

Hygienic, sanitary, physical, and functional conditions of Brazilian public school food services¹

Condições físico-funcionais e higiênico-sanitárias das unidades de alimentação e nutrição de escolas da Região Centro-Oeste, Brasil

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ABSTRACT

Objective

To verify the physical, functional, hygienic, and sanitary conditions of the food services of municipal schools located in the Brazilian Midwest region.

Methods

This is a cross-sectional study of 296 school food services conducted from February to June 2012. The food services were assessed by a semi-structured check list divided into the following sections: physical conditions, available equipment, food handlers' conduct, and food service cleaning processes and procedures. The study variables were classified as compliant or noncompliant with the regulations passed by the National Sanitary Surveillance Agency.

Results

Noncompliances were found in all study food services, especially with respect to food service conditions, and the wiring and plumbing in the food preparation area. In this section, 62.7 to 95.9% of the food services did not comply with nine out of the thirteen study items. The main problems were: poorly cleaned external areas,

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deteriorated walls, floors, ceilings, roofs, drains, and roof gutters; and unscreened doors and windows, allowing the entrance of insects; among others. The main noncompliance regarding processes and procedures was the uncontrolled temperature of the ready-to-eat foods.

Conclusion

The conditions of the study food services are unsatisfactory for the production of safe meals, possibly compromising meal quality, food safety, and the effectiveness of the School Food Program.

Indexing terms: Food security. Good manipulation practices. School food.

RESUMO

Objetivo

Verificar as condições físico-funcionais e higiênico-sanitárias das Unidades de Alimentação e Nutrição de escolas públicas municipais localizadas na Região Centro-Oeste do País.

Métodos

Estudo transversal, realizado entre fevereiro e junho de 2012, em 296 unidades de alimentação e nutrição escolares. Aplicou-se nestas unidades checklist semi-estruturado, dividido em blocos referentes às condições estruturais, disponibilidade de equipamentos, atuação dos manipuladores de alimentos, processos e procedimentos e higienização ambiental. Considerando as determinações da Agência Nacional de Vigilância Sanitária para Unidades de Alimentação e Nutrição, classificou-se as variáveis analisadas em conforme ou não conforme.

Resultados

Em todas as unidades de alimentação e nutrição que participaram do estudo identificou-se inadequações, com destaque para às condições dos edifícios e instalações da área de preparo dos alimentos. Neste bloco, 62,7 a 95,9% das unidades apresentaram não conformidade para nove dos treze itens avaliados, os principais problemas foram: higienização precária da área externa; paredes, pisos, forros, tetos, ralos e canaletas inadequados; portas e janelas sem telas de proteção contra a entrada de insetos, dentre outros. Quanto aos processos e procedimentos, a principal inadequação foi a falta de controle de temperatura dos alimentos prontos para o consumo.

Conclusão

As unidades de alimentação e nutrição pesquisadas apresentam-se em condições insatisfatórias para a produção de uma alimentação escolar segura do ponto de vista higiênico-sanitário, o que pode comprometer a qualidade da refeição, a Segurança Alimentar e Nutricional no ambiente escolar e a efetivação do Programa Nacional de Alimentação Escolar.

Termos de indexação: Segurança alimentar e nutricional. Boas práticas de manipulação. Alimentação escolar.

INTRODUCTION

A food service is "an organized service performing a sequence of actions that aim to supply balanced meals within established dietary and hygienic standards and meet the nutritional needs of its clientele, according to the financial means of the institution" (p.35)¹. In schools, these food services are the kitchens where school food is prepared.

The supply of microbiologically safe foods in schools is regulated by Law nº 11.947/2009²

because their clientele consists of children, the most vulnerable group to foodborne diseases³⁻⁵. These disease are caused by foods contaminated with pathogenic microorganisms or chemical products⁶.

The use of good practices, including appropriate and safe procedures, from facility construction to meal distribution, allows food services to ensure safe preparations⁷.

The characteristics of the physical structure of a food service, such as flooring, wall and ceiling coating, door and window conditions, drain size

and location, lighting, ventilation, temperature, and moisture, among others, directly affect its cleanliness⁸. Identifying the risk of food contamination allows determining what needs improvement and the stage of food preparation that is compromising food safety⁹.

Today the Technical Regulations for Good Food Service Practices is provided by *Resolução da Diretoria Colegiada* (RDC, Board Resolution) n° 216, passed on September 15, 2004 by the *Agência Nacional de Vigilância Sanitária* (Anvisa, National Sanitary Surveillance Agency). The objective of this RDC is to improve sanitary control and better protect people's health⁷. However, numerous school food services do not comply with these regulations and risk cross-contamination^{3,4,9-12}. In *Salvador* (BA), the conditions of approximately 57% of the 235 schools assessed were unsatisfactory³.

