannounced inspections as for the analysis on change in inspection result grades between consecutive inspections was also used to analyse the association of the inspection interval with compliance. The association of the inspection interval and compliance was examined for restaurants with the inspection result A or B in the first inspection. The inspection interval was divided into the following groups: ≤ 12 , 13, 14, 15–16, 17–18 and ≥ 19 months.

Change in grades between two consecutive inspections was analysed both at inspection-result level and item-specific level to evaluate the stability of compliance (i.e. maintaining a grade A between consecutive inspections) and correction of noncompliances. Respectively, the analyses of the association of preannouncement with grades were conducted at the inspection-result and item-specific level. The number of reports included in the item-specific analysis is smaller than in the analysis of the inspection-result grades as all items are not inspected at every inspection.

2.3. Statistical analyses

Statistical analyses were conducted using IBM SPSS 25 and R 3.6.2. A significance level of 0.05 was used. The association of the inspection result grades with the preannouncement of the inspections was evaluated with a Chi-Square test. The two-sided Fisher's exact test was used to test the statistical significance of the difference in the proportion of item-specific C and D grades between preannounced and unannounced first routine inspections. In addition, the two-sided Fisher's exact test was used to test the statistical significance of the difference in the proportion of 1) item-specific A grades of second unannounced inspections after item-specific B grade in the first routine preannounced or unannounced inspections and 2) item-specific A and B grades of second unannounced inspections after item-specific C grade in the first preannounced or

Table 1

Distribution of the inspection result grades in the subsets of the inspection report data in 2017–2018. A = Excellent, B = Good, C = To be corrected, D = Poor.

Inspection report subset	A		B		C		D		Total N
	%	n	%	n	%	n	%	n	
All inspections	32.7	4356	48.1	6411	18.5	2464	0.7	96	13,327
First routine inspections	34.1	2773	46.7	3804	18.9	1537	0.3	25	8139
Unannounced	29.4	1809	48.4	2975	21.9	1344	0.4	23	6151
Preannounced	48.5	964	41.7	829	9.7	193	0.1	2	1988
First routine inspections of the restaurants inspected also a second time	26.7	978	37.0	1356	35.7	1309	0.6	21	3664
Unannounced	28.0	844	39.4	1186	32.2	971	0.4	12	3013
Preannounced	20.6	134	26.1	170	51.9	338	1.4	9	651
Second inspections after the first routine inspections	33.9	1241	49.3	1806	16.2	593	0.7	24	3664
Unannounced	31.5	948	50.1	1511	17.6	531	0.8	23	3013
Preannounced	45.0	293	45.3	295	9.5	62	0.2	1	651
Unannounced second inspections after the first routine inspections	31.5	948	50.1	1511	17.6	531	0.8	23	3013
First routine inspection unannounced	31.7	841	50.2	1331	17.3	458	0.8	22	2652
First routine inspection preannounced	29.6	107	49.9	180	20.2	73	0.3	1	361
Third inspection of the restaurants receiving A or B in the second inspection after receiving C in the first inspection (only unannounced included)	14.8	28	54.0	102	30.2	57	1.1	2	189

unannounced routine inspections. The significance of the association between the inspection interval groups and inspection results was tested with a Chi-Square test.

The following transitions were standardised according to several variables, and confidence intervals were defined using the observed over expected analysis: A-A, A-C/D, B-A, B-C/D, C-A/B, C-D. Expected values were computed using logistic regression analysis. Variables taken into consideration for all transitions were the year of the first inspection, preannouncement statuses of the first and second inspections, actions taken at the first inspection (guidance, request and coercive measures) and inspection result of the first inspection. In addition, concerning all other transitions except C-D, the following variables were considered: the month of the first inspection, the area where the inspection took place (regional state administrative agency) and the share of inspected items. For the transitions from A and B grades, the proportion of items graded with B, C and D in the first inspection were also considered. Variables concerning preannouncement, guidance, request and coercive measures were dichotomic; the proportion of the items graded with B, C and D was categorised in groups low (among lowest 33%), mediocre and high (among highest 66%); and the share of inspected items was divided into quartiles. The item was plotted only if the number of restaurants was over 10.

3. Results

3.1. Grade distribution in the first routine inspection in 2017–2018

The most common inspection result of the restaurants' first routine inspection in 2017–2018 was B (46.7%) (Table 1). Grades varied between inspected items in the first routine inspection. Grade A was most often given for recalls (98.2%) and separation of product groups during selling and serving (97.8%) (Table 2). On the other hand, grade A was given least often, only in 60.6% of inspections, for chilling, which was also most often graded C (13.1%) (Table 2). Other items evaluated with a C grade more often than most were cold-stored foodstuffs (8.9%) and own-check plan and its controllability (7.6%) (Table 2). Grade D was given for 18 different items, yet the proportion of D grades did not exceed 0.2% (n = 1–6) in any of the items.

The inspection result B comprised on average 3.6 (median = 3) items graded with B, and inspections with an inspection result C had on average 3.4 (median = 3) items graded as C. In addition, restaurants with an inspection result C had a grade B on average for 4.0 (median = 4) items. Inspections with the result D had on average 2.1 (median = 2) items graded as D, 4.4 (median = 4) items graded as C and 3.1 (median = 3) items graded as B.

