



Hygiene compliance in Moroccan mass catering establishments: A cross-sectional assessment

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Abstract

With meals prepared outside the home posing a higher risk of foodborne outbreaks, the growing trend towards eating out raises concerns about the quality of meals served in mass catering establishments (MCEs). This study aimed to assess the determinants of hygiene in MCEs and identify the factors with the highest levels of non-compliance. A cross-sectional descriptive survey was conducted in six MCEs. Data on kitchen managers and food preparation workers (FPWs) were collected using a questionnaire. Data on hygiene status were collected through observations during food preparation and interviews with establishment managers and FPWs. Hygiene status was assessed using the method recommended by the Moroccan Ministry of Health for the inspection of food establishments. The result showed that 67% of the establishments outsource the management of their canteens. No establishment has a HACCP plan. 88% of FPWs were women. Among them 28% have never been to school, and the majority (88%) have never received any hygiene training. Two thirds of the establishments have a compliance rate of over 50% with 63% as the highest rate and the lowest compliance rate of 30%. Regarding the compliance rates according to the 5 dimensions assessed, the highest rates are obtained for Environment and Raw Material dimensions. However, Method and Labor dimensions have recorded the highest non-compliance rates. This study highlights the urgent need to enhance food handlers' knowledge of good hygiene practices and recommends implementing the HACCP system to ensure food safety in MCEs.

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1. Introduction

Unsafe food can cause acute or chronic illnesses from over 200 conditions, ranging from diarrhea to cancer, permanent disability, and death (1,2). The World Health Organization has estimated that 600 million people, or nearly one in ten people worldwide, become ill after consuming contaminated food (3). In the United States, 5,760 foodborne illness outbreaks were recorded between 2009 and 2015, resulting in 100,939 cases, 5,699 hospitalizations, and 145 deaths (4). In addition to the health impact, unsafe food also has significant economic implications, including direct and indirect costs of resulting illnesses, such as health care costs and productivity losses due to morbidity, disability, or mortality. Productivity losses in the United States have been estimated at between US\$6 billion and US\$9 billion in 1987 due to the seven specific pathogens alone (5). Foods prepared away from home have a higher risk

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of causing foodborne disease outbreaks than foods prepared at home (6). It has been estimated that more than 70% of foodborne disease outbreaks are attributed to foods prepared away from home (6,7).

In Morocco, the growing trend towards eating away from home among both young people and adults (8) and the increase in the number of meals served by collective catering establishments (9), have contributed to the increasing burden of foodborne diseases as a public health problem. Morocco also recorded 575 cases of foodborne illnesses, 42.2% of which were attributed to the consumption of food from collective catering during the year 2022 (10). A significant increase in foodborne illness outbreaks has also been revealed through the analysis of data from recent years in Morocco, mainly attributed to non-compliance with hygiene rules in collective catering establishments. Indeed, out of the 20,339 collective catering establishments inspected, 11% had a high health risk for consumers and 26% presented a medium risk (11). In addition, food has frequently represented the second cause of reported poisonings in Morocco in recent years (10,12). These data reveal significant gaps and poor hygiene management in catering establishments. These gaps may concern the precariousness of infrastructure, lack of training in good hygiene practices, lack of surface hygiene, insufficient quality of raw materials, and other contributing factors (6). Several studies conducted in various regions of Morocco, including the regions of Marrakech-Safi(13) , Casablanca-Settat (14), Rabat-Salé-Kénitra (15) and Fez-Meknes (16) , have reported worrying levels of food safety practices in mass catering establishment. However, According to the available literature, no similar study appears to have been conducted in the northwestern region of Morocco. Additionally, data assessing the level of compliance of Moroccan mass catering establishments with international food safety standards, such as those outlined by the Codex Alimentarius, remain scarce.

With this in mind, this work aims to assess the determinants of hygiene and identify the factors with the highest levels of non-compliance in a sample of catering establishments sited in the northwestern region of Morocco.

2. Materials and Methods

2.1. Survey Procedure

This descriptive cross-sectional study, carried out between November 2022 and April 2023, whose target population was six mass catering establishments in the province of Al Hoceima in Morocco. To collect the information, authorizations were obtained from the directors and managers of the establishments for the collection of data, after explaining the objectives of the study in detail.