Given this perspective and that sanitation is directly associated with the assurance of safe foods¹³, school meals must be produced in food services with good infrastructure and handling practices.

The *Programa Nacional de Alimentação Escolar* (PNAE, National School Food Program) is one of the social policies and programs that aim to promote food and nutrition security. Created in the 1950s, this nationwide, government-sponsored school food program became structured for the first time. Until then the program was known as school "lunch"¹⁴. The guidelines of the program include the use of healthy foods that promote schoolchildren's growth and development according to their age group, health status, and occasionally, special needs^{14,15}.

The municipal and state PNAE managers must ensure the acquisition, transportation, storage, and preparation of meals that remain safe until consumption¹⁵.

Given the above, RDC n° 216/2004⁷, and Law n° 11.947/2009², the present study aimed to check the physical, functional, hygienic, and

sanitary conditions of the food services of municipal schools located in the Midwest region of the country.

METHODS

This is a cross-sectional, descriptive study with a quantitative approach¹⁶ approved by the Research Ethics Committee of the *Universidade Federal de Goiás* (UFG) on October 21, 2011, under Protocol number 354/11. All participants signed an Informed Consent Form before study enrollment.

Data were collected by six dietitians who received 20-hour training to standardize personal conduct and checklist scoring. These dietitians visited the food services of municipal schools in the Brazilian Midwest states, namely *Goiás*, *Mato Grosso do Sul*, and *Mato Grosso*, from February to June 2012.

The schools were sampled in two stages. The first stage consisted of selecting municipalities in the Midwest that did not comply with Article 14 of Law n° 11.947 passed on June 6, 2009². This article establishes that at least 30% of the funds transferred to PNAE by the *Fundo Nacional de Desenvolvimento da Educação* (FNDE, National Education Development Fund) be used for purchasing foods from family farms². There was a survey of municipalities that received training or consulting services from the *Centro Colaborador em Alimentação e Nutrição* (Cecane) of the UFG of the Midwest Region in the last years, also excluded these municipalities, because these activities have a positive impact on the physical, functional, hygienic, and sanitary conditions of school food services¹⁷.

A total of 168 municipalities with 938 municipal elementary and high schools were selected. Based on the number of schools in these municipalities, a prevalence of food services with unsatisfactory sanitary conditions of approximately 50%, and a 95% Confidence Interval (95%CI), the final sample should contain at least 273 municipal schools. An additional 10% was added

to the minimum sample size to compensate for losses, so the final sample consisted of 300 schools, as recommended by Hoffmann¹⁸.

Sixty municipalities were randomly selected from the 168 that met the inclusion criteria, on the additional condition that they had a dietician in charge of the PNAE, as determined by Law n° 11,947/2009².

In the second stage, the schools were selected. The number of schools selected per municipality was given by the proportional distribution of the total number of schools. Only municipal elementary and high schools were included. State, indigenous, and *Quilombola* schools, preschools, and daycare centers were excluded. State schools were excluded because they are managed and followed by their State Department of Education; indigenous and *Quilombola* schools were excluded because they have particularities related to these communities; and preschools and daycare centers were excluded because they require special food services, capable of catering for sucklings.

As determined by RDC n° 216/2004⁷, a semi-structured checklist was created for data collection. The checklist was divided into the following sections: a) Physical, plumbing, and wiring conditions in the food preparation area; b) Equipment, utensils, and handlers; c) Handlers; d) Processes and procedures; and e) Food service cleaning.

Food handlers were asked to answer a specific questionnaire called "Handlers," which consisted of the following variables: type of job, type of employment contract, weekly hours of work, participation in training courses and subjects covered by said courses, having jobs other than food handling, and health checkup frequency. The instruments created and validated by Cecane of the *Universidade Federal de São Paulo* (Unifesp)¹⁹ helped to assess the physical, functional, hygienic, and sanitary conditions and the food handling practices of the study food services.

As the data were tabulated, the following categories were attributed to each study item: noncompliant (0); compliant (1); and not applicable (2); as recommended by RCD n° 216/2004⁷. A period (.) was attributed to unanswered questions, considered losses.

The database was created in the spreadsheet Microsoft Excel version 2007. The data were entered twice to check for inconsistencies, which was done by the statistical package Stata/SE version 11.0.

