

Role of School Pharmacists in Hygiene Management of School Lunches in Japan

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Background: Hygiene management of school lunch in Japan is implemented in accordance with the provisions of the School Lunch Law. Until the School Lunch Law was revised in 2008, hygiene management of school lunches was implemented based on the 'Standards for School Environmental Hygiene' and "Standards for School Lunch Hygiene Management", school pharmacists have been involved in the hygiene management of school lunches. These also served as activity guidelines for school pharmacists and no longer included information on the sanitation management of school lunches.

Objective: The purpose of this study was to determine whether the implementation of the new 'Standards for School Environmental Hygiene' may have changed the actual status of school pharmacist involvement.

Method: Using the aggregated results of the 2019 National School Health Survey, we analyzed the involvement of school pharmacists in school lunches from public elementary schools and public junior high schools.

Results: Regarding kitchen type, on-site kitchens in public elementary schools and communal kitchens in public junior high schools were the most common. A high percentage of school pharmacists involved in the hygiene management of school lunches in 2019 had been requested by schools and other entities prior to that time. And they also had experience in conducting inspections.

Conclusion: School pharmacists play important roles in improving the quality of hygiene management in school lunches. To increase their involvement, schools must strengthen cooperation with school pharmacists by calling for their participation in school health committees. Additionally, school pharmacists must appropriately explain the importance of hygiene management in school lunches.

Keywords: school pharmacist, school lunches, on-site kitchens, off-site kitchens, outsourced facility kitchens

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I. Introduction

School lunches in Japan are meals provided to students in compulsory education schools to foster sound physical and mental development and correct understanding and proper judgment of food, as stipulated in the School Lunch Law¹⁾. The term 'compulsory education schools', as used in the School Lunch Law, refers to public elementary, junior high, and compulsory education

schools, first semester courses of secondary schools, or public elementary/junior high schools of special-needs schools as defined in the School Education Law²⁾. School lunch kitchens are divided into three types: independent kitchens, where food is prepared in each school; shared kitchens that deliver lunches to multiple schools; and privately owned and operated kitchens.

Article 9 of the School Lunch Law states that the Minister of Education, Culture, Sports, Science and

Technology (MEXT) establishes ‘Standards for School Lunch Hygiene Management (MEXT Notification No. 64 in 2009)’³⁾. According to the ‘Standards for School Lunch Hygiene Management’, the principal of a compulsory education school or the head of a shared kitchen should Endeavor to grasp the actual situation regarding school lunch kitchen facilities and equipment, food handling, cooking work, and hygiene management system. Additionally, if there is a problem with the management, it is necessary to take prompt corrective measures with the cooperation of the school doctor or school pharmacist. To understand actual hygiene management conditions in school lunch kitchens, the ‘Norms for hygienic supervision over school lunches’³⁾ provides eight inspection forms for periodic and daily hygiene inspections. Among these, the ‘Periodic Inspection Sheet for School Lunch Facilities (Form 1)’, ‘Periodic Inspection Sheet for Sanitation Management of School Lunch Facilities (Form 2)’, ‘Periodic Inspection and Storage of Food for School Lunch Inspection Sheet (Form 3)’ and ‘Regular Inspection Sheet for Cooking Process (Form 4)’ are related to understanding the hygiene management of school lunches. These four forms are primarily used for inspections by school pharmacists. These standards for hygiene management of school lunches³⁾ functioned as administrative guidelines for school pharmacists from 1964–2009. This is because the school lunch sanitation management standards were described in the ‘Standards for School Environmental Hygiene’ based on the MEXT Notification No. 60 of 2009⁴⁾. Since 1997, it has been listed in the ‘Standards for School Lunch Sanitation Management’, the basis of the ‘Standards for School Lunch Hygiene Management’. However, in 2008, the School Lunch Law¹⁾ and the School Health Law (now the School Health and Safety Law⁵⁾) were amended, and hygiene management of school lunches was implemented according to the ‘Standards for School Lunch Hygiene Management’³⁾ of the School Lunch Law¹⁾. Then, the content concerning the hygiene management of school lunches was deleted from the ‘Standards for School Environmental Hygiene’.

School pharmacists are placed in schools other than universities/colleges nationwide based on the provisions of the School Health and Safety Law. School pharmacists, such as school doctors and dentists, are involved in specialized matters related to school health management and technical and instructional matters. In addition, school pharmacists are involved in environmental hygiene inspections and provide the necessary guidance regarding maintenance and improvement. Until 2009, school

pharmacists performed their duties related to the hygiene management of school lunches, a school environmental biosecurity activity, based on the ‘Standards for School Environmental Hygiene’ mentioned above. However, the actual situation is not always clear.