3.2. Change in grades between the consecutive inspections

3.2.1. Change in inspection results between the consecutive unannounced inspections

The inspection result (worst item-specific grade) A of the first routine inspection remained unchanged in 60.5% of the restaurants in unannounced inspections (Table 3). Grade B improved in 20.7% and decreased in 17.4% of the restaurants (Table 3). Grade C improved in 72.3%, remained unchanged in 25.8% and decreased only in 1.9% of the restaurants (Table 3). Out of the above-mentioned restaurants that improved their grade on the second inspection (from C in the first inspection), 31.2% received either an inspection result C (30.2%) or D (1.1%) in the third following unannounced inspection (Table 1). An inspection result D given in the unannounced first routine inspection improved to A or B in 33.3% of the restaurants (Table 3).

3.2.2. Change in item-specific grades between the consecutive inspections

Item-specific grades of the first routine inspection were compared to the corresponding item-specific grades of the following inspection to evaluate the stability of compliance and correction of noncompliances.

3.2.2.1. Change in A grades between the consecutive inspections. The median for the stability of A grades between the inspections was 92.2% for all of the items (range = 83.6–100.0% of the restaurants) (Fig. 1A). Grade A was least often maintained in general order and cleanliness of facilities (83.6%), cold-stored foodstuffs (83.8%) and chilling (83.8%) (Fig. 1A). Grades C or D followed a grade A most often in chilling (3.8%), cold-stored foodstuffs (3.7%), management of shelf-life and sale period in serving (3.0%) and risk management in production (2.4%) (Fig. 1B). Grade A dropped to a grade D only in the items of hand hygiene, hygiene of work practices and cold-stored foodstuffs. In the restaurants that received both A and other grades in the same inspection, a high proportion of B, C and D grades was associated with a lower stability of item-specific A (OR = 0.45, 95% CI = 0.33–0.61, p < 0.001) (Supplementary Table A.1).

3.2.2.2. Change in B grades between the consecutive inspections. The median probability for the correction of the item-specific grade B to A of all items was 63.3%, but the probability to improve varied between the items from 36.2% to 78.4% (Fig. 1C). Items with the most often improved grades were separation and cross-contamination (78.4%) and waste management (78.3%) (Fig. 1C). Items with a significantly lower probability for the improvement of grades than average were condition of premises (36.2%), suitability of facilities (43.3%), chilling (50.5%) and general order and cleanliness of facilities (53.1%) (Fig. 1C). Grade B dropped to grades C or D significantly more often than average in own-check plan (11.3%) and chilling (10.5%) (Fig. 1D). In addition, grades of

Table 2

Distribution of item-specific grades and proportion of To be corrected (C) and Poor (D) grades in unannounced and preannounced inspections. A = Excellent, B = Good, C = To be corrected, D = Poor. Statistical significance of difference between C and D grades in preannounced and unannounced inspections was tested with two-sided Fischer's exact test. Item-specific grades are presented when the number of grades per item is a minimum of 100. The first routine inspections (N = 8139) were included in this table.

Inspected item	Proportions of grades (%)				Unannounced N=6151		Preannounced N=1988		Unannounced(C+D)/ Preannounced(C+D)	p	
	A	B	C	D	Total (N)	C+D (%)	N	C+D (%)			N
	Recalls	98.2	1.7	0.1	0.0	842	0.0	637			0.5
Separation of product groups and hygiene during selling and serving	97.8	1.9	0.2	0.0	4508	0.3	3493	0.1	1015	2.6	0.47
Conditions in pick-up and delivery of foods	97.4	2.4	0.2	0.0	425	0.0	278	0.7	147	0.0	0.35
Waste management	95.4	3.7	0.9	0.0	3686	1.1	2646	0.4	1040	2.8	0.050
Hygiene of work practices used by personnel	95.0	4.0	1.0	0.0	5894	1.2	4521	0.6	1373	2.0	0.067
Separation and cross-contamination	94.6	4.7	0.7	0.0	4426	0.9	3259	0.3	1167	3.3	0.039
Vermin and other animals	94.6	4.7	0.6	0.0	3259	0.8	2366	0.2	893	3.8	0.056
Actions taken based on test results	93.8	4.6	1.5	0.0	582	1.9	466	0.0	116		0.22
Instruction, guidance and training of personnel	91.8	6.1	2.1	0.1	1698	2.9	1190	0.4	508	7.3	<0.001
Packaging	90.3	7.2	2.5	0.0	849	3.1	671	0.0	178		0.012
Traceability of foodstuffs	90.2	7.6	2.1	0.1	2224	2.4	1638	1.4	586	1.8	0.14
Management of shelf-life and sale period of products in sale of foods	88.9	8.6	2.5	0.0	1291	2.8	1048	1.2	243	2.2	0.25
Verification of hygiene proficiency	88.8	9.3	1.9	0.0	4884	2.5	3486	0.5	1398	5.0	<0.001
Risk control in food preparing	88.7	7.9	3.1	0.2	1241	4.2	926	1.0	315	4.4	0.0035
Packaging materials and other food contact materials	88.6	10.1	1.3	0.0	2696	1.7	1985	0.3	711	6.1	0.0021
Hand hygiene	87.8	10.3	1.9	0.0	7596	2.3	5758	0.8	1838	2.8	<0.001
Display of the Oiva report	87.7	11.5	0.8	0.0	4977	1.0	4237	0.1	740	7.5	0.017
Work clothes	86.9	11.6	1.5	0.0	7120	1.9	5429	0.2	1691	8.2	<0.001
Quick-freezing	86.7	9.1	4.2	0.0	757	5.4	594	0.0	163		<0.001
Temperature management in transport	86.1	9.3	4.6	0.0	410	6.1	261	2.0	149	3.0	0.085
Storage of foodstuffs	85.0	12.5	2.5	0.1	7015	3.2	5293	0.6	1722	5.0	<0.001
Cleanliness of working utensils and equipment	84.7	12.2	3.1	0.1	7800	4.0	5893	0.6	1907	6.3	<0.001
Reception of foodstuffs	83.2	12.9	3.9	0.0	3645	4.6	2678	1.9	967	2.5	<0.001
Suitability of facilities for use as food premises	82.4	13.9	3.6	0.0	6189	4.3	4425	1.9	1764	2.3	<0.001
Hot-stored foods	82.0	12.3	5.7	0.0	2622	6.8	2016	1.8	606	3.8	<0.001
Own-check plan and its controllability	81.9	10.4	7.6	0.1	5947	9.3	4233	3.5	1714	2.7	<0.001
Working utensils, fixtures and equipment	81.0	16.1	2.8	0.0	6284	3.6	4559	0.9	1725	3.9	<0.001
General labelling	77.3	20.7	1.9	0.0	3111	2.4	2383	0.4	728	5.8	<0.001
Monitoring of employees' health status	76.7	17.0	6.3	0.0	2455	7.9	1789	2.0	666	4.0	<0.001
Adequacy of the own-check plan	76.3	20.7	3.0	0.0	4432	3.6	2987	1.7	1445	2.1	<0.001
Management of shelf-life and sale period of products in serving of foods	75.7	16.7	7.5	0.1	5728	8.8	4402	3.4	1326	2.6	<0.001
Condition of premises	75.1	21.9	3.0	0.0	6345	3.5	4598	1.5	1747	2.3	<0.001
Foodstuffs with protected status	75.0	23.7	1.3	0.0	156	1.7	115	0.0	41		1.00
Cleanliness of the space for cleaning equipment and cleaning equipment	75.0	20.7	4.2	0.0	7483	5.3	5626	1.1	1857	4.9	<0.001
Sampling referred to in the own-check plan	74.8	19.8	5.3	0.1	1509	6.3	1197	1.9	312	3.3	0.0017
General order and cleanliness of facilities	73.3	21.2	5.5	0.1	7992	6.7	6042	1.9	1950	3.4	<0.001
Cold-stored foodstuffs	71.6	19.3	8.9	0.1	7906	10.6	5992	4.0	1914	2.7	<0.001
Chilling	60.6	26.2	13.1	0.1	3938	15.1	3038	7.0	900	2.2	<0.001

