

# Effect of Food Hygiene and Safety Training Intervention on Compliance with Food Hygiene and Safety Practices Among Food Handlers in Boarding Schools in Embu County, Kenya

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## Abstract

**Background:** While compliance with food safety and hygiene practices has been addressed by different stakeholders, scarce data exist on the effectiveness of training on food hygiene and safety among food handlers in boarding schools. The purpose of this study was to evaluate the effect of food hygiene and safety training on compliance with food hygiene and safety practices among food handlers in boarding schools in Embu County, Kenya.

**Results:** The overall compliance increased from 74% to 84% in the intervention arm compared to the control. This is a change of 12% that could be attributed to the intervention,  $p < 0.001$ . Results showed that compliance with personal hygiene measures increased from 70% to 76% in the intervention arm which is a DID change of 6%,  $p = 0.029$ . Compliance with food safety measures as far as premises are concerned increased from 72% to 89% in the intervention arm which is a DID change of 18%,  $p < 0.001$ . Compliance with environmental food safety measures increased from 81% to 85% in the intervention arm which is a DID change of 9%,  $p < 0.001$ .

**Conclusion:** Food hygiene and safety training intervention on compliance with food hygiene and safety practices was effective on various aspects of food hygiene measures assessed.

**Keywords:** Compliance, Food handlers, Food Hygiene and Safety Training Intervention

## 1. Introduction

Food serves as a source of various pathogens and an excellent means by which many pathogens can reach a suitable colonization site in a new host, making foodborne diseases an increasingly serious global public health concern with significant morbidity and mortality even in regions with already established modernized food safety systems [1]. Food hygiene is the process of preparing and preserving foods in a way that ensures they are safe for human consumption, according to the World Health Organization. Food safety requires proper food hygiene [2]. The Codex Alimentarius defines food handlers as employees who work in the food service industry. They deal with food or related items that are directly

related to food utensils that are intended to help with food preparation, processing, serving, transportation, delivery, and packaging in any established food establishment. The prevention of food contamination from food production to food consumption is largely the responsibility of those who handle food [3].

Data from developing African countries showed that 70% of diarrhea cases were related to foodborne diseases, which are spreading throughout the continent at an alarming rate [4]. About 75% of outbreaks of foodborne illness are linked to inadequate safe food handling procedures used by concerned food handlers in reputable restaurants. Food handlers are crucial in ensuring that

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the principles of food safety are strictly followed throughout the entire food production process, it has been noted [5]. For example, poor practice of food safety was observed among food handlers during a school health program in Ilishan-Remo, Nigeria [6]. According to the World Health Organization, 600 million cases of foodborne illness occur annually, or one out of every ten people (or 1/10), as a result of consuming contaminated food [7]. Foodborne illnesses are brought on by food contamination, which can happen at any point in the chain from food production to delivery to consumption. Inadequate hygienic and safety practices lead to foodborne illness [8].

In Kenya, there are 1,140 DALYs per 100,000 people due to foodborne illness, and over 70% of diarrhea cases are attributed to eating contaminated food and water with typhoid, dysentery, and gastroenteritis being the leading cases and this is linked with noncompliance to stipulated hygiene and safety standards in a country [9]. In developing nations such as Kenya, it's a legal requirement for a pre-placement medical examination for all food handlers serving on public premises which includes learning institutions with at least subsequent yearly post-placement medical evaluation [10]. This technique has been used to identify infected food handlers to prevent food contamination. However, the degree to which learning institutions adhere to these requirements is unknown and there is a need to ensure public health officers ensure compliance with these regulations to prevent the risk of foodborne illnesses [11]. The purpose of this study was to evaluate the effectiveness of food hygiene and safety training compliance to food hygiene and safety practices among food handlers in boarding schools in Embu County, Kenya.

## **2. Materials And Methods**

### **2.1. Study Design**

A longitudinal nonequivalent quasi-experimental survey design was used in this study.

### **2.2. Study Area**

The research was conducted at Embu County in Kenya among food handlers from December 2022 to May 2023. The research location was in boarding schools both primary and secondary situated in Embu County.

### **2.3. Study Population**

The study population consisted of food handlers who were willing to participate in the study and who were working in boarding primary and secondary schools in Embu County that met the inclusion criteria.