In addition, the ‘Standards for School Lunch Hygiene Management’³⁾ stipulates that a nutrition teacher or the like be appointed in charge of hygiene management of the school lunch kitchen and indicates that cooperation from the school pharmacist should be obtained. However, no mandatory provisions exist for school pharmacists.

Notably, school pharmacists’ awareness of school lunch sanitation management has weakened, yet the actual situation has not been clarified. The MEXT has not conducted a nationwide survey on school pharmacists or the environmental hygiene status of their schools. However, a nationwide survey, ‘National School Health Survey’⁶⁾, was conducted by the Public Interest Incorporated Association Japan Pharmaceutical Association (JPA) School Pharmacists Subcommittee, changing the items of annual school environmental hygiene inspections that are targeted.

This study uses the results of the ‘National School Health Survey’⁶⁾ to examine the sanitation management of school lunches and the involvement of school pharmacists.

II. Methods

1. Survey target

In the 2019 ‘National School Health Survey’⁶⁾, school lunch hygiene management was based on the ‘Standards for School Lunch Hygiene Management’ in each school in 2018 and the involvement of school pharmacists in that management. A survey form (**Figure 1**) was distributed to school pharmacists of each school through each prefectural pharmacist association of the JPA.

This survey form was completed by the pharmacist in collaboration with the school in charge, mainly by the *Yogo* teacher. Next, the survey forms were collected from each prefectural pharmacists’ association, and the School Pharmacists Subcommittee of the JPA tabulated the results. The ‘National School Health Survey’ was conducted among all schools in 2019 (including certified children’s institutions), other than universities nationwide; the analysis target was public elementary and junior high schools.

Basic data	
1	How old are you ? ① 20's ② 30's ③ 40's ④ 50's ⑤ 60's ⑥ 70's ⑦ 80's and over
2	Are you a member of the Japan Pharmaceutical Association ? ① Yes ② No
3	Where is your main workplace ? ① Pharmacy (founder) ② Pharmacy (worker) ③ Hospital / Clinic ④ Wholesale ⑤ Administration ⑥ Manufacturing management ⑦ Inspection agency ⑧ School (Staff) ⑨ Unemployed ⑩ Others
4	Did you know that the school environmental hygiene standards were partially revised and came into force on April 1, 2018 ? ① Yes ② No
5	Do you own the "School Environment Sanitation Management Manual 2018 Revised Edition" (including data ownership) ? ① Yes ② No
6	When creating the school health plan, did the school request confirmation of this plan ? ① Yes ② No
7	Did the school health plan include a school environmental hygiene inspection ? ① All inspection items were described ② Only some of the inspection items were listed ③ There was no description of inspection item ④ do not know
8	This is a question for those who marked ② and ③ in question 7. Did you inquire with the school about some or all of the inspection items not listed ? ① Yes ② No
9	Have you carried out all inspection items of the school environmental hygiene inspection ? ① All items stipulated in the school environmental hygiene standards were implemented. ② Some items could not be inspected ③ Not implemented at all
10	This is a question for those who marked ② and ③ in 9. What was the reason why you were unable to complete all the items ?(Multiple answers allowed) ① Lack of equipment ② Not enough budget ③ Had no plan ④ Time was not convenient ⑤ Others
11	This is a question for those who marked ② and ③ in 9. Have you requested the school to implement the items that have not been implemented ? ① Yes ② No
12	Did you directly report the results of the school environmental hygiene inspection to the principal or other management ? ① Yes ② No
13	Have you been asked to attend the school health committee ? ① Yes ② No
14	How many days did you attend school in 2018 ? (Including e-mail, telephone correspondence, and school lunch center on-site inspection)
15	This is a question for those who answered the number of days they attended school in 14. What is your purpose of attending school? (Multiple answers allowed) ① Periodic inspection ② Temporary inspection ③ Participation in School Health Committee ④ Peace talks, lectures and support on health education ⑤ others
School lunches at compulsory education schools	
1	Other than compulsory education schools, go to 13 question. Do you provide school lunches ? ① Yes ② No
2	Which of the following methods is used to provide school lunches at schools that cooperated with periodic inspections ? ① On-site kitchens ② Off-site kitchens ③ Outsourced facility kitchens
3	In 2018, did you receive a request from the school or the school establisher to cooperate with the regular inspection (including the inspection of the serving room of the delivery school of the common kitchen, the same applies hereinafter) ? ① Yes ② No →Go to question 11
4	This is a question for those who marked ① in 3. Have you accepted the request for cooperation in the periodic inspection ? ① Yes ② No →Go to question 10
5	How many times did you conduct periodic inspections in fiscal 2018 ? ① One time ② Twice ③ Three times
6	Which of the following formats did you use for the Periodic Inspection Result Report ? ① Ministry of Education, Culture, Sports, Science and Technology "Periodical and daily hygiene inspection check sheet" ② Form prepared by the School Pharmacists Association (Japan Pharmaceutical Association, Prefectural School Pharmacists Association, Municipal School Pharmacists Association) ③ Form prepared by the school pharmacist ④ Form created by the Board of Education ⑤ others
7	Which check sheet from the Ministry of Education, Culture, Sports, Science and Technology's "Periodical and daily hygiene inspection check sheet" did you use for the periodic inspection ? (Multiple answers allowed) ① First checklist ② Second checklist ③ Third checklist ④ Fourth checklist
8	When did you do your regular checkup ? ① Cooking(serving) ② After cooking(serving) ③ Before serving ④ others
9	Were you asked to submit stool test results before your routine checkup ? ① Yes ② No
10	This is a question for those who marked ② in 4. What is the reason why you did not accept the request for cooperation in the periodic inspection ? ① It was not convenient. ② I didn't have the confidence to do regular inspections. ③ Others
11	Since 2009, when the school environmental hygiene standards were revised and the hygiene management of school lunches was no longer mentioned in the environmental hygiene standards, the school or the painter's installer has been asked to cooperate with regular inspections of school lunches even once. Have you ever had a periodic inspection at the time of your request ? ① There was a request, and a periodical inspection was carried out ② Requested but not accepted ③ There was no request
12	Would you like to make use of any reference materials regarding the implementation of periodic inspections ? ① Want to utilize reference materials ② Unwilling or interested in using reference materials
13	This is a question for people other than compulsory education schools. Do you conduct hygiene inspections for school lunches (meals provided) at the kindergarten in charge ? ① Conducting sanitary inspections ② Not conducting sanitary inspections ③ No school lunch (meals provided)