management of shelf-life and sale period in serving (8.9%) and cold-stored foodstuffs (7.7%) dropped often to C or D grades (Fig. 1D). A high proportion of B, C and D grades of all the item-specific grades on the first inspection was associated with less improvement of B grade (OR = 0.56, 95% CI = 0.36–0.87, p = 0.011) (Supplementary Table A.2).

3.2.2.3. *Change in C grades between the consecutive inspections.* The median probability for the correction of the item-specific grade C to A or B was 83.1% (range = 60.1–94.3%) (Fig. 1E). The items with grades that least often improved were general labelling (60.1%), quick freezing (72.0%) and suitability of facilities for use as food premises (72.5%) (Fig. 1E). However, the median probability for the transition from a grade C to a grade D was only 1.5% (range = 0.0–4.6%) (Fig. 1F). In the restaurants that received both C and D grades in the first inspection, the C grade more often dropped to D in the second inspection (OR = 15.22, 95% CI = 1.97–117.67, p = 0.0091) (Supplementary Table A.3).

3.2.2.4. *Change in D grades between the consecutive inspections.* Altogether, 43 D grades were given in 16 items in 21 restaurants in the first routine inspection, which were followed by a second inspection in the

Table 3

The grades of the first routine inspections that were unannounced compared with the grades of the following inspections that were unannounced. N = 2652. A = Excellent, B = Good, C = To be corrected, D = Poor.

The first routine inspection result grade	The second inspection result grade							
	A		B		C		D	
	%	N	%	N	%	N	%	N
A	60.5	428	33.2	235	6.2	44		
B	20.7	216	61.9	647	17.3	181	0.1	1
C	22.1	196	50.2	446	25.8	229	1.9	17
D	8.3	1	25.0	3	33.3	4	33.3	4



Fig. 1. A–F. Item-specific grade change in restaurants with 95% confidence interval for each item. 1A: grade transition A-A; 1B: grade transition A-C/D; 1C: grade transition B-A; 1D: grade transition B–C/D; 1E: grade transition C-A/B; and 1F: grade transition C-D. A dashed line illustrates the mean for the transitions.

current data. Out of all item-specific grades, 51.2% improved to A, 23.3% to B, 11.6% to C and 14.0% remained unchanged. Items without any improvement were suitability of facilities for the use as food premises, reception of foodstuffs, display of the Oiva report, chilling, and management of shelf-life and sale period of product in serving foods.

3.3. Preannouncement of inspections and its association with grades

Out of the first routine inspections, 75.6% (6151/8139) were unannounced inspections. The inspection results varied significantly between the preannounced and unannounced first routine inspections (Chi-Square test $p < 0.001$). Inspection result A was more common in preannounced first routine inspections: 48.5% of the inspection results were A when the inspection was preannounced compared with 29.4% of unannounced inspections (Table 1). Further, the proportion of C and D

grades was higher in unannounced (21.9% and 0.4%, respectively) than preannounced first routine inspections (9.7% and 0.1%, respectively) (Table 1).

The proportion of item-specific C and D grades differed significantly between preannounced and unannounced inspections among the most items (Table 2). The proportion of C and D grades were minimum twofold in unannounced compared to preannounced inspections in all but three items (Table 2). The proportion of C and D grades was over seven times higher in unannounced compared to preannounced inspections in items concerning work clothes, the display of the Oiva report, and instruction, guidance and training of personnel (Table 2). Furthermore, when examining the change in item-specific grades, an unannounced first inspection associated with the higher stability of grade A (OR = 1.74, 95% CI = 1.48–2.05, $p < 0.001$) and lower probability for grade A dropping to a grade C or D (OR = 0.52, 95% CI =

B



Fig. 1. (continued).