The percentages of adequacy were estimated for the entire sample and by state (*Goiás*, *Mato Grosso*, and *Mato Grosso do Sul*) and segment (urban and rural). Measures of association based on the Chi-square statistic assessed the relationship between compliance and noncompliance. A type I error of 0.05 was considered for the statistically significant results. The compliance rates of the study variables were calculated to diagnose the conditions of the school food services and to identify the points with the greatest noncompliance rates.

RESULTS

Of the 59 municipalities in the Midwest region that participated in the study, 22.0% (n=13) were in *Goiás*, 30.5% (n=18) were in *Mato Grosso do Sul*, and 47.5% (n=28) were in *Mato Grosso*. The single loss was due to political problems in one of the selected municipalities. Hence, the sample consisted of 296 municipal school food services, of which 76.0% (n=225) were in urban areas and 24.0% (n=71) were in rural areas.

None of the study food services were compliant with all Good Handling Practices (GHP). In 294 (99.3%) schools, the meals were prepared in-house; in two rural schools, the meals were prepared at the cooks' homes.

Many items regarding the physical, plumbing, and wiring conditions of the food preparation area (Section A) were noncompliant

with RDC nº 216/2004. Items with noncompliance rates in excess of 86% were (Table 1): problems in the external areas of the food services, such as unused objects, insects and other animals, and/or exposed garbage; hard-to-clean floors; walls with mildew, moisture, peeling paint, and cracks; ceilings and roofs that leak or allow the entrance of insects; drains and gutters unprotected against the entrance of rodents and/or insects in the 67 food services with drains and gutters inside the food service; unscreened doors and windows; storage areas with poor lighting and ventilation, and unused objects;

Items with noncompliance rates below 40.0% were (Table 1): use of water from wells, cisterns, springs, rivers, streams, and water trucks, among others, none of which were guaranteed to be treated or potable; inappropriate food storage, such as foods inside cardboard boxes, on tables, chairs, floor and/or in unventilated cabinets. The storages in 268 (90.6%) schools were near the food preparation area; in 28 (9.5%) schools the foods were stored far from the food preparation area, such as in classrooms or even outside the school; inappropriate storage of foods that required refrigeration but were not refrigerated. Foods were stored close to cleaning materials in 57 (19.6%) food services, and close to school materials (books, paper, furniture, etc.)

in 18 (6.1%) food services; water tank not cleaned often enough: in 50 (19.3%) food services, the water tanks had not been cleaned in over six months, and in 36 (13.9%) food services, they had never been cleaned. Only 84 (37.7%) food services kept a water tank cleaning record and 10 (3.4%) food services did not have a water tank; of these, six (60.0%) were in urban areas and four (40.0%) were in rural areas.

Noncompliant items in the food distribution and consumption areas were found in 73.4% of the food services because they did not have cafeterias. In these schools the meals were served in the courtyard or classrooms (Table 1).

With respect to equipment (Section B), all food services had a stove; 294 (99.3%) food services had commercial stoves; one food service located in a rural area had a wood-burning stove and a residential stove (Table 2).

Six (2.0%) food services located in rural areas had no refrigerators. Nine (3.0%) food services had only a freezer, and of these, six (66.7%) were in urban areas and the remainder, in rural areas.

Only 53 (17.9%) food services had conventional weighing scales; six (2.0%) had platform scales; one (0.3%) had the two types of scales; and 238 (80.4%) had no scale. Only two

Table 1. Compliance of municipal schools in the Brazilian Midwest region with RDC nº 216/2004 regarding physical, plumbing, and wiring variables in the food preparation areas (Section A). Brazil, 2012.

Variables	Compliant		Non-compliant		Total	
	n	%	n	%	n	%
Food service water source	180	60.8	116	39.2	296	100.0
External area cleanliness	20	6.8	275	93.2	295	100.0
Food service flooring	20	6.8	276	93.2	296	100.0
Food service walls	18	6.1	278	93.9	296	100.0
Food service ceiling and roof	12	4.1	283	95.9	295	100.0
Food service drains and gutters	9	13.4	58	86.6	67	100.0
Door and window screens	16	5.4	278	94.6	294	100.0
Proper storage lighting, ventilation, and/or absence of unused objects	8	2.7	285	97.3	293	100.0
Raw materials stored on shelves, racks, or pallets.	176	61.1	112	38.9	288	100.0
Storage conditions of items that require refrigeration	239	84.7	43	15.3	282	100.0
Proper food distribution and consumption areas	78	26.6	215	73.4	293	100.0
Water tank cleaning frequency	173	66.8	86	33.2	259	100.0
Record of water tank cleanings	84	37.7	139	62.7	223	100.0

Table 2. Availability of equipment and utensils (Section B) in the food services of municipal schools of the Brazilian Midwest region. Brazil, 2012.