Figure 1 National School Health Survey in 2019 (partial excerpt)

2. Analysis population and statistical analysis

(1) Analysis population

Of the 16,581 public elementary schools and 8,054 public junior high schools that collected survey forms, the number of schools with one type of school lunch kitchen (on-site kitchens, off-site kitchens or outsourced facility kitchens) was 15,566 public elementary schools (93.9%) and 6,671 public junior high schools (82.8%). These schools were used as the population for analysis.

(2) Exclusion criteria from analysis and statistical analysis

A chi-square test was performed on the following items: The significance level was 5%.

Of the population in (1), 15,175 public elementary schools and 6,484 public junior high schools with school pharmacists received inspection requests and conducted periodic inspections. A chi-square test was used for comparisons between on-site kitchens, off-site kitchens, and outsourced facility kitchens, and Bonferroni's correction was used for multiple comparisons.

- ① Schools with no response or duplicate or inappropriate responses were excluded from the analysis. A total of 14,743 public elementary schools and 6,293 public junior high schools (analysis population 1) were analyzed for the type of school kitchen, implementation of periodic inspections per kitchen, number of inspection requests received by school pharmacists, and number of working days of school pharmacists. A chi-square test was performed between those without periodic inspections and those with periodic inspections after Bonferroni's corrections.
- ② Of the analysis population 1, there were 7,298 public elementary schools, and 2,555 were public junior high schools (analysis population 2), excluding schools with school pharmacists where no periodic inspections were conducted. The types of inspection forms used and the number of inspections by school pharmacists were analyzed in 5,571 public elementary schools and 1,876 public junior high schools, excluding schools that did not respond to the question about the type of inspection forms. We also examined whether school pharmacists in 2018 were asked for more than one periodic inspection after 2009. A chi-square test was conducted between the status of requests for periodic inspections since 2009 and whether or not periodic inspections were conducted in 2018.

- ③ In population 2, the presence or absence of requests for stool inspections and the number of periodic inspections were analyzed in 7,143 public elementary schools and 2,492 public junior high schools after excluding schools that did not respond to requests for stool inspection before periodic inspections. A chi-square test was used for comparisons between on-site kitchens, off-site kitchens, and outsourced facility kitchens, and Bonferroni's correction ($\alpha < 0.0167$) was used for multiple comparisons.

Microsoft Excel (Microsoft Japan Co., Ltd.) was used for the analysis of the above (1) results, and JMP Pro 15 (SAS Institute Japan) was used for the above (2) analysis.