0.35–0.77, $p = 0.0011$) (Supplementary Table A.1). The preannouncement of the first inspection was not associated with improved correction of noncompliances in the logistic regression models comprehending all items (Supplementary Table A.2 and A.3). When individual items were examined separately, the association of preannouncement of the first inspection with improved item-specific grades of the second unannounced inspection after item-specific grades B and C, was significant only in one item (Supplementary Table B). In addition, the proportions of improved grades among the restaurants with the preannounced first inspection were higher in many items on the second inspection but also contrary results were observed in many items. An unannounced second inspection associated with lower stability of an item-specific A grade (OR = 0.41, 95% CI = 0.34–0.50, $p < 0.001$) and less improvement of B (OR = 0.54, 95% CI = 0.45–0.64, $p < 0.001$) and C (OR = 0.23, 95% CI = 0.15–0.35, $p < 0.001$) grades (Supplementary Tables A.1, A.2 and A.3).

3.4. Inspection interval and its association with grades

Time intervals from the first routine inspection with grades A and B to the following inspection were examined. The median time interval from the first routine inspection to the following inspection for restaurants that received an inspection result A or B in the first routine inspection was almost the same (375 and 370 days, respectively). We did not observe distinct differences in the proportions of inspection results between different inspection intervals (Fig. 2) and the associations between inspection intervals and inspection results were not statistically significant (Chi-Square test, $p > 0.05$).

4. Discussion

On the first routine inspection, only 34.1% of the restaurants received an inspection result A, which means that two-thirds of the

C

Inspected item

Inspected item	n	%
Separation and cross-contamination	72	78.4
Waste management	56	78.3
Instruction, guidance and training of personnel	28	75.2
Quick-freezing	13	74.0
Hand hygiene	375	73.5
Hygiene of work practices used by personnel	105	73.3
Separation of product groups and hygiene during selling and serving	32	72.1
Packaging materials and other food contact materials	96	70.6
Management of shelf-life and sale period of products in sale of foods	39	70.4
Work clothes	370	69.3
Verification of hygiene proficiency	205	68.7
Storage of foodstuffs	435	68.4
Vermin and other animals	57	65.5
Management of shelf-life and sale period of products in serving of foods	374	65.2
Cleanliness of working utensils and equipment	489	65.1
Risk management in production	27	63.6
Reception of foodstuffs	154	63.5
Cold-stored foodstuffs	625	63.0
Cleanliness of the space for cleaning equipment and cleaning equipment	682	62.7
Hot-stored foods	109	61.8
Own-check plan and its controllability	200	60.1
Monitoring of employees' health status	110	60.1
General labelling	259	60.0
Sampling referred to in the own-check plan	99	59.4
Display of the Oiva report	265	59.2
Traceability of foodstuffs	54	58.5
Working utensils, fixtures and equipment	403	56.1
Adequacy of the own-check plan	254	55.7
Packaging	18	54.8
General order and cleanliness of facilities	802	53.1
Chilling	361	50.5
Foodstuffs with protected status	11	44.2
Suitability of facilities for use as food premises	267	43.3
Condition of premises	536	36.2

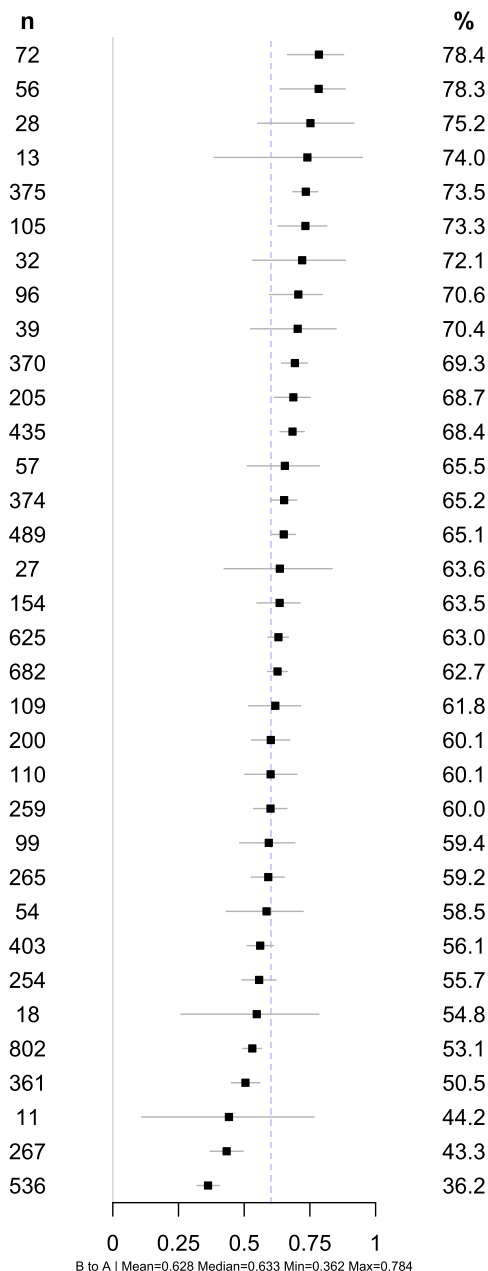


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restaurants had noncompliances. Noncompliances leading to grades B, C and D occurred most commonly simultaneously in several items. This result shows that noncompliances are common and the restaurant business should improve compliance. In addition, improvements should be made in maintaining compliance as the inspection result A was maintained only in 60.5% of the restaurants in the second inspection. This result emphasises the importance of inspecting also compliant restaurants at some interval.

