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**Al-Quds University**



**Evaluation of the Food Safety Situation and  
Characteristics in the West Bank Central Area  
Restaurants**

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**Master Thesis**

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**Evaluation of the Food Safety Situation and  
Characteristics in the West Bank Central Area  
Restaurants**

**By**

**Deaffallah Atyah Swaidat**

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for the Degree of Master of Public Health/ School of Public  
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**Evaluation of the Food Safety situation and characteristics in the West Bank central area  
Restaurants**

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## Dedication

For the Palestinian people and  
to all humanitarian services providers

With love and respect

## Declaration

I certify that this thesis submitted for the degree of masters in Public Health at Al-Quds University is a result of my research, and that this thesis has not been previously submitted for a higher degree to any other university or institute before.

Singed by the student: Deaffallah sweedat

Date : 28, April, 2012

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## **Abstract**

In West Bank (WB) studies on food safety situation in restaurants are limited. This study aimed to evaluate the food safety situation, its characteristics and determinants in all the restaurants of the districts of Ramallah, Bethlehem and Jericho. The inspection was carried out by means of physical inspection and filling of a questionnaire implementing HACCP model applying a scoring system. The study as well explored the value and the possible need for implementing such scoring system in the restaurants inspection in the WB.

About 187 restaurants were surveyed in the targeted areas in the year 2010 and many of the restaurants characteristics were studied. Among the results the study showed that of these restaurants 62% were from the popular category, 19.3% were fast food restaurants, 13.9% were hotel restaurants and 4.8% were touristic restaurants. About 79.1% of the restaurants were located in the cities, 2.7% in camps, and 18.2 % in suburban areas. The results showed that the mean food safety score for the restaurants was 71%. The proportion of the restaurants with a certified general manager was only 31% and the percentage of managers that had a post school education was only 46.6%. The results also showed that only 86% of the restaurants had a kitchen manager or chef but also only 53% were with kitchen manager who is certified in food safety. The percentage of food handlers who had knowledge about food safety, certified workers, was only 72.7%.

The top five high violations recorded in the study were poor personnel hygiene-hands detected in 86.6% of the restaurants, not using the sanitizer and rinse (hot water-chemical), or exposure time detected in 79.1% of the restaurants, lack of certification and knowledge of food handlers found in 72.7% of the restaurants, improper hand washing procedures detected in 64.7% of the restaurants and processing area for raw

and cooked food not separated detected in 52.5% of the restaurants. Additional violations deemed by the CDC as critical violations were also recorded at variable percentages such as; inappropriate cooking time and temperature recorded in 44.9% of the restaurants, contaminated equipment was found in 26.7% , improper hot holding temperature was recorded in 23.1%,and lack of obtaining food from a safe source which was recorded in 15% of the restaurants.

Association of the food safety score was detected with a number of variables at the bivariante analysis, however, the ones that remained significantly detectable as determinants of the score at the multivariate analysis were the educational level of the manager, the manager certification in food safety, presence of a CKM, number of working shifts/day in the restaurants, food handlers certification in food safety and time spent by the MoH during the last inspection.

The study has detected a general low food safety score and a high frequency of some of the critical violations suggesting the need for improvement and preventive activities. Application of a system such as the HACCP scoring system can help to improve the situation and to meet the criteria of the total quality management and food safety in the restaurants of the WB, however, the high number of restaurants that are with a safety score below 70% together with the other findings suggest that such application should be in a gradual level. The associations detected with the managers and their characteristics and the certification of workers in food safety and the low percentages of such qualified managers and workers suggests that a contribution to improving safety in restaurants can be through educating the managers and workers in food safety

## تقييم وضع وسمات الصحة والسلامة الغذائية في مطاعم المنطقة الوسطى للضفة الغربية

إعداد الطالب: ضيف الله عطية سويدات

مشرف الرسالة: الدكتور خلدون بدر

### ملخص

الوصول الى مفهوم سلامة الغذاء في المطاعم يتطلب دراسة العوامل والمسببات التي تؤثر به . في الضفة الغربية الدراسات التي تختص بقضايا سلامة الغذاء في المطاعم قليلة. هدفت هذه الدراسة الى تقييم وضع سلامة الغذاء ، خصائصه والعوامل المؤثرة به في منطقة رام الله ، بيت لحم وأريحا. اعتمد أسلوب التفتيش على الفحص الحسي وأيضاً على الأسئلة المباشرة الموجهة الى إدارة المطعم والتي اعتمدت في صياغتها على استخدام نظام HACCP. كما هدفت هذه الدراسة إلى إيضاح أهمية واحتمالية الحاجة إلى تطبيق نظام النقاط الحرجة في التفتيش الصحي على المطاعم في الضفة الغربية.