Equipment/Utensils	Number of school food services with the equipment/utensil	
	n	%
Commercial stove	294	99.3
Residential stove	19	6.4
Wood-burning stove	1	0.3
Single-door residential refrigerator	172	58.1
Double-door residential refrigerator	112	37.8
Freezer	275	92.9
Walk-in cooler	9	3.0
Conventional weighing scale	53	17.9
Platform weighing scale	6	2.0
Thermometer	2	0.7

Table 3. Compliance of municipal schools in the Brazilian Midwest region with RDC n° 216/2004 regarding processes and procedures performed in the food preparation areas (Section D). Brazil, 2012.

Variables	Compliant		Non-compliant		Total	
	n	%	n	%	n	%
Goods receiving clerk checks the raw materials upon receipt	58	20.4	227	79.6	285	100.0
Hand washing frequency	233	80.9	55	19.1	288	100.0
Hand sanitization	54	19.0	230	81.0	284	100.0
Utensils used on raw foods are sanitized before being used on cooked foods	17	6.0	268	94.0	285	100.0
Sanitization of fruits and vegetables	102	37.2	172	62.8	274	100.0
Food thawing process	207	72.1	80	27.9	287	100.0
Ready-to-eat foods are protected	140	50.7	136	42.3	276	100.0
Control of ready-to-eat food temperature	1	0.3	288	99.7	289	100.0
Leftover storage	23	85.2	4	14.8	27	100.0

(0.7%) food services had thermometers (Table 2). Equipment maintenance was done regularly in 175 (60.1%) food services.

Meals were prepared by cooks in 275 (92.9%) food services, and by handymen, teachers, and even students' parents in the remainder food services (Section C).

In 52 (18.1%) food services, the food handlers were properly dressed with uniforms in good conditions (clean and without holes or tears) and wearing closed shoes. In 264 (91.7%) food services, the handlers were wearing disposable caps, hair nets, or headscarves. The use of accessories and/or nail polisher was seen in 135 (47.0%) food services.

Many processes and procedures were noncompliant (Section D), reflecting the lack of

GHP in the meal preparation area, from goods receiving to meal distribution.

The main noncompliances (Table 3) were: the temperature of the ready-to-eat foods was not controlled. Only one food service had a food warmer to keep the food above 60°C. However, 289 (99.7%) food services served the meals as soon as they were ready; utensils used on raw foods were not sanitized before they were reused on cooked foods; hands were not sanitized properly because only water and soap or water alone was used for hand washing; upon receipt, goods' temperature, expiration date, and package integrity were not checked; in 37.2% of the food services, the fruits and vegetables were not sanitized properly because only water or water and soap and/or vinegar were used.

The highest compliance rates were found for the following items (Table 3): storage of leftovers under refrigeration: 85.2% of the 27 food services that saved the leftovers stored them properly; proper hand washing frequency, since the handlers reported washing their hands before they started their work, every time they changed activities, after going to the restroom, after touching the garbage can, and whenever necessary. However, two (0.7%) food services did not have running water; foods thawed under refrigeration, by a microwave oven, or cooked without prior thawing; the manner in which ready-to-eat foods were protected: with a plastic or paper food wrap, or a closed container. Noncompliant food services either did not protect the foods or covered them with a dish towel.

In 289 (99.7%) food services, the meats were always well done; all units (100.0%) served their eggs hard cooked. Forty-seven (16.4%) food services served pies, potato salad with mayonnaise, and creams, items whose ingredients include raw eggs.

Food service cleaning (Section E) included washing the floor daily (93.5%, n=272), weekly, or monthly; 149 (59.1%) food services used chlorine-based bleach, 96 (33.0%) food services used only water and soap, and 21 (7.2%) food services used only water or water and some other non-sanitizing product.

In 252 (86.6%) food services, the tables were washed daily; 28 (9.6%) food services washed them weekly; and five (1.7%) food services had never washed them. Of the food services that cleaned the tables, 149 (52.6%) used water, soap, and a sanitizing substance (chlorine-based bleach, 70% alcohol, or quaternary ammonium compounds).

Eighty-five (29.0%) food services had step garbage cans with garbage bags; 208 (71.0%) food services did not dispose of their garbage properly (inappropriate container or location). One hundred (35.0%) food services cleaned their garbage cans, 165 (57.7%) food services washed their garbage cans with water and soap, and 21

(7.3%) food services did not wash their garbage cans or used only water to wash them.

Most (n=188, 68.6%) food services relied on professional chemical pest control. Forty-five (16.4%) food services had some employee or another untrained individual do the job, and 41 (15.0%) food services did not control pests; 173 (67.8%) food services performed chemical pest control every semester or more often; 48 (18.8%) performed chemical pest control annually; and 51 (22.8%) food services did not perform chemical pest control regularly or at all.