3. Ethical considerations

This study was conducted based on the 'Ethical Guidelines for Medical Research Involving Human Subjects' issued by the Ministry of Health, Labour and Welfare and approved by the Ethical Review Committee of Tokyo University of Pharmacy and Life Sciences (Approval No. JIN-MEDICAL-2022-049).

III. Results

1. Kitchens serving school lunches

According to the survey data of the 2019 'National School Health Survey'⁶⁾, the implementation rate of school lunches was 98.3% (15,566/15,838 schools) in public elementary schools and 88.9% (6,671/7,505 schools) in public junior high schools.

Figure 2 shows the percentage of school lunch kitchens. Among public elementary school lunch kitchens, on-site kitchens accounted for the most, with 47.4% (7,370 schools), followed by off-site kitchens with 39.3% (6,121 schools) and outsourced facility kitchens with 13.3% (2,075 schools). However, public junior high schools had the highest percentage of off-site kitchens at 50.7% (3,385 schools), followed by on-site kitchens at 25.1% (1,672 schools) and outsourced facility kitchens at 24.2% (1,614 schools).

2. Implementation status of periodic inspections by school pharmacists by type of school kitchen

Figure 3 shows the number of public elementary schools and public junior high schools that requested

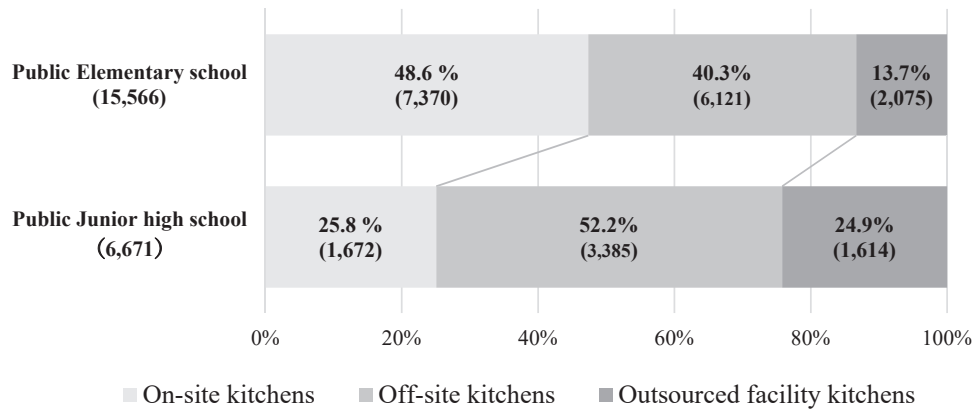
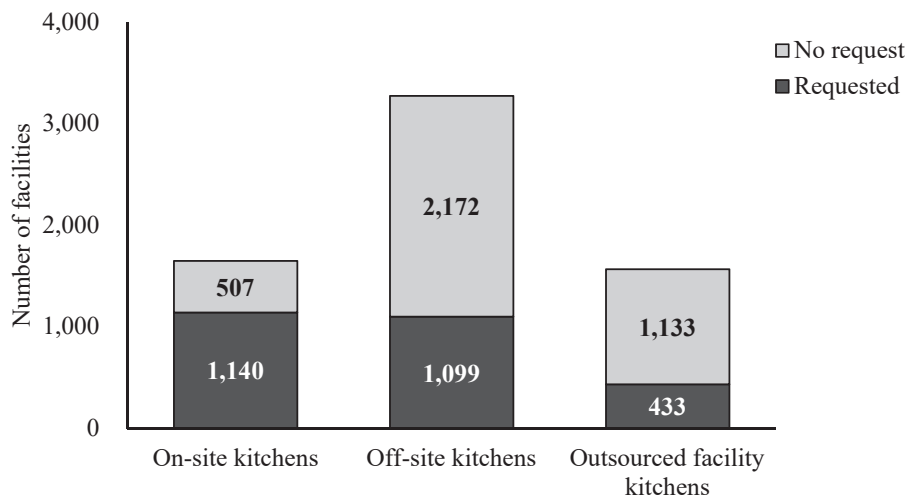


Figure 2 Percentage of school kitchens providing school lunches

15,566 responses were received from school pharmacists at public elementary schools that provide school lunches. Number of responses: 6,671 from school pharmacists at public junior high schools that provide school lunches.