In order to study how the grades changed in more detail, we examined item-specific grades. We discovered that the item-specific stability of A grades was high (median for all items 92.2%), and A grades dropped only seldomly to C or D (median for all items 0.8%). Unfortunately, when a drop from A to C or D occurred, it occurred most often in chilling (3.8%), cold-stored foodstuffs (3.7%), management of shelf-life and sale period of products in serving (3.0%), which are highly relevant to microbiological food safety.

Out of the restaurants with the inspection result B, only 20.7% were completely without recorded noncompliances in the consecutive inspection. Also, the item-specific examination revealed that the probability for correction was not that high (median for all items 63.3%) and varied greatly between the items. This is at least partly because non-compliances graded as B are not obliged to be corrected because they are determined to not decrease food safety. Further, results showed that a high proportion of grades weaker than A associated with decreased correction of item-specific B grades. Possibly the Oiva system could be developed to increase motivation of the restaurants with multiple non-compliances to improve compliance. However, the modest correction rate can also be because of problems in correcting some non-compliances. Especially noncompliances related to the condition of the premises, suitability and general order and cleanliness of the facilities, as well as chilling, were often uncorrected. Correction of non-compliances related to the premises may require renovation, and

D

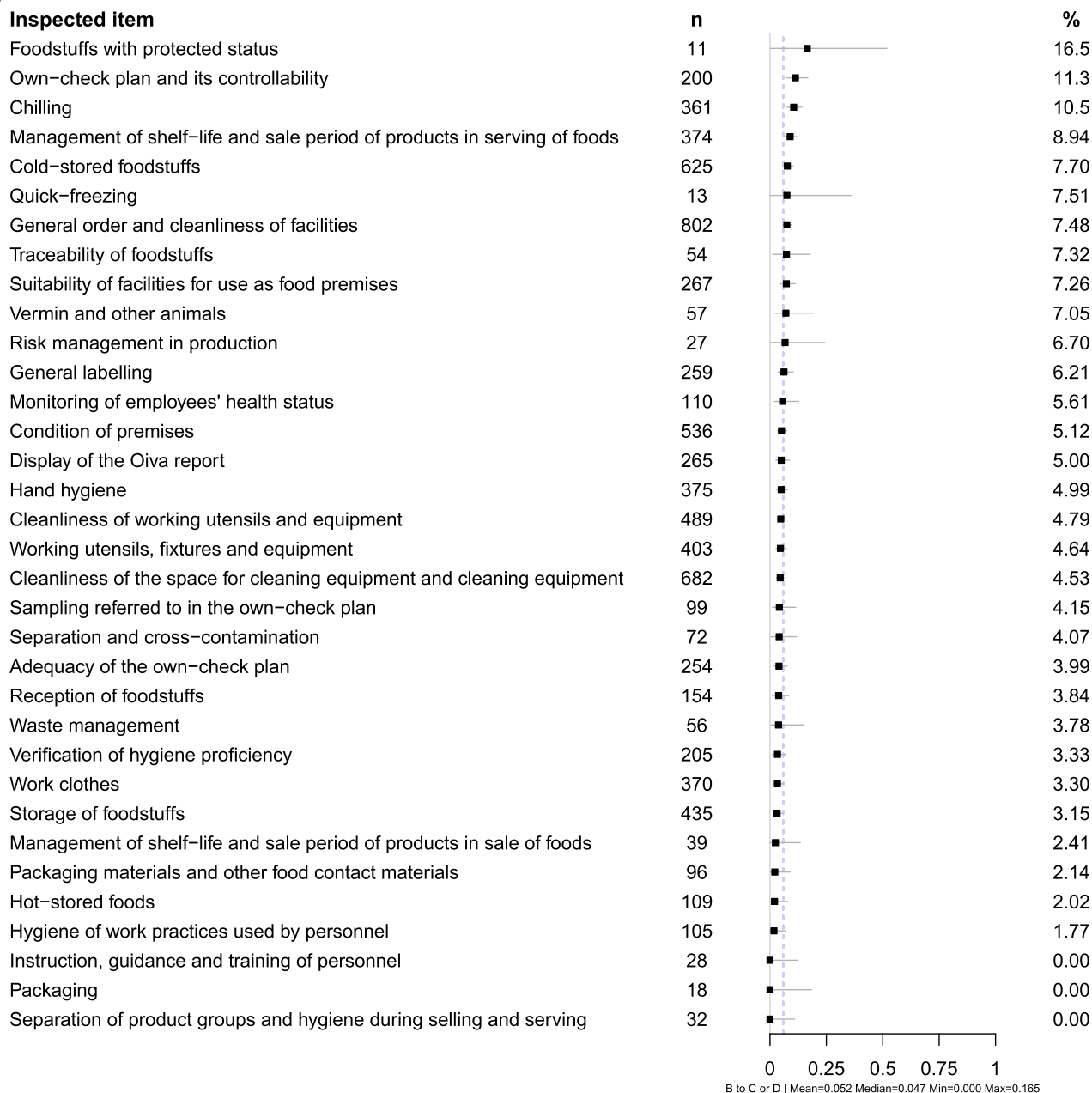


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correction of noncompliances concerning chilling may cause costs because of investment in cooling capacity. Needed costs may undermine the restaurants' capability and willingness to correct these non-compliances. Though noncompliances in general order and cleanliness of facilities might be corrected without extensive costs, they were often left uncorrected. Minor noncompliances related to the maintenance and sanitation of non-food contact surfaces have been found to be common in the restaurants (Thompson, De Burger, & Kadri, 2005), possibly indicating a lack of understanding of the importance of hygiene.