When the food services located in urban and rural areas were compared, those in urban areas presented higher compliance rates for the following items: water source, storage conditions of foods that require refrigeration, meal distribution and consumption area, water tank cleaning frequency, record of water tank cleanings, dedicated cook, use of headgear, use of uniforms, hand sanitization, preparations containing eggs, food thawing, table sanitization, garbage cans, and professional pest control (Table 4).

Food services located in rural areas presented higher compliance rates only for their storage conditions: they had proper lighting, ventilation, and absence of unused objects ($p<0.05$) (Table 4).

All food handlers from all study food services who were present on data collection day were interviewed, totaling 482 food handlers or 1.6 food handlers per food service.

The jobs of 425 (89.8%) food handlers were compatible with food handling, that is, they were either the cook or the cook's assistant, but 48 (10.2%) jobs did not include food handling; these individuals were either handymen or administrative workers. Most (69.7%, n=331) food handlers had passed an admission test for the job; 120 (25.3%) were hired without a test, and 24 (5.0%) were outsourced. Roughly half (51.6%, n=245) of the food handlers worked from 30 to 40 hours a week, 213 (44.8%) worked

Table 4. Comparative distribution of the food services of municipal schools located in the Brazilian Midwest region regarding compliance with RDC n° 216/2004. Brazil, 2012.

Variables	Number of schools compliant with RDC n° 216/2004				p-value*
	Urban		Rural		
	n	%	n	%	
<i>Section A: Physical, plumbing, and wiring conditions of the food preparation areas</i>					
Food service water source	178	79.1	2	2.8	0.00**
External area cleanliness	16	7.1	4	5.6	0.66
Food service flooring	17	7.6	4	5.6	0.58
Food service walls	13	5.8	5	7.0	0.70
Food service ceiling and roof	7	3.1	5	7.0	0.14
Screened doors and windows	13	5.8	3	4.2	0.74
Proper storage lighting, ventilation, and/or absence of unused objects	3	1.8	5	7.2	0.01**
Raw materials stored on shelves, racks, or pallets	139	62.6	38	57.6	0.46
Storage conditions of items that require refrigeration	189	85.5	49	80.3	0.00**
Cleaning materials stored away from foods	181	82.3	52	74.3	0.14
School materials stored away from foods	210	94.6	67	95.7	0.87
Proper meal distribution and consumption areas	67	30.0	11	16.9	0.02**
Water tank cleaning frequency	146	71.9	26	44.1	0.00**
Record of the water tank cleanings	73	39.7	11	25.0	0.00**
<i>Section C: Food handlers</i>					
Dedicated cook	215	95.6	60	84.5	0.00**
Use of headgear	217	98.6	51	83.6	0.00**
Use of proper uniforms	49	21.9	4	6.3	0.00**
Use of accessories	119	53.1	34	54.8	0.16
<i>Section D: Processes and procedures</i>					
Hand washing frequency	172	77.1	57	87.7	0.06
Hand sanitization	36	16.4	10	15.9	0.03**
Raw materials checked upon receipt	47	21.2	12	19.0	0.71
Ready-to-eat foods are protected	102	47.4	35	57.4	0.17
Utensils used on raw foods are sanitized before being used on cooked foods	15	6.8	2	3.2	0.26
Ready-to-eat food holding time	224	100.0	65	100.0	0.59
Storage of ready-to-eat foods	1	0.4	0	0.0	0.59
Preparations with eggs	194	87.4	47	72.3	0.00**
Proper food thawing	156	70.6	37	56.9	0.06
<i>Section E: Food service cleaning</i>					
Table sanitization	121	55.0	27	42.8	0.07
Floor sanitization	129	57.3	43	65.2	0.26
Garbage can	76	33.8	12	17.6	0.01**
Garbage can sanitization	77	34.8	23	35.4	0.86
Professional chemical pest control	165	78.6	23	36.5	0.00**

Note: *p-value associated with Chi-square tests of independence (Pearson's Chi-square, Fisher's exact test, or likelihood ratio as needed); **p-value <0.05.

from 20 to 30 hours a week, and the remainder (3.6%) worked fewer than 20 hours a week.

Most (78.5%, n=373) food handlers were dedicated exclusively to meal preparation, and 102 (21.5%) were teachers, handymen, or administrative workers. Some (26.9%, n=128) food handlers underwent health checkups every

semester, 179 (37.7%) had not undergone a health checkup in the last year or more, and the remainder (35.4%) never underwent any health checkup to handle food.