Types of kitchens for school lunch provision
Public elementary school



Types of kitchens for school lunch provision
Public Junior high school

Figure 3 Number of public elementary schools and junior high schools that requested pharmacists to conduct periodic tests

15,175 responses were received from school pharmacists at public elementary schools that provide school lunches. Number of responses: 6,484 from school pharmacists at public junior high schools that provide school lunches. Based on the number of responses, a chi-square test was conducted to determine whether or not schools had requested inspections by school lunch kitchen. A chi-square test was used for comparisons between on-site kitchens, off-site kitchens, and outsourced facility kitchens, and Bonferroni's correction was used for multiple comparisons.

pharmacists to conduct periodic inspections. For schools with kitchen facilities, the number of tests requested to pharmacists was 5,114 for public elementary and 1,140 for public junior high schools. However, for schools that have off-site kitchens and outsourced facility kitchens, the number of requests to school pharmacists was 3,940 and 1,513 for public elementary schools, and 2,172 and 1,133 for public junior high schools.

Table 1 shows the implementation status of periodic inspections by school pharmacists according to the type of kitchen in public elementary and public junior high schools. Among public elementary schools, 70.7% of the schools with on-site kitchens had the highest percentage of inspections conducted three times, followed by 32.0% of off-site kitchens and 24.9% of outsourced facility kitchens. Outsourced kitchens had the highest rate of no inspections (untested) at 75.1%, followed by off-site kitchens (68.0%) and on-site kitchens (29.3%). The same was observed for public junior high schools, with the highest rate of three inspections for on-site kitchens (69.4%), followed by off-site (33.0%) and outsourced facility kitchens (26.9%). The rate of no inspections was

highest in outsourced facility kitchens (73.1%), followed by off-site kitchens (67.0%) and on-site kitchens (30.6%).

3. Relationship between the number of working days of school pharmacists for school and periodic inspections of school lunch kitchens

Table 2 summarizes the number of working days for school pharmacists and the number of periodic inspections of school lunch kitchens in public elementary and public junior high schools. The percentage of public elementary schools with school pharmacists working 12 days or more per year increased as the number of inspections increased. In addition, regarding the kitchen inspection where the school pharmacist worked for 12 days or more per year, on-site kitchens had the highest inspection rate of 3 times (35.4%).

Public junior high schools with on-site kitchens had the highest percentage of school pharmacists working 12 days or more per year. The number of working days of school pharmacists with the highest percentage worked 4 -7 days in all kitchens inspected twice or three

Table 1 The implementation status of periodic inspections by school pharmacists by school lunch kitchen in schools

Public elementary school						
Implementation status of periodic inspections	Types of kitchens for school lunch provision					
	On-site kitchens (N=7,032)		Off-site kitchens (N=5,741)		Outsourced facility kitchens (N=1,970)	
	n	n/N (%)	n	n/N (%)	n	n/N (%)
Implementation	4,971	70.7	1,836	32.0	491	24.9
Not implemented	2,061	29.3	3,905	68.0	1,479	75.1

Public junior high school						
Implementation status of periodic inspections	Types of kitchens for school lunch provision					
	On-site kitchens (N=1,573)		Off-site kitchens (N=3,204)		Outsourced facility kitchens (N=1,516)	
	n	n/N (%)	n	n/N (%)	n	n/N (%)
Implementation	1,091	69.4	1,056	33.0	408	26.9
Not implemented	482	30.6	2,148	67.0	1,108	73.1

The number of responses from school pharmacists at public elementary schools was 14,743, and the number of responses from school pharmacists at public junior high schools was 6,293.

A chi-square test was performed between those without periodic inspections and those with periodic inspections after Bonferroni's corrections.

Table 2 Relationship between the number of periodic inspections conducted in each type of public elementary school kitchen and the number of days school pharmacists attend school

1) On-site kitchens

Number of periodic inspections	Number of working days for school pharmacists at school									
	0 Day		1-3 Days		4-7 Days		8-11 Days		12 Days or more	
	n	n/N (%)	n	n/N (%)	n	n/N (%)	n	n/N (%)	n	n/N (%)
0 time (N=1,957)	21	1.1	346	17.7	842	43.0	452	23.1	296	15.1
1 time (N=1,389)	0	0	158	11.4	500	36.0	364	26.2	367	26.4
2 times (N=634)	0	0	37	5.8	191	30.1	200	31.5	206	32.5
3 times (N=2,749)	0	0	127	4.6	832	30.3	816	29.7	974	35.4