ما يقارب 187 مطعم اشتركت في الدراسة في المناطق المستهدفة حيث ان هنالك العديد من الخصائص لهذه المطاعم قد تم دراسته . بعض نتائج هذه الدراسة بينت بأن ما نسبته 62% من هذه المطاعم كانت من نوع شعبي ، 19.3% من المطاعم كانت من نوع الوجبة السريعة ، 13.9% من المطاعم كانت من نوع الفنادق ، و 4.8% من المطاعم كانت من نوع السياحي . كانت نسبة 79.1% من المطاعم من المدينة ، 2.7% من المطاعم كانت من المخيمات ، 18.2% كانت من مناطق الحضرية . أظهرت نتائج الدراسة ان معدل علامة سلامة الغذاء للمطاعم 71% . كانت نسبة المطاعم التي لديها مدير عام مؤهل في سلامة الغذاء 31% وأيضاً نسبة الذين لديهم مستوى تعليم عالي 46.6% من مدراء المطاعم . كما أظهرت النتائج بان هنالك 86% فقط من المطاعم لديها مدير مطبخ او طبخ رئيسي ولكن 53% من هذه المطاعم فقط لديها مدير مطبخ مؤهل في سلامة الغذاء . كانت نسبة عمال المطاعم الذين لديهم مؤهلات في سلامة الغذاء هي 72.7% . حسب الدراسة كانت نسبة أعلى خمسة خروقات لسلامة الغذاء في المطاعم هي غياب النظافة الشخصية للعاملين والتي لوحظت في 86.6% من المطاعم ، عدم استخدام مواد التنظيف بشكل جيد كانت في 79.1% من المطاعم ، غياب المعرفة والمؤهلات لدى العاملين في الأغذية لوحظت في 72.7% من المطاعم ، الطرق الغير سليمة لغسل اليدين لوحظت في 64.7% من المطاعم و منطقة تحضير الطعام كانت غير مفصولة عن منطقة الغذاء الغير جاهز كانت في

52.5% من المطاعم. خروقات إضافية تم تعريفها من قبل CDC كخروقات حرجة هي الأخرى تم توثيقها في الدراسة حيث ان عدم ملائمة درجة حرارة الطبخ مع الوقت للطبخ سجلت في 44.9% من المطاعم ، تلوث الأجهزة لوحظ في 26.7% من المطاعم ، عدم ملائمة درجة حرارة التسخين للطعام الجاهز للتقديم في جهاز حافظ حرارة سجلت في 23.1% من المطاعم وعدم الحصول على غذاء من مصدر امن لوحظت في 15% من المطاعم.

العلاقة مع علامة سلامة الغذاء للمطاعم لوحظت مع العديد من المتغيرات في التحليل الأحادي. ولكن تم اعتماد أسلوب التحليل متعدد المتغيرات لهذه العلاقات مع علامة سلامة الغذاء للمطعم في لإثبات ارتباط هذه العلاقة، حيث كانت العوامل مستوى تعلم المدير العام، حصول المدير العام على مؤهلات في سلامة الغذاء، وجود مدير للمطعم لدية مؤهلات في سلامة الغذاء، عدد الورديات للمطعم في اليوم، امتلاك عمال المطعم مؤهلات في سلامة الغذاء والوقت المستنفذ من قبل مفتشي وزارة الصحة في آخر تفتيش للمطعم و التي بقيت لها علاقة مع علامة المطعم.

سجلت الدراسة بشكل عام علامة منخفضة لسلامة الغذاء في المطاعم وأيضاً تكرار للخروقات الحرجة التي تتعلق بسلامة الغذاء مما يدعو إلى تطوير تعليمات وقائية في المطاعم لمنع حدوث الأمراض تطبيق نظام النقاط الحرجة HACCP ممكن أن يساعد في تحسن سلامة الغذاء في المطاعم وأيضاً ادارة الجودة الشاملة في المطاعم لسلامة الغذاء في الضفة الغربية. مع ذلك لا بد من الأخذ بعين الاعتبار بان هنالك عدد كبير من المطاعم التي لديها علامة اقل من 70% وبالنظر الى نتائج أخرى في الدراسة نقترح ان يتم تطبيق النظام بشكل تدريجي. لوحظت علاقة بين علامة سلامة الأغذية والمتغيرات وجود المدراء وخصائصهم وأيضاً تأهيل العمال في سلامة الغذاء ولكن وجود نسبة قليلة من المدراء والعمال المؤهلين في سلامة الغذاء يقود الاقتراح انه يمكن تحسين سلامة الغذاء من خلال تعليم المدراء والعمال في سلامة الغذاء.

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## List of abbreviations

<b>BSF</b> .....	<b>Brazilian spotted fever</b>
<b>CDC</b> .....	<b>Centers for diseases control and prevention</b>
<b>CIPs</b> .....	<b>Cleaning in places</b>
<b>CKM</b> .....	<b>Certified kitchen manager</b>
<b>CV</b> .....	<b>Critical violation</b>
<b>ECDC</b> .....	<b>European center for disease prevention and control</b>
<b>EHS</b> .....	<b>Environmental health specialist</b>
<b>EFSA</b> .....	<b>European food safety authority</b>
<b>EU</b> .....	<b>European union</b>
<b>FAO</b> .....	<b>Food and agriculture organization</b>
<b>FBI</b> s.....	<b>Food-borne illnesses</b>
<b>FDA</b> .....	<b>Food and drug administration</b>
<b>FHPM</b> .....	<b>Food handling practice model</b>
<b>FOS</b> .....	<b>Food safety and zoonoses</b>
<b>FSIS</b> .....	<b>Food safety and inspection services</b>
<b>HACCP</b> .....	<b>Hazard analysis of critical control point</b>
<b>KM</b> .....	<b>Kitchen manager</b>
<b>MoH</b> .....	<b>Ministry of health</b>
<b>RTE</b> .....	<b>Ready to eat</b>
<b>STEC</b> .....	<b>Shiga Toxin-producing E.coli</b>
<b>US</b> .....	<b>United states</b>
<b>vCJD</b> .....	<b>variant Creutzfeldt-Jakob disease</b>
<b>WB</b> .....	<b>West Bank</b>
<b>WHO</b> .....	<b>World health organization</b>