### **2.4. Sample Size Determination**

The population was gathered from 27 boarding schools in Embu County (15 primary public, 3 primary private, 8 secondary public, and 1 secondary private). Nevertheless, 84 food handlers from the various primary and secondary boarding schools in the upper and lower zones of Embu County were chosen as samples. The

Magnani formula has been recommended as the best method for estimating the sample size when conducting an impact study [12]. Consequently, 198 study participants were enlisted for this investigation. Since the study was an impact study, the 198 study participants were divided in half for each of the two study arms, yielding 99 participants per arm.

### **2.5. Sampling Technique**

Embu County was specifically chosen for this study because there has been an increase in the incidence of foodborne illnesses linked to a lack of adherence to food hygiene and safety practices. This research used multistage sampling and purposive sampling techniques. For instance, there were foodborne outbreaks in 2017 and 2019 that led to 46 cases and 3 fatalities.

### **2.6. Data Collection Tools And Procedures**

After collecting the baseline data from the two arms, food hygiene training was given to the intervention group. Each training session had a cluster of 15 – 20 respondents at a time. There were five sessions within the one-week training period to ensure all the respondents received training. Each training session lasted for one hour. The training was based at the sub-county headquarters for each of the three sub-counties under the intervention arm. After one month, a second training was conducted to reinforce the information given during the first training, and then a third and final training after the second month. The training entailed improving the knowledge and hygiene practices of food handlers in boarding schools. The training contents were on transmission routes for food-borne diseases (F-diagram), Hygiene of food premises, and environmental waste management including both solid and liquid waste. Materials and methods included the use of lectures, leaflets, and demonstrations. Posters displaying proper steps of handwashing and the fecal-oral route of disease transmission (F-diagram) to serve as a reminder were provided in the kitchen and dining facilities. Six months after the baseline survey, post-intervention data was collected from the intervention group and the control group. Immediately after the end-line survey, the control group was given the same food hygiene training for them to benefit from the training.

### **2.7. Statistical Analysis**

Data from food handlers was gathered, and it was transformed into frequency and percentage. Data analysis was conducted using STATA version 17. The difference-in-difference (DID) impact evaluation method was used to assess the effectiveness of the intervention on the study outcomes [13]. The responses on each of the variables used to measure compliance were added up to create composite scores. The summative score was divided by the total expected score for that item to determine the percentage score for each person.

### **2.8. Ethical Consideration**

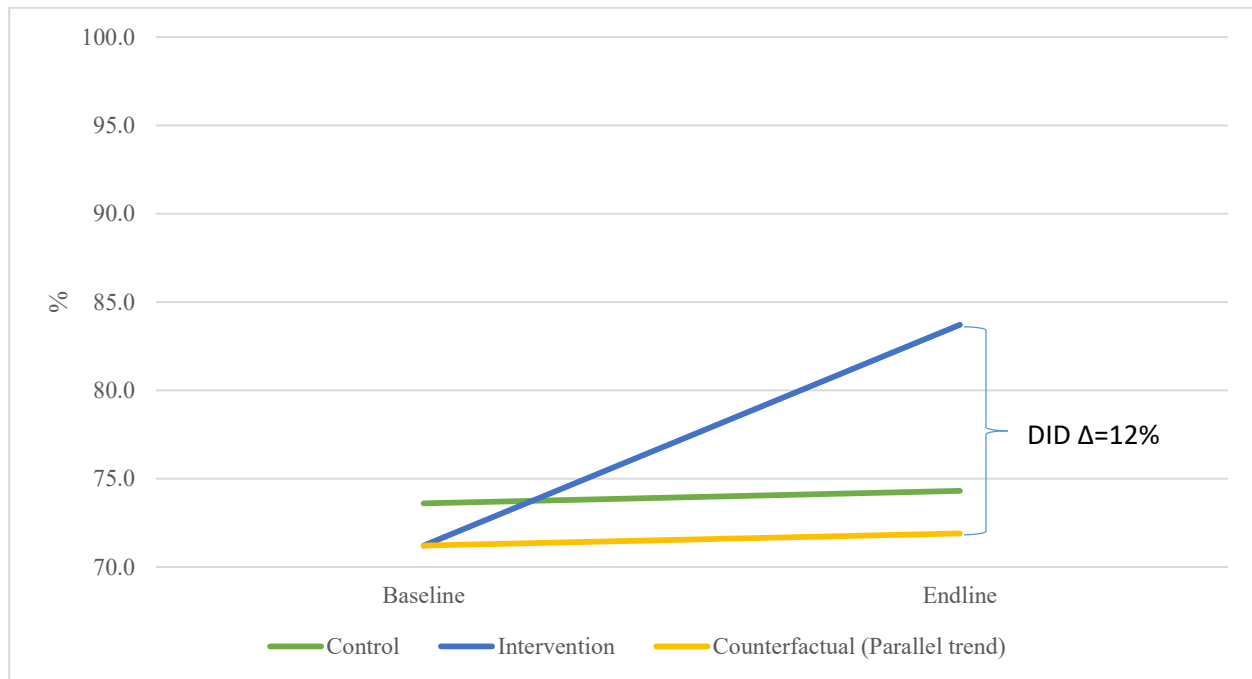
The MKU Institutional and Ethical Review Committee (IERC) provided the study with ethical approval, and the National