2) Off-site kitchens

Number of periodic inspections	Number of working days for school pharmacists at school									
	0 Day		1-3 Days		4-7 Days		8-11 Days		12 Days or more	
	n	n/N (%)	n	n/N (%)	n	n/N (%)	n	n/N (%)	n	n/N (%)
0 time (N=3,759)	46	1.2	1,129	30.0	1,754	46.7	588	15.6	242	6.4
1 time (N=805)	0	0	139	17.3	404	50.2	185	23.0	77	9.6
2 times (N=183)	0	0	29	15.8	70	38.3	64	35.0	20	10.9
3 times (N=772)	0	0	78	10.1	358	46.4	196	25.4	140	18.1

3) Outsourced facility kitchens

Number of periodic inspections	Number of working days for school pharmacists at school									
	0 Day		1-3 Days		4-7 Days		8-11 Days		12 Days or more	
	n	n/N (%)	n	n/N (%)	n	n/N (%)	n	n/N (%)	n	n/N (%)
0 time (N=1,432)	10	0.7	352	24.6	691	48.3	258	18.0	121	8.4
1 time (N=181)	0	0	30	16.6	81	44.8	40	22.1	30	16.6
2 times (N=69)	0	0	10	14.5	34	49.3	15	21.7	10	14.5
3 times (N=224)	0	0	12	5.4	93	41.5	59	26.3	60	26.8

The number of responses from school pharmacists at public elementary schools was 14,743 (no responses, duplicate responses, and inappropriate responses were excluded as invalid). A chi-square test (significant level was $P < 0.05$) was conducted on the number of working days of school pharmacists and the number of regular inspections conducted for each school kitchen.

times yearly, except for schools with on-site kitchens. Regarding public elementary schools, the trend results were the same as the analytical data results for public junior high schools.

4. Relationship between type of inspection forms for periodic inspections and number of inspections

Table 3 shows the types of inspection forms used by the school pharmacists for periodic inspections and the number of inspections. In public elementary schools, the rate of use of all four inspection forms for inspection by

school pharmacists was the highest (on-site kitchens; 73.4%, off-site kitchens; 73.7%, outsourced facility kitchens; 65.3%), regardless of the number of inspections or the types of kitchens. However, the usage rate of 1-3 types of inspection forms had no relationship with kitchens or the number of inspections. Similar results were obtained in public junior high schools (data not shown).

5. Factors behind periodic inspections of school lunch kitchens by school pharmacists in 2018

Table 4 shows the schools that implemented periodic

Table 3 Relationship between types of checklists and number of periodic inspections in various kitchens of public elementary schools

1) On-site kitchens

Type of checklist	Number of periodic inspections					
	1 time (N=1,102)		2 times (N=499)		3 times (N=2,294)	
	n	n/N (%)	n	n/N (%)	n	n/N (%)
One	243	22.1	67	13.4	160	7.0
Two	110	10.0	40	8.0	248	10.8
Three	47	4.3	117	23.4	203	8.8
Four	702	63.7	275	55.1	1,683	73.4

2) Off-site kitchens

Type of checklist	Number of periodic inspections					
	1 time (N=589)		2 times (N=120)		3 times (N=674)	
	n	n/N (%)	n	n/N (%)	n	n/N (%)
One	171	29.0	34	28.3	71	10.5
Two	129	21.9	9	7.5	32	4.7
Three	38	6.5	7	5.8	74	11.0
Four	251	42.6	70	58.3	497	73.7

3) Outsourced facility kitchens

Type of checklist	Number of periodic inspections					
	1 time (N=87)		2 times (N=39)		3 times (N=167)	
	n	n/N (%)	n	n/N (%)	n	n/N (%)
One	25	28.7	10	25.6	26	15.6
Two	13	14.9	5	12.8	23	13.8
Three	8	9.2	5	12.8	9	5.4
Four	41	47.1	19	48.7	109	65.3

The number of responses from school pharmacists at public elementary schools was 5,571 (no responses, duplicate responses, and inappropriate responses were excluded as invalid), and a chi-square test (significance level was $P < 0.05$) was conducted on the inspection forms used by school pharmacists and the number of regular inspections by school kitchen.

The Standards for School Lunch Hygiene Management stipulate four periodic inspections by school pharmacists and the use of test forms. These standards stipulate those inspections using the periodic inspection form for school cafeterias (form 1) and the periodic inspection form for cooking processes (form 4) must be conducted once a year. Additionally, inspections using the periodic inspection form for hygiene management of school lunch facilities (form 2) and periodic inspection form for acceptance and storage of school lunch foods (form 3) are stipulated to be conducted three times a year.

inspections by school pharmacists in 2018 and requested periodic inspections once or more after 2009⁶). Over 86% (chi-square test $P < 0.05$) of the school lunch kitchens for public elementary schools and over 89% (chi-square test $P < 0.05$) for public junior high schools were inspected by school pharmacists in 2018 at schools that requested inspections once after 2009⁶).