## **1-2 The global burden of food-borne disease**

Through the globalization of food marketing and distribution, contaminated food products can affect the health of people in numerous countries at the same time. This has been demonstrated by recent events surrounding melamine contamination in food that were prepared by manufactures and distributed in different places in the world to be consumed (WHO 2005), and if one consider that diarrhoeal disease alone, a considerable proportion of which is food-borne, kill 2.2 million people globally every year (WHO 2008), the global importance of food-borne illness (FBI) becomes clear . A recent publication by Jones et al (2008) has shown that approximately 30% of all emerging infectious diseases over the past 60 year were caused by pathogens commonly transmitted through food. This trend is complicated by the industrialization of food and animal feeding production as well as intensive farming which catalyses the appearance and spread of pathogens such as the case with prions, the cause of Brazilian spotted fever (BSF) and variant Creutzfeldt-Jakob disease (vCJD) during the 1990s which was caused by the use of meat and bone meal in the production of animal rations (Smith 2003).

The WHO (2007) considered that estimation of the burden of food-borne disease worldwide require strong surveillance system that is generated according to age, sex, and region of occurrence of FBI for a defined list of causative agents of microbial, parasitic, and chemical origin. According to the international organization this information enable policy makers and others to:

- Appropriately allocate resources to food-borne disease, prevention, and control efforts.
- Monitor and evaluate food safety measures
- Develop new food safety standards

- Assess the cost-effectiveness of the intervention
- Quantify the burden in monetary cost
- Attribute human illness to specific food source to support risk management strategies

### **1-3 Food safety**

The signs and symptoms of food-borne illness range from gastrointestinal symptoms, such as upset stomach, diarrhea, fever, vomiting, abdominal cramps and dehydration, to more severe systematic illness, such as paralysis and meningitis. Avoiding foods that are contaminated with harmful bacteria, viruses, parasite, toxin, chemical and physical contaminants are vital for healthy eating. In the U.S, (Dietary guidelines for Americans 2005) to avoid such consequences, the government adopted a system that is based on:

- Establishment of Safety Standards.
- Monitoring and Inspection.
- Enforcement of legislation.
- Tracking Food Safety Problems
- Protecting the Food Supply .

The most important food safety problem is microbial contamination causing food-borne illnesses (Dietary Guideline for American 2005). Therefore education, training, and cleaning are important to preserve food safety. To keep food safe, people who prepare food should clean hands, food contact surfaces, fruit and vegetables, as well should separate raw, cooked, and ready-to-eat foods; cook foods to a safe internal temperature; chill perishable food promptly; and defrost food properly. Uncooked and undercooked meat, poultry, and eggs and egg products are potentially unsafe, raw

meat, poultry and eggs should always be cooked to safe internal temperature by using food thermometer (Guide in Food Safety and Nutrition 2009).

#### **1-4 Foods of particular importance for food-borne illness**

CDC (2006) identified some of the foods that are the most associated with food-borne illness; Raw foods of animal origin are the most likely to be contaminated. Foods that mingle the products of many individual animals, such as bulk raw milk, pooled raw eggs, or ground beef, are particularly hazardous because a pathogen presence in any one of the animals may contaminate the whole batch.

Fruits and vegetables consumed raw are a particular concern; washing can decrease but not eliminate contamination so the consumers can do little to protect themselves, Un-pasteurized fruit juice can also be contaminated if there are pathogens in or on the fruit that is used to make it.

Alliance (2009) analyzed Centers for Disease Control data associated with food-borne illness outbreaks occurring between 1990 and 2007, and found that 88 % of food-borne illness outbreaks were from non-produce food items. Of the remaining 12 %, more than 10 % were associated with improper handling of produce. For instance, 65% of outbreaks traced back to a produce item can be attributed to improper handling in a restaurant, most likely the result of cross contamination or improper employee hygiene. As well he found that mishandling at community events caused 14% of the produce-related outbreaks and that 2 % of produce-related outbreaks were associated with the growing, packing, shipping or processing of produce.

#### **1-5 Food contaminants and diseases they cause**

We live in a microbial world, and there are many opportunities for food to become contaminated as it is produced and prepared. Many food-borne microbes are present in healthy animals (usually in their intestines) raised for food. Meat and poultry

carcasses can become contaminated during slaughter by contact with small amounts of intestinal contents. Similarly, fresh fruits and vegetables can be contaminated if they are washed or irrigated with water that is contaminated with animal manure or human sewage. Some types of *Salmonella* can infect a hen's ovary so that the internal contents of a normal looking egg can be contaminated with *Salmonella* even before the shell is formed. Oysters and other filter feeding shellfish can concentrate *Vibrio* bacteria or other bacteria that are naturally present in sea water, or present in human sewage dumped into the sea (Food info 2009).

Microbes are killed by heat. If food is heated to an internal temperature above 160°F (78°C) for even a few seconds this would be sufficient to kill parasites, viruses or bacteria, except for the *Clostridium* bacteria, which produce a heat-resistant spore. *Clostridium* spores are killed only at temperatures above boiling (CDC 2005).