Commission for Science, Technology, and Innovation (NACOSTI) granted permission to conduct the study. Written informed consent was used to obtain the subjects' voluntary consent to participate in the study, and participant confidentiality was protected by withholding any information that could be used to identify them, such as their names. The safety training was given to the control group after the research exercise because it was determined to be effective, ensuring that they also benefited from the intervention.

### 3. Results

#### 3.1. Overall Compliance On Food Safety Measures

Figure 1 shows the changes in overall compliance between baseline and end-line in both control and intervention arms and the amount of change that could be attributed to the intervention based on the DID analysis. Results showed that overall compliance increased from 74% to 84% in the intervention arm compared to the control arm which did not significantly change (from 74% to 72%). This is a change of 12% that could be attributed to the intervention,  $p < 0.001$ .

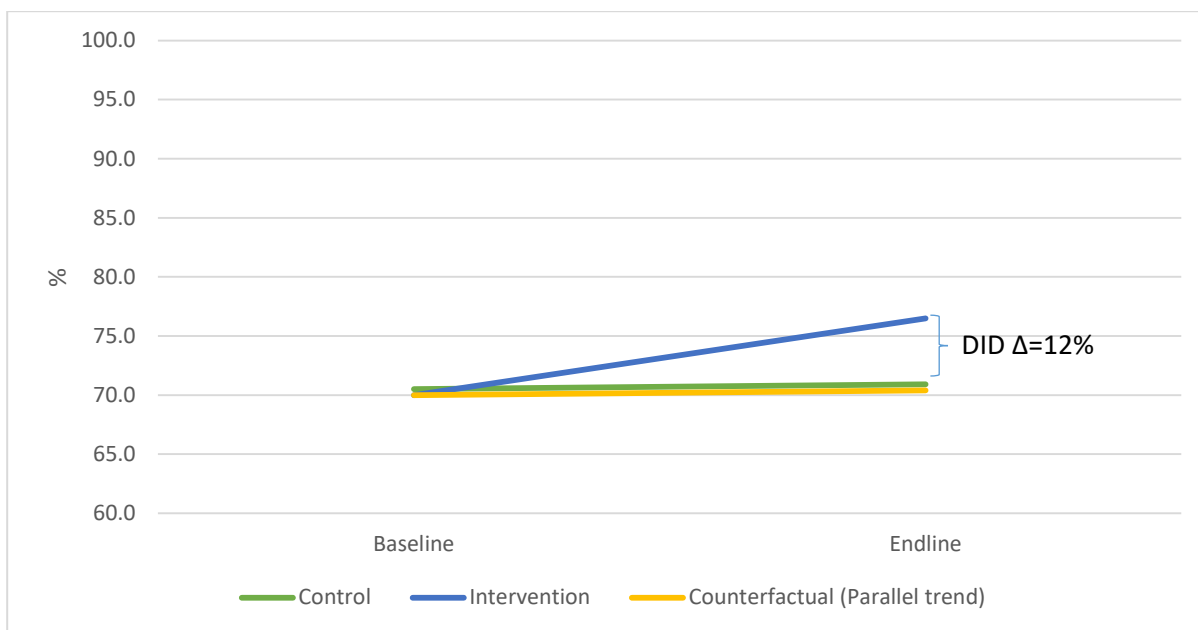


**Figure 1:** Effect of the intervention on the overall compliance food safety measures accounting for the parallel trend assumption of the DID analysis

#### 3.2. Compliance With Personal Hygiene Measures

Figure 2, shows the changes in compliance levels for personal hygiene measures between baseline and end-line in both control and intervention arms and the amount of change that could be attributed to the intervention based on the DID analysis. Results

showed that compliance with personal hygiene measures increased from 70% to 76% in the intervention arm compared to the control arm which did not significantly change (from 70% to 71%) which is a DID change of 6%,  $p = 0.029$ .