Regarding training, 115 (24.2%) food handlers had never attended a training course, 112 (23.6%) food handlers had not attended a

training course for at least one year, 188 (39.7%) food handlers had attended a training course in the last semester, and 59 (12.4%) food handlers had attended a training course in the last year. The most common subject in training courses was

food hygiene, reported by 321 (89.4%) food handlers.

When the compliance rates for the physical, plumbing, and wiring conditions of the food preparation areas, food handlers' conduct,

Table 5. Percentage of compliance with RDC n°216/2004 of the study items of food services of municipal schools in the Brazilian Midwest region. Brazil, 2012.

Variables	GO		MS		MT		p-value*
	n	%	n	%	n	%	
<i>Section A: Physical, plumbing, and wiring conditions of the food preparation areas</i>							
Food service water source	35	67.3	57	81.4	88	50.6	0.00**
External area cleanliness	2	3.8	6	8.6	12	6.9	0.59
Food service flooring condition	3	5.8	10	14.3	8	4.6	0.03**
Food service wall condition	7	13.5	4	5.7	7	4.0	0.04**
Food service ceiling and roof condition	6	11.5	3	4.3	3	1.7	0.01**
Screened doors and windows	3	5.8	6	8.6	7	4.1	0.61
Proper storage lighting, ventilation, and/or absence of unused objects	1	1.9	1	1.4	6	3.5	0.63
Raw materials stored on shelves, racks, or pallets	40	80.0	39	58.2	98	57.3	0.01**
Storage of items that require refrigeration	49	94.2	59	85.5	130	80.7	0.01**
Cleaning materials stored away from foods	47	94.0	48	70.6	138	80.2	0.01**
School materials stored away from foods	49	100.0	66	94.3	162	93.6	0.00**
Proper meal distribution and consumption areas	4	7.8	15	21.7	59	34.1	0.00**
Water tank cleaning frequency	21	47.7	55	85.9	96	62.3	0.00**
Record of water tank cleanings	19	51.4	24	41.4	41	30.8	0.04**
<i>Section C: Food handlers</i>							
Dedicated cook	52	96.2	70	97.1	174	90.2	0.10
Use of headgear	47	97.9	70	100.0	164	92.7	0.02**
Use of proper uniforms	46	34.8	70	42.9	171	4.1	0.00**
Use of accessories	45	68.9	70	62.9	171	45.6	0.00**
<i>Section D: Processes and procedures</i>							
Hand washing frequency	48	91.7	70	64.3	170	82.4	0.00**
Hand sanitization	48	25.0	70	22.9	166	10.8	0.04**
Raw materials checked upon receipt	46	15.2	70	30.0	169	18.3	0.08
Ready-to-eat foods are protected	44	63.6	69	30.4	163	54.0	0.00**
Utensils used on raw foods are sanitized before being used on cooked foods	47	4.3	69	18.8	169	1.2	0.00**
Ready-to-eat food holding time	49	100.0	70	100.0	171	99.4	0.70
Storage of ready-to-eat foods	48	0.0	70	1.4	171	0.0	0.21
Sanitization of fruits and vegetables	49	28.6	68	45.6	168	30.3	0.01**
Preparations with eggs	48	64.6	68	92.6	171	86.0	0.00**
Proper food thawing	48	93.8	68	70.6	170	58.8	0.00**
<i>Section E: Food service cleaning</i>							
Table sanitization	48	81.2	70	94.3	168	87.5	0.17
Floor sanitization	49	46.9	70	64.3	172	60.5	0.14
Garbage can	49	32.7	70	40.0	174	25.3	0.07
Garbage can sanitization	48	45.8	70	40.0	168	29.8	0.20
Professional chemical pest control	44	52.3	63	82.5	166	68.1	0.02**

Note: *p-value associated with Chi-square tests of independence (Pearson's Chi-square, Fisher's exact test, or likelihood ratio as needed); **p-value <0.05.

GO: Goiás; MS: Mato Grosso do Sul; MT: Mato Grosso.

rightness of the processes and procedures, and food service cleaning were compared by state, *Goiás* presented the highest compliance rates and *Mato Grosso* the lowest (Table 5).

DISCUSSION

School food quality includes not only nutritional aspects but also safety aspects. Compliance with sanitary requirements protects and promotes the health of public school students⁴ and avoids foodborne disease outbreaks.

In the United States, foodborne diseases affect approximately one in every six people; yearly, 128,000 people are hospitalized and 3,000 die²⁰. Of the cases reported in Brazil from 2000 to 2011, 9.09% occurred in educational institutions²¹.