Collins (1997) reviewed food-borne diseases data, reported to the CDC between 1983 and 1992, he conclude that common practices contributing to disease was poor personal hygiene of food workers. While the literature support that transmission of pathogens from food workers hands to food is a significant contributor to food-borne illness, the true data on the number of food-borne illness is likely to be underestimated because of underreporting, lack of a good diagnosis of presenting signs and symptoms and also by identifying the disease etiology. Most food-borne illness result from a microbial, chemical, or physical contaminant in food, a food itself also can cause severe adverse reaction like allergy.

#### **1-5 -1 Microbial contamination**

Microbial contamination is the main source of Food-borne illness and is a large and growing public health problem. The emergence of increased antimicrobial resistance in bacteria causing disease is aggravating this picture. Most countries that have a

system for reporting cases of food-borne illness have documented significant increase over the past few decades in the incidence of cases caused by microorganisms in food, including pathogens like *Salmonella*, *Compylobacter Jejuni*, *Enterohaemorrhagic Escherchia coli*, and parasites like *Cryptosporidium*, *Crytospora*, and *Trematodes* (WHO & FAO, 2002).

Change in eating patterns, such as preference of fresh and minimally processed foods, the increasingly longer interval between processing and consumption of foods and the increasing prevalence of food prepared at home all contribute to the increased incidences of food-borne illness ascribed to microbiological organisms (WHO & FAO, 2002).

### **1-5-2 Allergen contamination**

In the United States food allergy is an important problem Kayosaari M, (1982), and Bock (1987), found that 2 to 4 percent of children under 6 years are allergic for specific food and Sampson et al. (1992) estimates that 1 to 2 percent of the adults are allergic to specific foods. The food most likely to cause allergic reaction are milk and milk products, egg and egg products, fish and fish products, shellfish and shellfish products, cereals containing gluten, and seeds. Allergic reaction to natural rubber latex from food handlers gloves have also been reported (Schwartz H J, 1995 & Tomazic et al. 1994).

Food allergy is the most frequent cause of anaphylaxis occurring outside of New York State hospitals and the most common cause for emergency department visits for anaphylaxis (Kemp et al.1995), studies by Yocum et al. (1994) and Sampson. H.A, (1998), estimated that in the United State 2,500 individual per year experience food that include anaphylactic components. Because potentially allergenic foods even as

traces are present as ingredients in a variety of food products, so beside education, clear food ingredient labeling information are critical for managing food allergies.

### **1-5-3 Physical contamination**

Food contaminants are multiple and may present in the same product in addition to the microbial contamination, such contaminants that cause a physical hazard to the consumers are ; pieces of glass which pose an obvious risk of cutting the consumers mouth or doing even-greater damage if swallowed, pieces of metal, sharp stones, bone or wood. Any physical object may cause damage on teeth and even wider range of other harmful situation, often apparently innocuous. In addition physical object can cause choking when swallowed (Adams et al. 1999).

### **1-5-4 Chemical contamination**

Food might become poisonous if it has been contaminated by chemicals during the growth, preparation, storage, and cooking. Throughout these stages many materials may be used to improve the quality or taste of the food, and so any violation to safety regulations related to use of such materials may lead to food-borne illnesses. Additional chemicals include cleaning material, pesticides, insecticidal spray, packaging materials, toxic elements, naturally occurring toxin like mycotoxins and phytotoxins and residues in animal products.

While assessment of the risk associated with exposure to pesticides is difficult veterinary drugs and food additives are usually supported by extensive information a case that still limited in application for toxicology of the contaminants in food. (WHO & FAO, 2002). Chemical contamination of food can affect health after a single exposure or, more often, after long-term exposure; however, the health consequences

of exposure to chemicals in food are often inadequately understood because slow developing long term effect of the chemical exposure.

### **1-6 Conditions and violations in restaurants leading to FBI**

Restaurants served more than 70 billion meals in the United States during the year 2005, of all the money spent on food in the United States, (47%) is spent in restaurants, and the food service industry employs more than (9%) of the nation's workforce (National Restaurant Association 2005), but still in the same country food-borne diseases cause approximately 76 million illnesses and approximately 5000 deaths in the US each year (Mead et al. 2005). A number of recent studies raised the question about the food safety in restaurants and demonstrated the need for additional studies. De Waal et al. (1996) reported on a research by the Center for Science in the Public Interest which identified improper temperature for holding or storing food as the top cause of food-borne illness outbreaks in restaurants in the U.S. According to this study, improper temperatures caused (59%) of food-borne illness; followed by poor hygiene of food handlers (36%), improper cooking of food (28%) and contaminated equipment which was responsible for (16%) of the FBIs.

In an analysis for data published by the centers for disease and control (CDC) for the period between (1988-1992). Pointe by Bean et al and Olsen et al. (1996) concluded that the five major categories of food borne disease outbreak causes are as follows:

- Improper holding temperature.
- poor personal hygiene.
- Inadequate cooking.
- Contaminated equipment.
- Food from unsafe sources.

### **1-6-1 Improper holding temperature**

Food temperature is one of the most important methods of controlling the growth of bacteria in food, a recent FDA report found that nearly 65% of the restaurants studied in the U.S were out of compliance with the hot and cold storage recommendations of the Food Code (FDA 2004).

Food Code in the US recommends a cold storage temperature of 41°F(4°C) For the raw and cooked foods that needs to be refrigerated (U.S FDA 2005), this is essential because many types of bacteria thrive at room temperature and can cause severe food poisoning.