6. Submission of the school pharmacist's stool test results before the periodic inspection

Table 5 shows the status of requests for stool tests to school pharmacists before periodic inspections in each kitchen and the number of periodic inspections. In public elementary schools, over 6% (Bonferroni's correction ($\alpha < 0.0167$)) of school pharmacists were asked to take a stool test, regardless of the kitchen type or the number of

Table 4-1 Whether periodic inspections have been conducted since 2009 and in 2018 for each type of public elementary school kitchen

Kitchen for providing school lunches	Implementation status of periodic inspections since 2009	Implementation status of periodic inspections in 2018		Total	%	P-value
		Implementation	No implementation			
On-site kitchens	Implementation	4,466	202	4,668	95.7	<0.001
	No implementation	265	1,801	2,066	12.8	
Off-site kitchens	Implementation	1,585	207	1,792	88.4	<0.001
	No implementation	143	3,580	3,723	3.8	
Outsourced facility kitchens	Implementation	426	68	494	86.2	<0.001
	No implementation	40	1,365	1,405	2.8	

Table 4-2 Whether periodic inspections have been conducted since 2009 and in 2018 for each type of public junior high school kitchen

Kitchen for providing school lunches	Implementation status of periodic inspections since 2009	Implementation status of periodic inspections in 2018		Total	%	P-value
		Implementation	No implementation			
On-site kitchens	Implementation	969	46	1,015	95.5	<0.001
	No implementation	68	420	488	13.9	
Off-site kitchens	Implementation	926	109	1,035	89.5	<0.001
	No implementation	78	1,974	2,052	3.8	
Outsourced facility kitchens	Implementation	340	41	381	89.2	<0.001
	No implementation	48	1,025	1,073	4.5	

The number of responses from school pharmacists at public elementary schools was 14,743, and the number of responses from school pharmacists at public junior high schools was 6,293.

A chi-square test was conducted between the status of requests for periodic inspections since 2009 and whether or not periodic inspections were conducted in 2018.

periodic inspections. However, the percentage of requests for stool tests increased as periodic inspections increased for all kitchen types.

Similarly, in public junior high schools, the percentage of requests for stool tests before periodic inspections was high in all kitchens (data not shown).

IV. Discussion

1. Periodic inspection of school lunch kitchens

There are three types of school lunch kitchens: on-site, off-site and outsourced facility kitchen that provide one or more schools, and establishers/schools that entrust

Table 5 Number of periodic inspections conducted in various kitchens of public elementary schools and whether stool inspections are requested

1) On-site kitchens

Request for stool test	Number of periodic inspections					
	1 time (N=1,423)		2 times (N=654)		3 times (N=2,806)	
	n	n/N (%)	n	n/N (%)	n	n/N (%)
Yes	120	8.4	57	8.7	376	13.4
No	1,303	91.6	597	91.3	2,430	86.6

2) Off-site kitchens

Request for stool test	Number of periodic inspections					
	1 time (N=801)		2 times (N=186)		3 times (N=799)	
	n	n/N (%)	n	n/N (%)	n	n/N (%)
Yes	110	13.7	27	14.5	175	21.9
No	691	86.3	159	85.5	624	78.1

3) Outsourced facility kitchens

Request for stool test	Number of periodic inspections					
	1 time (N=181)		2 times (N=68)		3 times (N=225)	
	n	n/N (%)	n	n/N (%)	n	n/N (%)
Yes	11	6.1	15	22.1	50	22.2
No	170	93.9	53	77.9	175	77.8

The number of responses received from school pharmacists at public elementary schools where regular inspections were conducted was 7,143 (no responses, duplicate responses, and inappropriate responses were excluded as invalid). Chi-square tests were used for comparisons between independent kitchens, communal kitchens, and outsourced kitchens, and Bonferroni's correction ($\alpha < 0.0167$) was used for multiple comparisons.

private kitchens (outsourced facility kitchens). Lunches in public elementary schools were made in on-site kitchens at 47% or more, the highest rate among the three types of kitchens. However, in public junior high schools, the percentage of on-site kitchens was much lower, at approximately 25%. Compared with the 2008 'National School Health Survey', the percentage of schools without school lunches and schools with on-site kitchens was slightly decreased, and schools that adopted outsourced facility kitchens increased.