**Figure 2:** Effect of the intervention on the compliance with personal hygiene measures of food safety measures among food handlers accounting for the parallel trend assumption of the DID analysis

As indicated in Table 1 regarding compliance with personal hygiene, Significant changes were observed in the following variables: Not using aprons and dirty kitchen towels to wipe kitchen surfaces (Control: 31% to 30%, Intervention: 37% to 95%, DID change=59%,  $p<0.001$ ); food handler using an apron when handling, preparing and serving (Control: 77% to 74%, Intervention:

88% to 98%, DID change=13%,  $p<0.001$ ), food handler being in headgear when handling, preparing and serving food (Control: 35% to 34%, Intervention: 15% to 85%, DID change=72%,  $p<0.001$ ) and food handler having short nails (Control: 86% to 84%, Intervention: 88% to 99%, DID change=13%,  $p<0.001$ ).

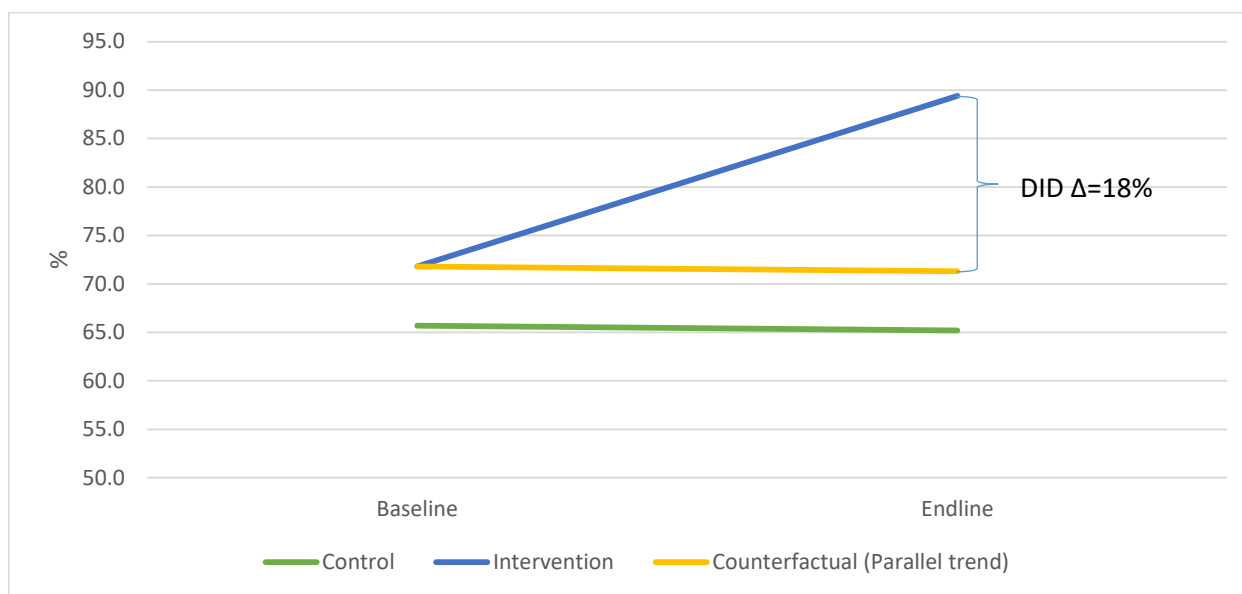
	Control (%)		Intervention (%)		DID	
	Baseline (n=99)	Endline (n=96)	Baseline (n=99)	Endline (n=96)	Change	p-value
Not use of aprons and dirty kitchen towels to wipe kitchen surfaces	31.3	29.9	37.4	94.8	58.80	<0.001
Absence of nail polish among food handlers	90.9	88.5	93.9	94.8	3.30	0.223
Are the food handler clean in person and in clothing	89.9	88.5	96.0	99.0	4.40	0.212
Does the food handler use an apron when handling preparing and serving	76.8	74.3	87.9	97.9	12.50	0.015
Does the food handler have short nails	85.9	84.1	87.9	99.0	12.90	0.017
Is the food handler in headgear when handling, preparing and serving food	35.4	33.8	15.2	85.4	71.80	<0.001
Does the food handler NOT wear jewellery?	83.8	83.3	94.9	99.9	5.50	0.128