2.2. Data Collection

Visits were carried out to collect the data for this study, using a questionnaire intended for the manager of the establishments. The data collected concerned the management of the kitchen and information related to food handlers. For the assessment of the state of hygiene, the data was collected by 2 main methods: interviews with the managers of the establishments and food handlers as well as observations during food preparation to concretely verify compliance with good hygiene practices.

2.3. Assessment of Hygiene Determinants

The assessment of hygiene criteria was carried out by applying the method recommended by the Ministry of Health of Morocco for the inspection of food establishments (17). This consists of classifying potential sources of contamination into five categories which are:

- Environment: The environment where food is prepared or stored, including construction, sanitary facilities, ventilation, cleanliness.
- Equipment: The equipment used in the preparation or storage of food, such as kitchen utensils and surfaces in contact with food.
- Method: The procedures and techniques applied in the handling and preparation of food, from the reception of raw materials to the use of finished products.
- Raw material: The ingredients and raw materials used in the preparation of food, including animal or animal-derived foods, plant products, water and ice.
- Labor: The staff, including their training and their personal and clothing hygiene.

This method is based on the principle of the Ishikawa diagram which is used to identify and organize the causes that lead to an incident (18). It is a widely used tool to analyze risks in food establishments and industries (18-20).

On the previously developed evaluation grid, the data collected on the dimensions studied are entered. These are the five main parts or groups of evaluated criteria corresponding to (I) Environment, (II) Material, (III) Method, (IV) Raw Material and (V) Labor. Each of the five parts contains a list of hygiene criteria specific to each dimension evaluated. A score is awarded for each criterion evaluated during the evaluation of the latter and recorded on the grid. These scores are awarded according to the following rating system: A score of 2 is assigned when the criteria are deemed compliant (optimal compliance), a score of 1 if these criteria are partially compliant and a score of 0 is considered for non-compliant criteria. A total of 100 criteria were included in our evaluation grid.

The criteria included in this study were developed based on the hygiene requirements necessary to guarantee food safety as mentioned in national and international standards, namely:

- ISO 22000:2018 (21)
- Codex Alimentarius (22)
- NM 08.0.000 (23)
- Inspection guide for food establishments (17)

To ensure the anonymity of the establishments, an indicative code was assigned to each: Establishment No.1: E1, Establishment No. 2: E2, Establishment No. 3: E3, Establishment No. 4: E4, Establishment No. 5: E5, Establishment No. 6: E6

2.4. Data Processing and Analysis

The collected data were entered and analyzed using Excel software. Data concerning kitchen management and socio-demographic characteristics of food handlers are presented in frequencies and percentages. For the processing and analysis of data related to the assessment of hygiene criteria, compliance rates were calculated for each establishment and for each dimension assessed as follows:

2.4.1. Method for rating compliance rates by establishment:

$$\bullet \text{ Optimal compliance rate} = \frac{\text{Number of criteria rated 2}}{\text{Total number of criteria assessed}} \times 100 \quad (1)$$

$$\bullet \text{ Partial compliance rate} = \frac{\text{Number of criteria rated 1}}{\text{Total number of criteria assessed}} \times 100 \quad (2)$$

$$\bullet \text{ Non-compliance rate} = \frac{\text{Number of criteria rated 0}}{\text{Total number of criteria assessed}} \times 100 \quad (3)$$

2.4.2. Method for rating compliance rates by dimension:

The rates are calculated in a similar way to the compliance rates by establishment, except that the denominator represents the total number of criteria associated with the dimension, and the numerator corresponds to the number of criteria in this dimension that received a score of 2, 1 or 0, to calculate the optimal compliance rate, the partial compliance rate and the non-compliance rate respectively.

Given the small sample size, it was not possible to perform further statistical analyses.

3. Results and Discussion

3.1. Sample Description

The results of this study are presented in Table 1. The data show that 67% of the establishments studied subcontract the management of their canteen to a company. No establishment has a HACCP plan at the kitchen level. The vast majority of food handlers (88%) are women. Among the food handlers who participated in this study, 28% have never been to school and only 12% have a university/professional degree. Most of the food handlers (88%) have never received any hygiene training.