The lack of strict control during food preparation, poor physical conditions of the food preparation areas, and bad practices during food preparation processes and procedures may contaminate foods and compromise their safety, increasing the risks of foodborne diseases and their consequences²².

Foodborne disease outbreaks and food service studies indicate that many areas where school meals are prepared and distributed are not appropriate for meal production^{9,10,12}.

High noncompliance rates may stem from the lack of specific regulations for school food services, which are much more similar to residential kitchens than commercial kitchens. School and institutional food services are subject to the same legislation, which may impair the implementation of more complex regulations⁹. However, this does not justify noncompliance with the basic requirements for the production of safe meals, such as personal and food service hygiene.

Regarding physical, plumbing, and wiring conditions (Section A), a study pointed out that even food services of daycares located in the municipality of *São Paulo* (SP) had physical

noncompliances, especially doors without door sweeps and unscreened windows⁹. These noncompliances were also found in 94.6% of the study food services, and were the second most common noncompliances.

In *Salvador* (BA), of the 253 municipal and state school food services covered by PNAE, only 0.4% were in good conditions; 57.0% were unsatisfactory, especially regarding their physical, plumbing, and wiring conditions, which compromises the preparation of safe school meals⁴.

In the same city, some of the main problems were inappropriate cleaning of the food preparation areas and surfaces, unscreened doors and windows, unprotected lamps, inappropriate garbage can sites, and absence of liquid soap and paper towels in restrooms and kitchens¹¹.

Contrary to the study data, 37.5% of the 24 food services of state schools in the city of *São Paulo* (SP) presented good hygienic and sanitary conditions; the most common problem was inappropriate cleaning of stoves and refrigerators¹².

In agreement with the present study, 100% of the school food services assessed in *Natal* (RN) presented noncompliances. The lack of cafeterias and meal distribution outside the kitchen, that is, in classrooms, halls, and sport courts¹⁰ were among the greatest problems in both studies. The lack of cafeterias is also common in the schools of Ghana and South Africa, but these countries do not yet have effective school food programs like Brazil²³.

According to RDC nº 216/2004⁷, water tanks should be cleaned at least once per semester, and the cleanings should be recorded. In the present study, 66.8% of the food services cleaned the water tanks at least once per semester, but most kept no records. Water is one of the most important recourses for meal production and a determinant of food safety. Improper water tank cleaning method and/or frequency can affect food safety and quality²⁴.

Regarding equipment and utensils (Section B), good use of the food service layout and enough devices to meet meal production requirements reduce workload and improve efficiency⁸. However, the present study found that essential items, such as refrigerator, weighing scale, and thermometer, were not available in all food services.

Thawing should be done under refrigeration with a temperature below 5 °C or in a convection oven⁷. Thawing in a microwave, water, or at room temperature requires controlling thawing time and temperature of the surface layer of the food²⁵. Although nine food services did not have a refrigerator, only ten food services had a microwave oven, and nearly all food services did not have a thermometer, 72.1% of the food services thawed foods correctly: in the absence of the necessary equipment, they cooked the food in a pan or oven without prior thawing.

When foods are ready, they must be kept in clean food warmers in perfect working condition⁷; only one food service had a food warmer. However, 99.7% of the study food services served the meals as soon as they were ready, minimizing the risk of contamination.

Given the numerous physical noncompliances and absence of essential equipment in the study food services, public managers need to invest more in this sector, and dieticians, together with the School Food Council (CAE) need to participate more, to improve surveillance and guarantee safer meals.

In *Salvador* (BA), 49.4% of the food handlers had long nails, 70.6% used nail polishers, and in 51.7% of the food services, food handlers did not wash their hands often enough³. In Andalusia, Spain, the food handlers in 35.0% of the school canteens did not wash their hands properly, and in some canteens food handlers did not wash their hands at all²⁵. The findings for the study food services were similar, except for hand washing frequency because 80.9% of the interviewed food handlers complied with the legislation.

Food handlers are one of the main sources of contamination by staphylococci and coliforms because these microorganisms inhabit human skin²⁴. However, although hand washing is critical for the production of safe meals, a study of 38 elementary schools in *Hulu Langat* (Malaysia) found that only 15.3% of the food handlers knew all the steps for proper hand washing and that this activity was neglected by most food handlers²⁶.

Regarding processes and procedures (Section D), *Silva Jr*²⁴ reported that during goods receiving, the first stage of hygienic and sanitary control, the receiving clerk should check the expiration date, perform sensory analysis, check the packaging, observe the conditions of the delivery person, and weigh, measure, and record the temperature of the foods that require refrigeration. In the study food services, the lack of thermometers and weighing scales prevented verification of the temperature and weight of the delivered goods.