**Table 1: Compliance with Personal Hygiene Measures.**

### 3.3. Compliance with Hygiene Measures for the Food Premises

Figure 3 shows the changes in compliance levels to hygiene measures for the premises between baseline and end-line in both control and intervention arms and the amount of change that could be attributed to the intervention based on the DID analysis. Results showed that compliance to food safety measures as far as premises

are concerned increased from 72% to 89% in the intervention arm compared to the control arm which did not significantly change (from 66% to 65%) which is a DID change of 18%,  $p < 0.001$ . Table fourteen presents the results for each variable used to measure compliance regarding premises.



**Figure 3:** Effect of the intervention on compliance with hygiene measures of food safety measures for premises accounting for the parallel trend assumption of the DID analysis

As indicated in Table 2, regarding compliance with hygiene measures for the premises, Significant changes were observed in the following variables: Evidence of adequate ventilation (Control: 80% to 78%, Intervention: 84% to 98%, DID change=16%,  $p=0.008$ ); presence of equipment that ensure safe handling of food (Control: 56% to 58%, Intervention: 64% to 100%, DID change=35%,  $p<0.001$ ), adequate natural/artificial lighting in the premises (Control: 91% to 90%, Intervention: 90% to 98%, DID change=9.4%,  $p=0.034$ ), adequate supply of cold and hot water

in the food premises (Control: 67% to 65%, Intervention: 69% to 100%, DID change=9%,  $p<0.001$ ), availability of food storage area maintained in a clean condition (Control: 84% to 82%, Intervention: 90% to 100%, DID change=12%,  $p=0.006$ ), adequate kitchen equipment designed to perform their duties (Control: 61% to 62%, Intervention: 67% to 81%, DID change=12%,  $p=0.005$ ) and are adequate facilities designed to perform the duties (Control: 59% to 60%, Intervention: 64% to 84%, DID change=19%,  $p=0.002$ )

	Control (%)		Intervention (%)		DID	
	Baseline (n=99)	Endline (n=96)	Baseline (n=99)	Endline (n=96)	Change	p-value
Evidence of adequate ventilation	79.8	78.2	83.8	97.9	15.70	0.008
Presence of equipment that ensure safe handling of food	56.6	58.1	63.6	100.0	34.90	<0.001
Adequate natural/artificial lighting in the premises	90.9	89.5	89.9	97.9	9.40	0.034
Adequate supply of cold and hot water in the food premises	66.7	65.2	58.6	100.0	42.90	<0.001

Availability of food storage area maintained in a clean condition	83.8	81.8	89.9	100.0	12.10	0.006
Availability of adequate handwashing facilities available	60.6	62.3	94.9	97.9	1.30	0.886
There are adequate kitchen equipment designed to perform my duties (refrigeration, food preparation equipment, and small wares)	61.1	62.3	66.9	80.5	12.40	0.005
There are adequate facilities designed to perform my duties (working space, adequate lighting and ventilation, washing facilities, drainage system & adequate water supply)	59.1	60.2	64.2	84.1	18.80	0.002

**Table 2: Compliance with hygiene measures for the premises**

### 3.4. Compliance With Environmental Hygiene Measures

As indicated in Table 3, regarding compliance with environmental hygiene measures. Significant changes were observed in the following variables: availability of pest control measures (Control: 83% to 78%, Intervention: 65% to 96%, DID change=36%,  $p<0.001$ ); absence of pest vermin and vectors rodents evident around the food premise (Control: 82% to 83%, Intervention:

52% to 83%, DID change=31%,  $p<0.001$ ) and presence of a handwashing facility next to the toilet (Control: 71% to 82%, Intervention: 74% to 100%, DID change=15%,  $p=0.008$ ). Lastly, findings revealed that compliance to environmental food safety measures increased from 81% to 85% in the intervention arm compared to the control arm which changed (from 85% to 79%) which is a DID change of 9%,  $p<0.001$