Table 1. Sample description

	Number (n)	Percentage (%)
Canteen management method		
Internal	2	33 %
External	4	67 %
HACCP Plan		
With	0	0 %
Without	6	100 %
Gender of food handlers		
Female	22	88 %
Male	3	12 %
Education level of food handlers		
Never attended school	7	28 %
Primary school	4	16 %
Middle school	10	40 %
High school	1	4 %
University/professional degree	3	12 %
Number of food handlers that have ever had Hygiene training		
No	22	88 %
Yes	3	12 %

3.2. Assessment of Compliance with Hygiene Criteria by Establishments

As illustrated in Figure 1, the rate of compliance with hygiene criteria varies from one establishment to another. A compliance rate of over 50% was obtained by the majority of establishments (2/3). The highest compliance rate was 63% and was observed for one establishment (E5). On the other hand, the lowest compliance rate, i.e. 30%, was recorded for one establishment (E3).

For the establishments participating in this study, these compliance rates obtained are relatively higher than those found by the study of El Ghaza et al.(15) which was conducted in three school catering locations in the Gharb Cherarda Beni Hssen region in Morocco and which assessed the level of compliance with hygiene conditions in these canteens. Indeed, in this last study, compliance rates of 33% were reported for 2 establishments and 48.58% for the third establishment (15) .

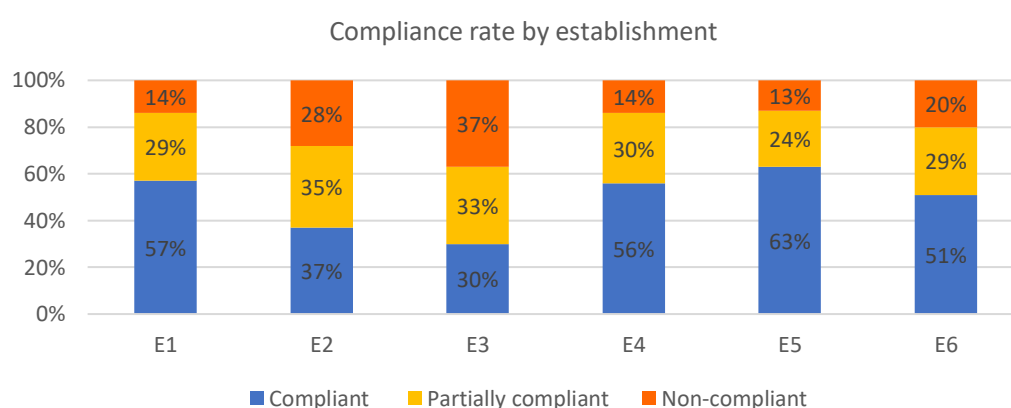


Figure 1. Rates of compliance, partial compliance and non-compliance with hygiene criteria by establishment (E1-E5).

3.3. Evaluation of Compliance of Hygiene Criteria According to the 5 Dimensions Assessed

The compliance rates obtained according to the 5 dimensions assessed are presented in Figure 2. The figure shows that the highest compliance rates are obtained for the two dimensions Environment and Raw Material compared to the other dimensions.

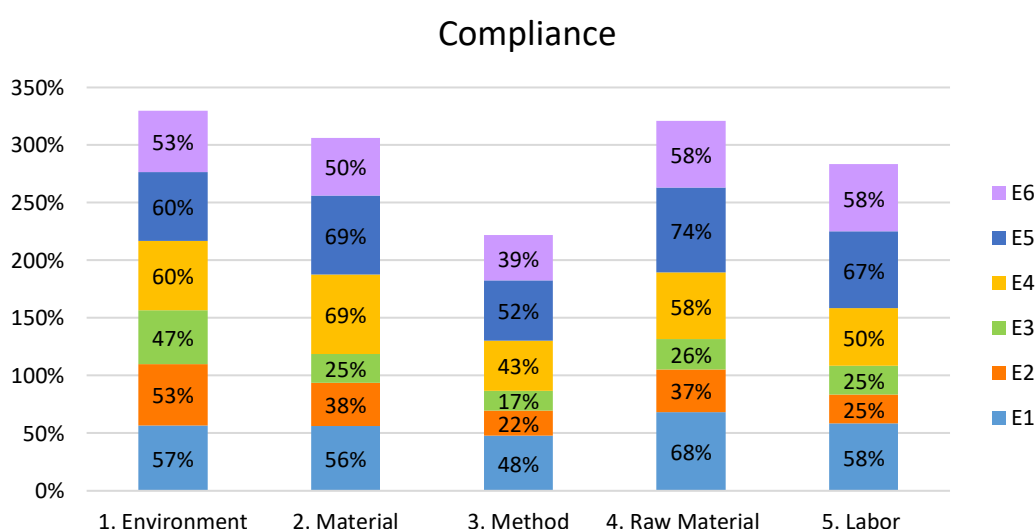


Figure 2. Rate of compliance with hygiene criteria according to the 5 dimensions assessed

Thus, all the establishments had obtained a compliance rate greater than or equal to 47% for the criteria related to the Environment, while for the criteria related to Raw Material, two thirds of the establishments studied obtained a compliance rate greater than or equal to 58% (Table 2).