Proper temperature control prevents many types of pathogens from multiplying to the level that cause food-borne disease such as: The *Clostridium* which can grow in foods that were not well enough cooled or kept hot. *Clostridium perfringens* can grow better than most bacteria at temperature that is as high as 120°F (49°C). Also *Clostridium botulinum* continues to multiply slowly in food at low temperature, and thus must be refrigerated properly to stop the growth.

### **1-6-2 Poor personal hygiene**

The U.S Food and Drug Administration's (FDA) Food Code for retail establishments includes guidelines on prevention of food contamination by workers hands (Guzewich et al. & FDA 2005), and so hands washing is one of the recommended methods of the food-borne illnesses prevention, for it can reduce the transmission of pathogen from hands to food and other objects (Guzewich et al.1999 & Michaels et al. 2006 & Montvill et al.2002).

CDC recently estimated that 20% of food-borne illnesses caused by bacteria are passed into food by an infected worker (Greig et al. 2007). Hands are the main conduit for the spread of viruses and pathogens, and can carry millions of germs. Poor

hand washing practices by food-service workers can have disastrous and far-reaching consequences by contaminating food that is then served to many people. Ron Sympson, (1995) reported that three pathogens come primarily from infected workers Hepatitis A virus, *Shigella*, and *Staphylococcus aureus* bacteria. Hepatitis A virus and *Shigella* are carried out by human fecal matter, and so the illness they cause can be prevented by proper hand-washing after toilet used.

The FDA indicates that for proper hand washing it should last no less than 20 second with the use of running warm water, soap, friction between the hands, rinsing, and drying with clean towels or hot air. Deli tissue, tongs, and disposable gloves, are commonly used as barriers in the food service establishments. Michaels et al. (2002) & Montvill et al. (2004) suggested that anecdotal evidence suggested that gloves use for this purpose may be increasing.

### **1-6-3 Inadequate cooking**

Proper cooking is vital to ensuring food safety, FDA estimates that nearly 16% of food full-service restaurants in U.S do not adequately cook foods (FDA 2004). Undercooked meat, poultry, and eggs can harbor enough bacteria to sicken diners. Frozen meat that has not been properly thawed before cooking is often accidentally undercooked.

Cleaning surfaces in places CSIP (2007) have reported that two of the most harmful bacteria linked to raw and undercooked meats, Salmonella and E. coli O157:H7 accounted for over 20% of the reported restaurants-associated outbreaks between 1998 and 2005 in the US. Hepatitis A caused 1.1% of all reported restaurants-related outbreaks for the same period.

Food must be cooked properly to ensure proper destruction of harmful microorganisms. Cooking temperatures are divided into: 145°F (62.7°C), 155°F (68°C), and 165°F (74°C) ; whole muscle and intact: beef, pork, veal, lamb, as well as eggs and fish must be cooked to a 145°F(62.7°C), all ground beef, pork, veal, and lamb, as well as injected meats must be cooked to 155°F(68°C), all poultry, stuffed meats, and stuffing containing meats must be at 165°F (74°C) (Food facts 2010).

#### **1-6-4 Contaminated equipment**

Equipment may contact food directly or indirectly through the processing of foods, preparation, display, cooking and other operations. Using equipment unless clean, free of abrasive, and free of detergents cause cross-contamination to food. FDA recently found that over 56% of full-service restaurants in the U.S were not following appropriate guidelines for sanitizing equipment and food contact surfaces (FDA 2004). Storage containers and knives used to prepare food can harbor harmful bacteria if they are not thoroughly and regularly cleaned and sanitized before and during use.

Counter and other food preparation surfaces that are inadequately cleaned or cutting surfaces simply wiped down with a wet cloth, or food preparation areas that are improperly separated, can promote the transfer of bacteria from one food to the other, resulting in widespread contamination. As reported by Marler et al. (2008) this type of contamination was the most likely violation resulting in an *E. coli* outbreak that sickened hundreds and killed one customer at a Sizzler Steakhouse in Wisconsin in 2000.

### **1-6-5 Food from unsafe sources**

Food sources are variable that may be locally produced or imported from other countries. Purchasing the raw material from a safe source contribute to preventing contaminations during the processing, and therefore regulation is needed like, origin, health, and analysis certification to ensure the compatibility of the safe source. In U.S FDA( 2004) found that about 13% of full service restaurants are out of compliance with guidelines for receiving food from safe sources. Food safety risks in a restaurant begin with the purchase of raw food from suppliers. Bacteria that exist in raw food from original source can multiply and produce toxins if the food is inadequately refrigerated during shipping and handling, even before it reaches the restaurants, therefore, raw foods should be requested from safe source.

Alonso (2008) reported that a truck loaded with thousands of pounds of raw ground beef suspected to be tainted with *E. coli O157:H7* bacteria were stolen from food manufactures 'in parking lot in Northern Texas. The thief allegedly sold the contaminated meat to at least one restaurant, and attempt to sell it to others, putting consumers at grave risk for exposure to *E. coli* from cross-contamination or improper cooking.

### **1-7 Inspection methods of food safety and hygiene**

Food production and preparation for human consumption passes through many different stages. Violations of regulations and guidelines for food safety at any stage may lead to contamination of the final product. This, might also become complicated by several causes and factors, therefore, protecting the safety of the food from source to table is a multi-layered task that needs continuous effort to identify potential hazards, to identify points at which those hazards can be prevented or controlled, and

to systematically monitor those control points (Hogue et al. 1998). This can be assistance reached by food inspection to ensure the safety.