	Control (%)		Intervention (%)		DID	
	Baseline (n=99)	Endline (n=96)	Baseline (n=99)	Endline (n=96)	Change	p-value
Availability of pest control measures	82.8	78.2	64.6	95.8	35.80	<0.001
No vermin and vectors rodents around the food premises	81.8	83.0	51.5	83.3	30.60	<0.001
Adequate waste (water or food) disposal facilities available	87.9	89.5	100.0	99.0	-2.60	0.956
Environment around the food store is far from rubbish, waste water, toilet facilities, open drains and animals?	97.0	98.0	97.0	100.0	2.00	0.884
Presence of a handwashing facility next to the toilet	70.7	81.8	73.7	100.0	15.20	0.008
There is potable water at the site or close to the site	86.9	85.0	100.0	100.0	1.90	0.567

**Table 3: Compliance with Environmental Hygiene Measures**

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#### 4. Discussion

Concerning overall compliance with food hygiene and safety practices, Food handlers have a significant role in ensuring the safety of food throughout the production process, storage, and preparation. A recent meta-analysis has indicated food hygiene training increases and improves knowledge which also improves attitudes about hand hygiene practices and it has been proven improved training and regular emphasis on hand washing practices among food handlers [14]. The significant change in the intervention arm may be attributed to repeated training during the study.

Regarding compliance with personal hygiene measures, It's mandatory for any food production establishment to comply with the Food Drugs and Chemical Substances Act of 2013. The act regulates how food should be handled during the process of production and preparation, how food should be stored, how to construct buildings, and various ways to dispose of waste accordingly. Besides, food establishments must comply with the by-laws for each [15].

Regarding compliance with hygiene measures for the premises. From previous studies, the Kenyan Public Health Act has set out criteria for how food Premises which include buildings and rooms involved in food preparation and storage should be constructed and maintained. They must be kept clean and in good condition and the design must provide suitable space for working and maintaining hygienic practices, prevent a build-up of dirt and mold, and provide suitable conditions for handling and storage of food [16]. This is because they form the immediate food environment and hence play a crucial role in food hygiene. From the results, the intervention really contributed to the compliance with the laid down regulations. Concerning compliance with environmental hygiene measures, The results after the intervention concurs with the European Union of food safety, which demands, that food premises should meet environmental standards linked to their construction. These standards stipulate that premises should be built in a way that minimizes the associated potential for environmental pollution which can lead to contamination. The standard lays out various environmental-related regulations linked to food premises and kitchen areas are laid out [17]. The Kenya Public Health Act Cap 242 of 2012 provides that the food premises should be designed appropriately so that they are easy to clean, maintain, and repair [18].

#### 5. Conclusion

The study evaluated the effectiveness of the training (the intervention) on overall compliance and on each of the three categories of compliance, using a difference-in-difference analysis method. Concerning, Compliance with personal hygiene measures; Results showed that compliance to personal hygiene measures increased from 70% to 76% in the intervention arm compared to the control arm which did not significantly change (from 70% to 71%) which is a DID change of 6%,  $p=0.029$ . Concerning, Compliance with premise hygiene and food safety measures; Results showed

that compliance to food safety measures as far as premises were concerned increased from 72% to 89% in the intervention arm compared to the control arm which did not significantly change (from 66% to 65%) which is a DID change of 18%,  $p<0.001$ . Concerning, Compliance with environmental hygiene and food safety measures; Results showed that compliance with environmental food safety measures increased from 81% to 85% in the intervention arm compared to the control arm which changed (from 85% to 79%) which is a DID change of 9%,  $p<0.001$ .

#### Declaration

**Funding:** No funding sources.

**Conflict of interest:** The authors declare that they have no competing interests.

**Ethical approval:** The study was approved by the Institutional Ethics Committee.

**Consent to participate:** The participant was asked to voluntarily participate in the study through written informed consent and the confidentiality of the study participants was ensured by not indicating any form of identification like the name of the participant.

**Consent for publication:** Not Applicable

**Availability of data and materials:** The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

**Code availability:** Not Applicable

**Acknowledgment:** The study participants' enthusiasm for taking part in this research is acknowledged by the authors.

#### Research highlights

- To determine the level of compliance with hygiene measures for the food premises.
- To determine the level of compliance with environmental hygiene measures.
- To determine the level of compliance with Personal Hygiene Measures.
- To determine the effect of food hygiene and safety intervention on the overall compliance of food safety measures

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