Furthermore, the highest non-compliance rates are recorded for the dimensions Method and Labor compared to the other dimensions (Figure 3). In fact, a non-compliance rate greater than or equal to 48% was observed for the criteria related to the Method in 1/3 of the establishments and a non-compliance rate varying from 17% to 50% was obtained for the criteria related to the Workforce (figure 3; table 2)

Table 2. Rate of compliance according to the 5 dimensions assessed

The 5 dimensions assessed	Establishments					
	E1	E2	E3	E4	E5	E6
1. Environment						
Compliant	57%	53%	47%	60%	60%	53%
Partially compliant	30%	27%	33%	30%	33%	30%
Non-compliant	13%	20%	20%	10%	7%	17%
2. Material						
Compliant	56%	38%	25%	69%	69%	50%
Partially compliant	31%	43%	31%	13%	19%	31%
Non-compliant	13%	19%	44%	19%	13%	19%
3. Method						
Compliant	48%	22%	17%	43%	52%	39%
Partially compliant	35%	30%	30%	39%	26%	30%
Non-compliant	17%	48%	52%	17%	22%	30%
4. Raw material						
Compliant	68%	37%	26%	58%	74%	58%
Partially compliant	21%	42%	42%	31%	15%	26%
Non-compliant	11%	21%	32%	11%	11%	16%
5. Labor						
Compliant	58%	25%	25%	50%	67%	58%
Partially compliant	25%	42%	25%	33%	16%	25%
Non-compliant	17%	33%	50%	17%	17%	17%

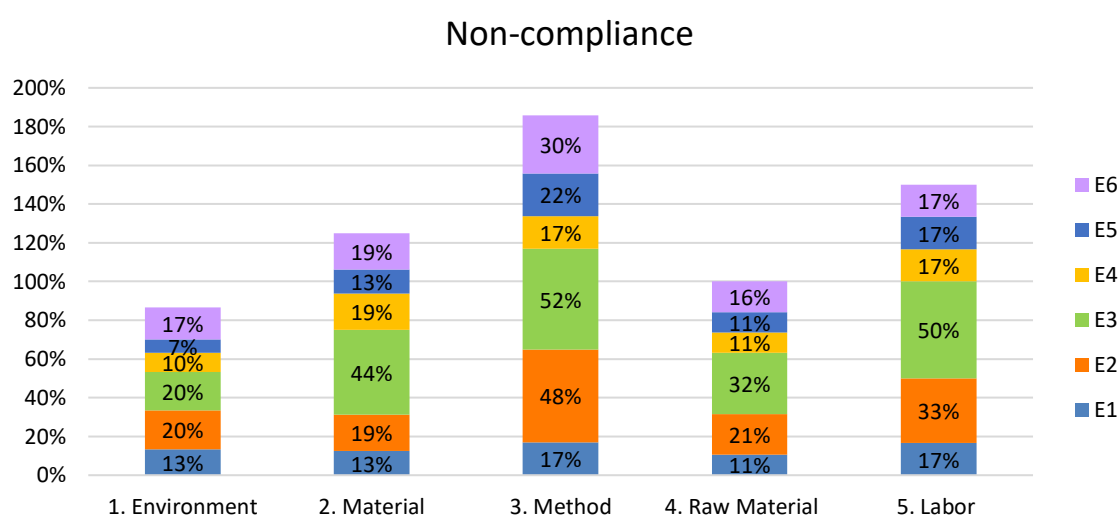


Figure 3. Rate of non-compliance with hygiene criteria according to the 5 dimensions assessed

In this study as well as that of El Ghaza et al.(15) , the highest non-compliance rates are observed for hygiene criteria related to the method and the workforce. Comparable results are also obtained in another study conducted by El Kadmiri and colleagues who found that the most frequent hygiene failures revealed at the level of collective catering establishments in the "Hay Hassani" district of Casablanca, are defects mainly related to the working method, in this case the preparation, handling and preservation of food as well as to the workforce, namely, hand hygiene and personal hygiene (14). In Malaysia, similar findings have been reported regarding the causes of foodborne diseases; approximately 50% of reported food poisoning cases were linked to insanitary food handling practices and a lack of cleanliness in food establishments (24). This is comparable to the present findings in Morocco, where the non-compliance rate for the Method dimension reached 52%. This similarity may reflect shared challenges in the implementation of food safety practices in low- and middle-income countries.