Studies have shown that inspection contributes to controlling problem in food establishments to prevent outbreak. More than one method of inspection is participated worldwide by the inspection authorities. These are comprehensive, unannounced inspections, intended to evaluate both food-borne illness risk factors and good retail practices. Routine restaurants inspection is intended to prevent food-borne illness by ensuring safe food handling and preparation. Inspections are required by food sanitation codes in many countries throughout the world. In the U.S it have been recommended in model food codes and sanitation ordinances published by the federal government since 1934 (Food Code 1999).

#### **1-7-1 Routine inspection method**

Routine inspections at food establishments, which are the most commonly, used inspection methods are a "snapshot" of food safety operations on the particular day they are carried out. The focus of these inspections is on critical risk violations, which are those violations most likely to contribute to food-borne illnesses. However, the inspections mainly depends on the personal judgment of the public health inspectors performing the inspection without a clear criteria to perform the required inspection and follow up on the violation when detected then corrected by the inspected establishment. One of such inspection methods is the traditional visual foodservices inspection, which usually represents one point in time, is based on individual judgments of inspectors, and often rate operations differently than peer do (Bryan.F.L.1990).

### **1-7-2 Hazard analysis of critical control point (HACCP).**

An alternative method to traditional inspection is the Hazard Analysis of Critical Control Point (HACCP) which was developed in the 1950s by a food manufacturer. It was adopted later by NASA for the purpose of ensuring food safety in space so astronauts would not become ill. The food manufacturer worked with NASA to design the critical safety controls into a preventive system. The system became used more and more common, and restaurants are complying with it as well now.

The flow of food in a foodservice environment consists of stages of receiving, storing, preparing, cooking, holding, serving, cooling and reheating. Each of these stages includes a number of operations. The system is a scientifically designed program that identifies the steps in these stages in food where contamination is most likely to occur and then puts in place preventive controls. It also helps to identify the foods and procedures, along the pathway that are most likely to cause food-borne illness. As so, procedures are designed within the system to reduce the risk of food-borne outbreaks and monitors practices throughout an operation to ensure food safety.

The concept of (HACCP) has been adopted as a framework for the regulation of the sea food industry by the U.S. Food and Drug Administration (FDA) and for the regulation of the meat and poultry industries by the U.S. Department of Agriculture, Food safety and inspection Service (FISIS) (Hogue et al. 1998). Later it was modified and adopted by many states in the U.S, and many other countries, as means for food safety evaluation and inspection and significant emphasis has been placed on the system programs for foodservices operation in the US (Food and Drug Administration. 2002).

This hazard analysis serves as the basis for establishing critical control points for the safety of the food and provides at least a partial objective alternative to the traditional

visual foodservices inspection. In this system critical violations are food safety violations that, according to the Food and Drug Administration (FDA) have been determined to be the most likely to contribute to food-borne illness. The system can translate into a quantitative method of inspection that as well, allocates a safety score to each inspected location.

### **1-7-3 HACCP Scoring System**

The HACCP system was developed into scoring system that assigns a numeric point value to each violation. The point value signifies the seriousness of each violation. The higher numeric value attributed to each violation (point), the more serious it can be once deficient. This scoring system provides food service operators with a clear understanding of where a problem exists and what they must do to prevent illness or disease.

Critical violations at restaurant inspection are used as a proxy for food-borne illness risk assessment it assumes that restaurants with many critical violations will be at higher risk of causing food-borne illness in customers than would restaurants with a few critical violations (Tome F Jonse et al. 2006). The method for scoring Food service Establishment inspections reflects the overall sanitary condition of an establishment. The scoring system now in place is consistent with current public health food safety trends. In 1998, the Los Angeles County Department of Health Services implemented a new inspection program that require public posting of inspection scores by restaurant and other commercial food establishments and it to be located in unincorporated area of the county and in cities that adopted an ordinance for the program as means of communicating results to the public for their decision on where to eat (Fielding et al. 1999).

## **1-8 Research problems and study justification**

The Department of Food Safety and Zoonoses (FOS) in the WHO strives to reduce the serious negative impact of food-borne diseases worldwide. Food and waterborne diarrheal diseases are leading causes of illness and death in the least developed countries, killing approximately 2.2 million people annually, 1.9 million of whom are children (WHO 2008). In the U.S, regardless the relatively low number of cases and outbreaks, the report of "healthy people" 2000, mentioned that each year, as many as 9,000 people die and between 6.5 and 33 million become ill from food borne diseases with an estimation cost \$7.7 to \$23 billion annually ( "healthy people 2000", 2005). In Europe, The European Food Safety Authority (EFSA) and the European Center for Disease Prevention and control (ECDC) estimated a total of 5,609 outbreaks occurring in 2007, which affected almost 40,000 people and caused 19 deaths in the EU countries (The European Food Safety Authority Report 2007). The same report indicated that Salmonella remained the most common cause of food-borne outbreaks in the EU, followed by food-borne viruses and Campylobacter. Restaurants seem to play an important role in these cases.

Information about sources of food-borne disease outbreaks reported to the Centers for Disease Control and Prevention in the US during the period 1998-2004, indicated that restaurants contributed to 52% of food-borne outbreaks (CDC 2006). De Waal (1996) suggested that food poisoning from restaurants is twice as to be reported as food poisoning at home. Restaurants outbreaks typically affect more people therefore just one violation in a public kitchen can cause illness to many people.