A remarkably higher proportion of the restaurants with an inspection result B in the first routine inspection received an inspection result C in the second inspection compared to the restaurants with an inspection result A in the first routine inspection. These results demonstrate that the use of both A and B grades is justified although neither of them indicate any food safety problems. The fact that restaurants with B grades have more often serious noncompliances in the next inspection is an

important finding and can be used in targeting inspections.

Most, but not all, of the noncompliances leading to grades C were corrected in the second inspection. This shows that even though Oiva inspections can be effective, in some cases there is still a need for other control measures such as guidance and sanctions. In addition, it should be ensured that consumers are familiar with the Oiva reports and understand them correctly in order to achieve full advantage from disclosure. Most of the restaurants that received an inspection result C in the first routine inspection, and improved in the second inspection, did not receive an inspection result C in the third inspection. However, the probability for a grade C was noticeably higher for the restaurants with C in the past than among all restaurants with an inspection result B or A. Also, Waters et al. (2015) observed that the probability for the reoccurrence of critical violations after reinspection was elevated. These restaurants should be supported to improve and maintain compliance. One method to support these restaurants could be to conduct

E

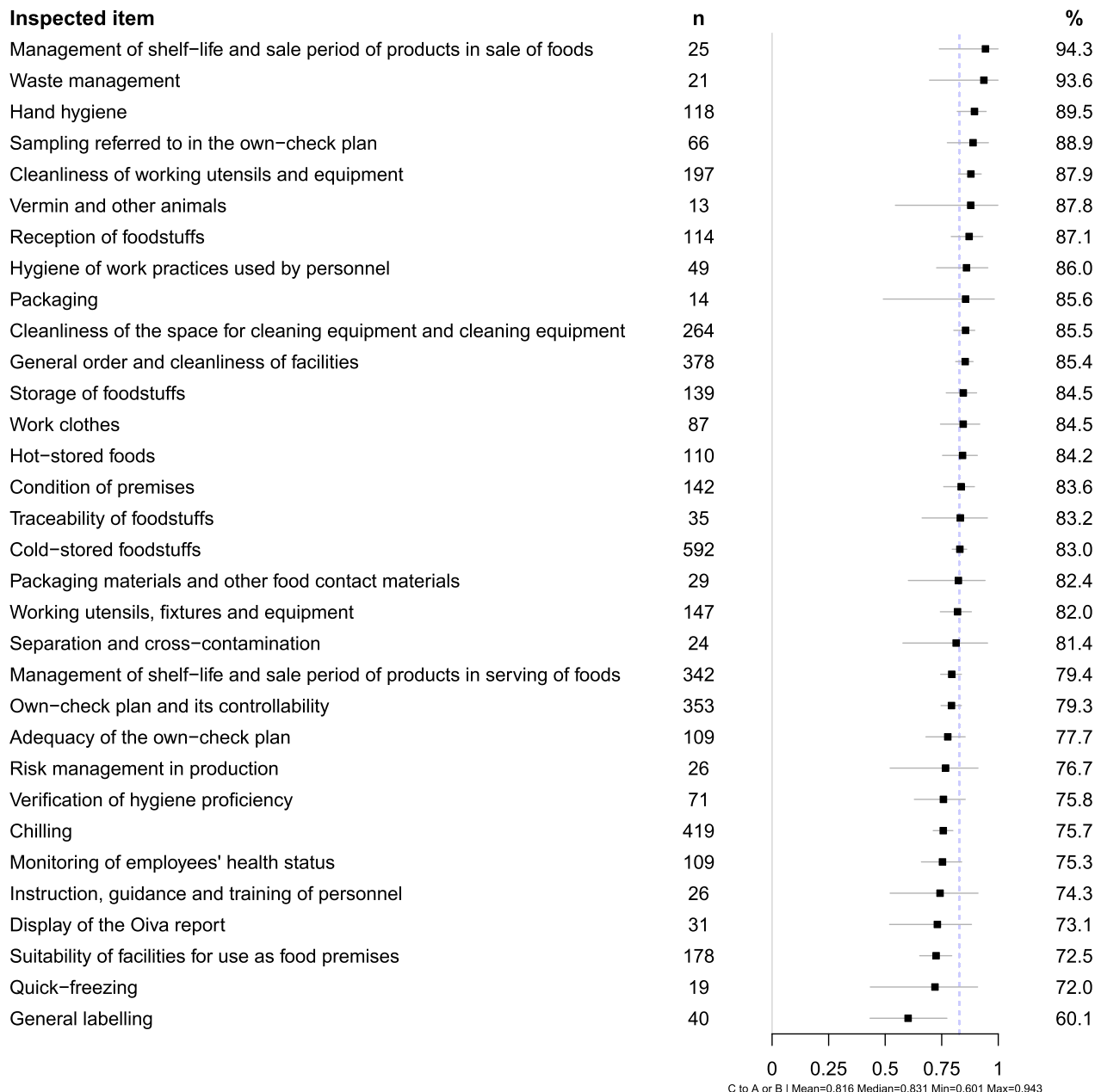


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prescheduled guidance-oriented inspections after the routine inspections where a grade C was given. The increased proportions of improved grades in many items after the preannounced inspection suggest that preannouncement might improve compliance in some cases. However, the differences were mostly relatively small and statistically insignificant. Therefore, the results of this study do not provide significant additional evidence of the positive impact of preannouncement. However, it must be noticed that preannouncement of the inspection depends on multiple factors that could not be controlled in this study. Therefore, controlled trials would be needed in order to understand the full potential of preannounced guidance-oriented inspections' efficacy on improving compliance. Based on our results of decreased frequency of noncompliances recorded on preannounced inspections, we suggest that unannounced inspections should be conducted for randomly selected restaurants within a few months after the

preannounced inspection. The knowledge that the restaurant might be shortly reinspected to check that the compliance has remained could motivate some of the restaurants to maintain compliance.