This finding can be explained firstly by the low level of education of food handlers as well as the insufficiency, or even the absence, of basic training and/or continuing training in terms of hygiene. In fact, the results reported by both the present study and previous studies are related to the low level of education and the absence of hygiene training of the food handlers in their vast majority (25-29). Education and training of food handlers are essential measures for the prevention of foodborne diseases as highlighted by the WHO (26,30,31). Additionally, the health risk assessments conducted by the Ministry of health of Malaysia have identified the improper food handling training as one of the three critical risks for food-borne disease (32).

In line with this, the Moroccan standard on general principles of food hygiene requires that managers of establishments regularly organize food hygiene training for food handlers (23) . In addition, the role of training, which is of crucial importance in improving the knowledge of food handlers and ensuring food safety in mass catering, has also been highlighted by many other studies (24,29,31,33-36).

In addition, posting hygiene information sheets in food preparation areas has a positive influence on food handler behaviour, as demonstrated by a study conducted in eight mass catering establishments in southern Ontario, Canada, which leading to improved

handwashing practices and a significant reduction in direct and indirect cross-contamination events (37). Garayoa et al. also observed, in their study aimed at assessing the storage temperatures of prepared foods and surface hygiene, that the percentage of prepared foods stored at the recommended temperature ($\geq 65^{\circ}\text{C}$) significantly increased and that surface cleaning and disinfection activities became more effective after training provided to food handlers (38). These findings underscore the importance of the implementation of structured interventions, such as regular in-service training sessions and the use of visual tools like the WHO's "Five Keys to Safer Food" posters in kitchen areas, to reinforce the key hygiene behaviours in mass catering establishments.

In addition to the lack of hygiene training provided to food handlers, as revealed by the data recorded in this study, the results also showed that none of the participating establishments had a HACCP system in place. This finding is particularly worrying; as the implementation of a HACCP system in mass catering is strongly recommended to control food insecurity hazards and reduce the risk of foodborne illness (22,39,40). Indeed, following the announcement of a nosocomial outbreak of foodborne salmonellosis in a university hospital in Greece, Gikas and colleagues stated that bacteriological sampling of the finished product, regular medical monitoring of food handlers and inspection of their practices remained insufficient in the absence of implementation of a HACCP system in mass catering aimed at ensuring the safety of the dishes served and preventing food-borne illnesses (41). The absence of the HACCP plan in mass catering establishments can be explained by several factors, including lack of knowledge about HACCP, the absence of prerequisite programs, inadequate training of staff, limited financial and technical resources, high implementation costs, and notably, a lack of motivation among both employees and managers (42,43). Therefore, targeted training, technical support and motivational strategies are recommended to facilitate effective HACCP implementation in mass catering establishments. Successful HACCP implementation in various types of food businesses has been documented in several low- and middle- income countries, such as Turkey (42) and Malaysia (44).

4. Conclusions

This study assessed the determinants of hygiene in collective catering establishments. The data reported reveal a moderately satisfactory state of hygiene in the establishments studied. However, certain determinants, in particular the method and the workforce, showed a worrying level of non-compliance. This finding is in line with the results of other studies conducted both in Morocco and internationally and indicates that food handling methods and the workforce in this sector remain a major issue for food safety in collective catering. These results highlight the urgent need to improve the level of knowledge of food handlers in terms of good hygiene practices, in particular through continuous training and the display of hygiene information sheets in food preparation areas. On the other hand, the implementation of the HACCP system within collective catering establishments is necessary and strongly recommended, due to its crucial role in improving and guaranteeing food safety.

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Author Contributions

FF carried out the research and wrote the paper. HC, IB, HB & RM participated in the design of the research and the analysis of the results and participated in data collection.

AE, AF & RB contributed to the discussion of the results and revision of the manuscript. RB supervised the research.

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Conflicts of Interest

Authors declare no conflict of interest.

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