In Palestine about 882 cases of food poisoning were reported to the MoH during the year 2001 with an incidence rate of 28 per 100,000 populations. Most of these cases

were caused by consumption of food prepared in houses or streets food vendors (MoH, annual report 2001). Tests performed in 2001 by the Environmental Health units in the MOH showed that 26% of food samples collected in the WB restaurants were contaminated in 2001. The Palestinian MoH as well in the same report reported on some infectious diseases that might be transmitted through food even though that in the report these were not reported under food poisoning, such diseases included *Salmonellosis* (361 cases), *Shigellosis* (18 cases), *Amebiasis* (11,661 cases), *Guardia Lambia* (5501 cases), *Brucellosis* (271 cases) and *Viral Hepatitis A* (2074 cases)

A study carried out by a master's student at Al-Quads University School of public health (2003) in the WB assessed the role of different kinds of food in food poisoning occurrence. The study reviewed food examination results carried out and recorded by MoH "between" 1996-2002 at the Environmental Health Department. It showed that 27.5% of the tested samples were contaminated, where 57.7% of these samples were collected from restaurants (Ibrahim A, 2003).

The institute of Community and Public Health at Birzeit University conducted a study in the WB (2009) to investigate knowledge and practices about food safety by food handlers in Ramallah and Al-Bireh. The results showed that 63.4 % of workers had received no training on food safety and sanitation. It also reported that restaurants lacked basic conditions of hygiene and sanitation, such as hot water and cleaning materials, and that many workers had poor personal hygiene practices. The study concluded that training is required for workers and owners of restaurants to improve good hygiene practices and standards (I.A.Al-khatib, et al. 2009).

Regardless these studies and as in the case in many parts of the world, where, underreporting of FBIs expected as a results of lack of integrated reporting system, no

clear determination of the size of the problem, its determinants or risk assessment are available in the WB. On top of that the inspection system used by the Palestinian MOH is the routine inspection method, which depend on inspectors judgment and no clear inspection criteria is available, therefore there is a clear need to evaluate the food safety situation in restaurants in Palestine, its determinants and the possibility of applying HACCP as an inspection system.

### **1-9 Significance of the study**

Food-borne illnesses impose a burden on public health and contribute significantly to the cost of health care. In United Stat (U.S), food-borne disease causes 76 million illness and 500 deaths each year (Mead et al. 1999). Of an annual mean of 550 food-borne disease outbreak incidents reported to the Centers for Disease control and Prevention for the period from 1993 through 1997, more than40% of these outbreaks were attributed to commercial food establishments (Olsen et al. 2000). Part of these food establishments are restaurants which are considered an integral part of today's society, where in the U.S alone 40% of all adults are eating on a typical day (National restaurant association, 2002).

While the industry sales in the world are increasing; consumer confidence in food safety in restaurants has decreased. As an example in the U.S only 39% of the people surveyed in 2000 believed in the restaurants industry's ability to ensure the well being the costumers, compared to a high rate of 50% in 1995 (Allen R, 2000).

Up to one-third of the population of developed countries are affected by food-borne illness each year, and the problem is likely to be even more widespread in developing countries, the poor are the most susceptible to ill health (WHO 2002).

The availability of safe food improves the health of people which is a basic human right, contribute to the productivity and provide an effective platform for development and poverty alleviation. It also have economic consequences on individual, families, communities, businesses and countries, as food-borne diseases impose a substantial burden on health-care systems and markedly reduce economic, productivity, and leads to loss of income due to food-borne disease which perpetuates the cycle of poverty (WHO & FAO, 2002).

Studying the problem in the WB and its deterrents can help in improvement in food production, processing, preparation, and storage practices, preventing illness and reducing burden of associated diseases with relation to restaurants.

This study was conducted as first of its kind implementing the HACCP system in the central area of the West Bank (Ramallah, Jericho, and Bethlehem). The study is expected to provide information that will help in shading light on the food safety situation in restaurants the size of the problem, and also to evaluate the situation of food safety in the restaurants, to identify the main violations and to evaluate the appropriateness of HACCP for implementation by the MOH in the West Bank as a preventive and inspection system and so contribute in improving the food safety in Palestine.

### **1-10 Aims of the study**

1-To evaluate food safety situation, its characteristics and determinants in restaurants in the target area

2-To determine factors that affect application of such a scoring system in these restaurants, and the appropriateness and/ or need for such a system for application as an inspection system for restaurants

### **1-11 Objectives of the study**

1-To identify the food safety violations, and their frequency in the study area restaurants and to classify their occurrence to severity as related to their importance in contribution to food-borne illness in food safety and its requirements.

2-To measure the food safety scores in each restaurant in accordance to the HACCP system

3-To determine the factors associated with food safety scores in the restaurants.

### **1-12 Hypotheses**

- Food safety score is dependent on a number of factors such as type of restaurant, training, frequency of inspection per year, managers education level, number of years in business and others.
- The average scores of restaurants are different from 70% advised in parts of the US for self closure.

## **Chapter Two**

### **Literature review**

#### **2-1 introduction**

At the beginning of the 20th century, two technologies; milk pasteurization and retort canning, were developed, promoted, and virtually canonized as preventive measures against food-borne diseases. By the beginning of the 21st century food-borne diseases remained as major problems to public health, as new pathogens and products have emerged. However, many of these problems can be controlled by applying new technologies, sanitation procedures, and strong inspection systems for food establishments (Tauxe RV, 1997).