Horikawa⁸⁾ reported similar results: as of May 2018, 47.2% of public elementary schools nationwide adopted on-site kitchens, and 52.0% adopted off-site kitchens. In 1977, 43% of public elementary schools adopted off-site kitchens, and by 2018, the number continued to increase slightly, with a percentage of on-site kitchens still in place. Sudo⁹⁾ also reported that the percentage of outsourced cooking for school lunches in public elementary and public junior high schools doubled, from

21.3% in 2006 to 46.0% in 2016. Therefore, school pharmacists must ensure the proper implementation of periodic inspections of off-site kitchens in the future.

The percentage of periodic inspections carried out three times a year was the highest in on-site kitchens. In addition, school pharmacists in charge of inspecting on-site kitchens in public elementary and public junior high schools received the highest requests compared to outsourced kitchens (off-site and outsourced facility kitchens). This may be related to the fact that school pharmacists that know well of their own school are more likely to be requested multiple periodic inspections, whereas in outsourced kitchens, their request is rather awkward. However, most outsourced facility kitchens were not inspected due to the lack of inspection requests to school pharmacists.

Increasing the number of periodic inspections of kitchen hygiene management contribute to students' health. Therefore, schools and pharmacists should strive

to conduct periodic inspections of kitchens. Consequently, pharmacists should have a common understanding of the significance and purpose of inspections.

2. Relationship between the number of working days of school pharmacists and the inspection form used during the inspections

With the increasing number of periodic inspections, the percentage of school pharmacists who work for the school for 12 or more days per year also increased. School pharmacists who work more days in a school are more involved in school environmental hygiene, so it is easier for them to request the school pharmacist for school lunch hygiene management. Therefore, the number of periodic inspections of kitchens increased. Compared by each type of kitchen, schools with on-site kitchens (35.4%) had the highest percentage of school pharmacists attending school for 12 days or more and carrying out periodic inspections of school lunch kitchens thrice per year, followed by outsourced facility kitchens (26.8%) and off-site kitchens (18.1%). From this, it can be inferred that school pharmacists attending more days of school are highly involved in the hygiene management of on-site kitchens. Inspection forms 1-8 is used for periodic/daily inspections. Forms 1-4 are related to periodic inspections of kitchens that provide school lunches and are usually used by school pharmacists. School pharmacists who conducted three inspections regardless of kitchen type were most likely to use all four forms.

This suggests that the effective use of the four inspection forms is vital for proper hygiene management.

3. Involvement of school pharmacists in hygiene management of school lunch after law revision

Due to the revision of the School Health Law (currently the School Health and Safety Law⁵⁾), contents related to the hygiene management of school lunches³⁾ were deleted from the 'School Environment Sanitation Standards'⁴⁾. However, it is unknown if a school pharmacist received a request for inspection even once after 2009⁶⁾ in any kitchen (after the revision of the School Lunch Law). The implementation by the school pharmacist in 2018 was high at 86% to 95%. This data might suggest that removing the school lunch sanitation section from the 'Standards for School Environmental Hygiene'⁴⁾ may have reduced school pharmacists' awareness of the hygiene management of school lunches,

and thus the quality is unfounded. School pharmacists have felt less involved in the hygiene management of school lunches because they are less involved in school lunches outside of schools, such as in off-site and outsourced kitchens, even before the revision of the law. Since the off-site and outsourced facility kitchens provide school lunches to multiple schools, it is necessary to indicate the school pharmacist in charge. Since school pharmacists are heavily influenced by requests for inspection, schools/establishers must also involve school pharmacists in the hygiene management of off-site and outsourced kitchens.

4. Pros and cons of a stool test for school pharmacists before the periodic inspection

The percentage of schools that requested a stool test from a school pharmacist before periodic inspections increased as the number of inspections increased (**Table 5**). Although school pharmacists are in charge of the hygiene management of school lunches from a third-party perspective, they are not directly involved in the school lunch cooking process. This raises questions regarding their need to perform stool tests for norovirus polymerase chain reaction testing. When schools/establishers request the school pharmacist to conduct inspections for the hygiene management of school lunches, it may be important to review the contents of the inspections with the school pharmacist and discuss the need for stool tests.

V. Conclusion

In this study, we were able to clarify the reality of the involvement of school pharmacists, which had been unknown until now, due to the enforcement of the new "School Environmental Hygiene Standards." Additionally, in order to improve the quality of school lunch hygiene management by school pharmacists, it is necessary to strengthen collaboration between school pharmacists and schools. To this end, schools need to invite school pharmacists to participate in school health committees, and school pharmacists need to appropriately explain the importance of school lunch hygiene management.

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Conflict of interest

There are no conflicts of interest to disclose regarding this paper.

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