Almost one-fifth of the restaurants had noncompliances that decreased food safety or misled consumers, which is of major concern. Furthermore, the highest proportions of C and D grades were in chilling, cold-stored foodstuffs, own-check plan and its controllability and management of shelf-life and sale period of products in serving. The above-mentioned items were also among the ones most often dropping from A and B grades to C or D grades, but only chilling was among the items that improved least often from grades C or B. This shows that restaurants have problems especially with chilling; both improving and maintaining the compliance is clearly challenging. Compliance in temperature and time management of foods should be improved to decrease food safety risks associated with these noncompliances.

F

Inspected item

Inspected item	n	%
Waste management	21	4.62
Suitability of facilities for use as food premises	178	4.17
Condition of premises	142	4.08
Display of the Oiva report	31	3.94
Traceability of foodstuffs	35	3.93
Hygiene of work practices used by personnel	49	3.89
Instruction, guidance and training of personnel	26	3.38
Packaging materials and other food contact materials	29	3.13
Hand hygiene	118	2.93
Verification of hygiene proficiency	71	2.72
Storage of foodstuffs	139	2.70
Own-check plan and its controllability	353	2.68
Working utensils, fixtures and equipment	147	2.61
Work clothes	87	2.47
Monitoring of employees' health status	109	1.93
Chilling	419	1.53
General order and cleanliness of facilities	378	1.45
Management of shelf-life and sale period of products in serving of foods	342	1.37
Hot-stored foods	110	1.28
Cleanliness of working utensils and equipment	197	1.25
Cold-stored foodstuffs	592	1.17
Cleanliness of the space for cleaning equipment and cleaning equipment	264	1.02
Adequacy of the own-check plan	109	0.00
Separation and cross-contamination	24	0.00
General labelling	40	0.00
Reception of foodstuffs	114	0.00
Sampling referred to in the own-check plan	66	0.00
Vermin and other animals	13	0.00
Risk management in production	26	0.00
Packaging	14	0.00
Quick-freezing	19	0.00
Management of shelf-life and sale period of products in sale of foods	25	0.00

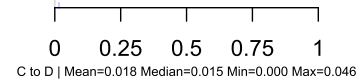


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Almost 70% of restaurants receiving the worst grade (grade D) in the first routine inspection did not adequately correct all noncompliances, which thereby means that these noncompliances may have caused food safety risks or misled consumers until the second inspection. This demonstrates that noncompliances leading to a grade D are not corrected efficiently to an adequate level. In these cases, the inspector should use coercive measures to secure food safety (Finnish Food Authority, 2020).

Interestingly, a grade D was given only for 0.3% of restaurants. The low proportion of D grades might be because true findings, i.e. grave noncompliances endangering food safety, are rare. The low proportion of D grades could also be caused by inspectors avoiding giving a D grade. When a D grade is given, the inspector should also use coercive measures according to the Oiva assessment guidelines (Finnish Food Authority, 2020). However, the use of coercive measures have been perceived as challenging according to many inspectors in a previous study (Kettunen,

Nevas, & Lundén, 2017). This could decrease the willingness to use them and consequently affect the grading. It would be important to study whether there are discrepancies in the use of the D grade to make sure that the grading is correct and follows enforcement measures adequately.

In our sample of the first routine inspections, the inspection results and most item-specific grades were significantly better in preannounced inspections. Previous studies have shown that especially serious non-compliances are more seldom detected on preannounced inspections (Makofske, 2019; Nwako, 2017). However, contrary to our results, a study by Waters et al. (2013) showed that only the noncompliances in personal hygiene and equipment cleanliness associated with pre-announcement of an inspection. The fact that we found significantly fewer noncompliances at preannounced inspections is probably because of restaurants improving compliance before the preannounced inspection. This is supported by the fact that the difference between