Vegetables should be washed by immersing them in chlorine-based bleach (150 to 200 ppm of chlorine) for 10 to 15 minutes, and both chlorinated isocyanurates and sodium hypochlorite may be used as the chlorine source²⁴. Appropriate cleaning reduces the amount of pathogenic microorganisms to an amount compatible with our immunity²⁴. However, most school food services did not wash the vegetables, which may place students' health at risk.

According to *Kaku et al.*²⁷, poor meal preparation hygiene in a school food service located in *Pontalina* (SP) caused 211 people to acquire foodborne disease from a mayonnaise sauce containing raw eggs. The main symptoms were diarrhea, fever, abdominal pain, vomiting, shivering, and headache, and 38.9% of those affected required hospitalization. Analysis of biological material and leftovers attributed the disease to *Salmonella* enteritidis²⁷. Although all study food services served only hard-boiled eggs, 16.4% offered preparations that contained raw eggs, which may increase the risk of foodborne disease outbreaks.

Given that dietitians are in charge of the PNAE and that their tasks include planning, creating, following, and assessing the school food menu¹⁵, their presence in schools is critical, as well as their submitting of food handlers to periodical training to minimize risks and provide a safe and healthy menu.

Regarding table cleaning, only 52.6% of the study food services cleaned tables properly, corroborating a study done in school canteens in *Andalusia* (Spain) that found unsatisfactory table cleaning and disinfection conditions²⁵.

Gomes *et al.*²⁸ found that 44.4% of the 18 food services they investigated in the state of *Goiás* did not perform chemical pest control, different from this study, which found that only 13.8% of the food services did not perform this control.

According to RDC n° 216/2004²⁹, food services must take measures to prevent the presence of pests and hire professional chemical pest control when their measures are not effective⁷. Pest control providers must follow a series of practical and operational regulations regarding type of product used and application techniques to minimize environmental impact and ensure consumer and operator health, and service quality and safety²⁹.

Most food handlers interviewed by the present study reported not undergoing periodical training. Frequent training minimizes the risk of foodborne diseases substantially³⁰. Food handlers are not knowledgeable about foodborne diseases, and their work has low social status and does not require a high education level³¹.

The legislation determines that food handlers undergo regular training on personal hygiene, safe food handling, and foodborne diseases, and have documented proof of their participation in such training sessions⁷. However, many study food services did not comply with this regulation, as did not 72.2% of the 13 food services investigated by another study conducted in the state of *Goiás*, which did not train their food handlers²⁸.

Since dietitians are in charge of the PNAE, they must train these professionals³². Under this perspective and given that one of the inclusion criteria was the presence of a dietitian in charge of the municipal school food, it is strange that so many food handlers did not undergo training regularly or at all, which may explain the high noncompliance rates of the GHP processes and procedures.

School food services located in urban areas differed significantly from those located in rural areas. The former presented higher compliance rates for almost all study variables, except for storage lighting, ventilation, and absence of unused objects (Table 3).

The results show that, since meals are prepared at school, the school should have proper places for storing foods, and preparing and distributing meals, to minimize the risks of contamination and provide safe foods to all public school students²³.

CONCLUSION

In light of the legislation, the food services of municipal schools in the Brazilian Midwest region present unsatisfactory physical and functional conditions, the food handlers do not comply with the proper hygienic and sanitary guidelines, and the GHP have not been implemented. The study results indicate that safe and quality meals cannot be guaranteed in the study schools.

The numerous noncompliances regarding the physical, plumbing, and wiring conditions of the food preparation areas and the lack of equipment suggest the need of greater interventions and involvement of municipal managers (mayor, head of the department of education), dietitians in charge of the school food, school principals, school food councils, and food handlers. Team work can ensure school compliance with food safety regulations, especially in schools located in rural areas.

Regarding processes and procedures, food handlers must be continuously and periodically trained to minimize the risk of food contamination stemming from the poor physical conditions of the school food services.

Over the years, the PNAE has made many advances to guarantee food and nutrition security. However, all social actors who work in the program need to invest, incentivize, intervene, and work more to ensure compliance with school food-related laws (Laws nº 11,947/2009 and 11,346/2006) and RDC nº 216/2004.

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CONTRIBUTORS

KM ALMEIDA helped to conceive and design the study, collect, analyze, and interpret data, review the literature and write the article. MCP ANDRÉ helped to conceive and design the study and write and review the article. MRH CAMPOS helped to conceive and design the study and review the article. MEP DÍAZ helped to define the methodological strategy, analyze and interpret the data and write and review the article.

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