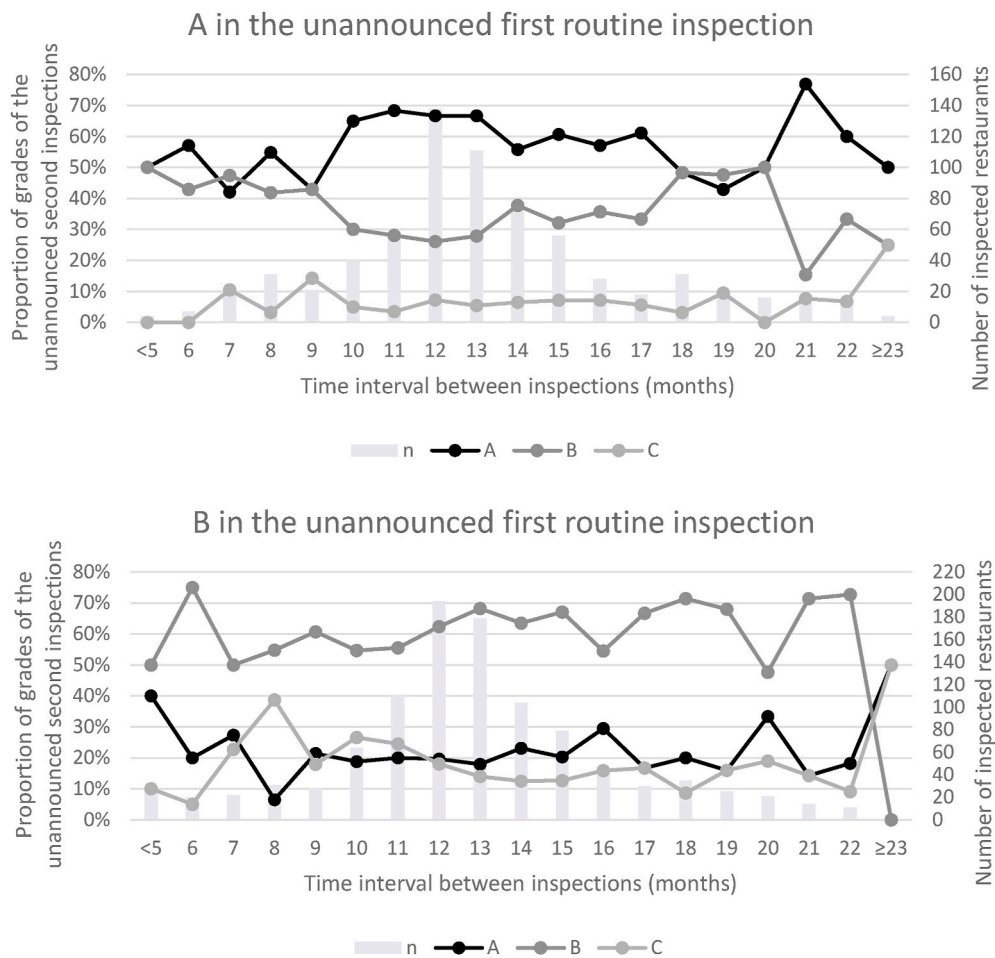


Fig. 2. Proportion of grades of the unannounced second inspections following the unannounced first routine inspection.

noncompliances was particularly large in items that can often be corrected easily such as noncompliances related to work clothes and the display of the Oiva report. However, some other factors may also influence the observed difference in noncompliances, especially whether a person responsible for the operations is attending the inspection or not. A responsible person, possibly attending more often a preannounced than unannounced inspection, can explain the prevailing situation, which could remain unclear for the inspector otherwise. This is supported by the grades that were markedly better in preannounced inspections concerning items where verbal information provided by the responsible person may be important. Such items were, for example, related to instruction, guidance and training of personnel and labelling including verbally given information concerning served foods.

Differences in C and D grade proportions between unannounced and preannounced inspections were especially high in cleanliness of working utensils and equipment. Unclean food contact surfaces can contaminate food and cause microbiological food safety risks. Considerably lower proportions of C and D grades among preannounced compared to unannounced inspections in most items demonstrate that unannounced inspections cannot be substituted with preannounced inspections, especially in a food control system that has low inspection frequency. Also, the Finnish system should be critically assessed. Almost one-quarter of the first routine inspections were preannounced despite that the inspection interval was usually more than 10 months. Further, the stability of A grades decreased if the preceding inspection was preannounced, which may relate to the temporality of corrections made before preannounced inspections. The results of this study show that this may have consequences on food safety as the inspector may not receive the right impression of the restaurant. It is also noteworthy that the

principle of the European Union legislation is that the inspections are unannounced (EC No 625/2017). However, there is also a need for preannounced inspections. The value of preannounced inspections is that the inspector can guide the food business operator (Reske et al., 2007), particularly related to items with new requirements to the food business operator and to the items with existing noncompliances.

The results of this study can be used to assess probable compliance in the future. We found that the restaurants with a B inspection result compared to the restaurants with an A inspection result have more often noncompliances that cause food safety risks or mislead consumers in the next inspection. This indicates that a grade B can give valuable information to the inspectors about the restaurants' probable compliance after the inspection. Further, the probability for a noncompliance causing a food safety risk or misleading consumers was higher for the restaurants with an inspection result C in the past than generally among restaurants with an inspection result B or A in the past. Such information can be used in planning the following year's inspection frequencies. This information could also be used among consumers making dining choices as the disclosed Oiva report contains the two latest inspection results in addition to the current inspection result. However, previous results show that consumers do not make a difference between A and B grades (Vainio, Kaskela, Finell, Ollila, & Lundén, 2020).

We did not find a significant association between decreased compliance and inspection intervals, contrary to the study by Leinwand et al. (2017). They studied the inspection results of restaurants with data from a two-year time period and found that the inspection frequency associated with compliance but only in non-chain restaurants. However, further studies are needed to examine if a period of more than two years would affect the results.

This study examined the change in item-specific grades mainly between two consecutive inspections. In future studies, change in grades between several inspections could be analysed to recognise if challenges in the stability are focused on certain restaurants or occur widely among restaurants in the longer time period. Further, this study was a retrospective study based on inspection reports with limited data. Thus, factors depending on the restaurant, for example the size or whether it belongs to a chain, could not be considered here. Circumstances related to whether the inspections were preannounced or unannounced are not considered here. Further, the data do not reveal possible inspector-related factors influencing the inspection interval. However, the data are representative, as they comprise all inspections carried out during the study period covering the whole country.

In conclusion, although compliance was often maintained and non-compliances were often corrected, compliance should be further improved. Noncompliances leading to a grade C or D occurred in items crucial to food safety, and their correction was not adequate. Especially temperature and time management in restaurants should be improved with additional control measures. Clearly, higher grades recorded in preannounced inspections compared to unannounced inspections in almost all items demonstrate the need for unannounced inspections. Unannounced inspections are important to receive an accurate impression of the food safety situation in the food premises and to be able to take adequate control measures.

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Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.foodcont.2020.107775>.

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