Food-safety hazards can be introduced into food service operations through a number of ways, including raw food, equipment, supplies and customers. Diseases can also be spread by cross-contamination, utensils, washcloths, and human hands which can contaminate ready-to-eat foods. Contamination can also occur via food-to-food, such as when thawing meats drips on ready-to-eat foods. Restaurants are one link in the food-supply chain; their role against food borne illness is important. So it is obvious that the restaurant industry, particularly the fast food industry, needs to train their food handlers more vigorously, hire healthy individuals and take every possible precaution to protect foods, and preventing ingesting food that have been contaminated by bacteria, viruses, parasites or chemicals causes food borne illness.

#### **2-2 Hygienic practices of the food workers**

Improper food handling practices in restaurants are a major contributor to the transmission of food-borne diseases. Infected food workers can transmit infectious diseases caused by food-borne microbes and so, it is important for food safety that personal hygiene practices are maintained to prevent the pathogenic microbes from

entering food chain during food processing. Studying these practice and their distribution is important as a number of studies have shown the importance of hygiene practices for the food safety during processing of the foods in restaurants.

Many studies pointed that violations related to hygienic practices; hand-washing, glove using, glove changing, frequency of hand washing, minimal bare hand contact with food, wiping hand clothes, ill worker, eating and smoking while working were associated with food-borne diseases (Adera D et al. 1999, Manning C et al. 1993, Oteri T et al. 1989, U.S FDA 2004). Hygienic food preparation and the education of the food handlers whom involved in preparation, processing and service of food are important lines of defense in the prevention of most types of food-borne illness. (Gibson et al. 2002).

Altekruse et al. (1996) conducted a telephone survey for 1,620 respondents in the U.S to determine the belief about food-borne pathogens, foods at risk for transmitting infection, knowledge of safe food handling, and food-handling practices. The results indicated that one-third of the respondents who prepares meals reported unsafe food hygiene practices; unsafe practices were reported more often by men, adults 18 to 29 years of age, and occasional food processors than by women or persons 30 years old or older. The author concluded that food hygiene practice plays important role on food safety to prevent food-borne illness through training and educational program.

### **2-2-1 Hand-washing practices of food handlers**

The transmission of contaminants from food handlers hands to food is a significant contributor to food illness therefore, improving hand-washing practice is critical to food safety, to prevent transmission of pathogens like enteric pathogen to surfaces of utensils or to ready to eat food.

Chen Y et al. (2001) investigated bacterial transfer rates between hands and other common surfaces involved in food preparation in the kitchen. Samples from at least 30 different participants were collected to determine the statistical distribution of each cross-contamination rate and to quantify the natural variability associated with that rate of bacterial transmission. Results indicated that the transfer rates among food workers hands, foods, and kitchen surfaces of utensils were highly variable, being as low as 0.0005% and as high as 100%. The researcher concluded that risk management strategy in food establishment to prevent cross-contamination by food handler's hands is needed.

Hasan A et al. (2004), in military hospital in Turkey found that 16 different bacteria were isolated from bare and gloves hands of workers before and during preparation of food, these included *Staphylococcus aureus* (70%), *coagulate-negative staphylococci* (56.7%), *diphtheroid bacilli* (21.7%), *Bacillus spp* (10.5%), and *Escherichia coli* (7.8%). The researcher concluded that poor hand hygiene and improper glove use by the food handlers was clear and that training in personal hygiene and food safety should be improved as well, inexperienced personnel should not be employed in kitchens without being well trained.

Guzewich et al. (1999), studied the risk factors of some of the outbreak cases of food-borne diseases in the U.S. His results indicated that in 81 food outbreaks attributed to food handlers 89% of these outbreaks occurred by transmission of pathogen by contaminated hands of the handlers into food.

Barry Michaels, et al. (2004), reviewed over 300 reports of outbreaks attributed to ill or asymptomatic food handlers. Hazards and contributory factors responsible for food-borne illness outbreaks were identified. The researcher pointed that various personal hygiene intervention measures for the development of preventive

management strategies, designed to improve food-handling practices at various levels of the food chain are needed. In that restaurants where ground beef handling was observed in the U.S. April K et al. (2004) reported that hands were not washed between handling raw ground beef and RTE food or cooked ground beef in (49%) of restaurants, but instead hands were wiped on wiping cloths or aprons after handling raw ground beef (without hand-washing step) in (60%) of the restaurants. In another study pointing to the issue of hand washing Laura et al. (2006) collected detailed data on food worker hand washing practices during preparing food on specific work activities for which hand washing is recommended. Workers made hand washing attempts in only (32%) of these activities and washed their hand appropriately in only (27%) of these work activities. Attempted and appropriate hand washing rates varied by work activity, they were significantly higher in conjunction with food preparation than other activities and were significantly lower in conjunction with touching the body than other work activities. The researcher concluded that inappropriate hygienic practices might lead to food disease through hands pathogen transmission to food , and the hand washing practices of food workers need to be improved, and restaurants should consider reorganizing their food preparation activities to reduce the frequency with which hand washing is needed.

Risk factors for transmission of food borne illness were studied as well in Jakarta by A.M.Vollaard et al. (2004) in restaurants and street vendors. Poor hand-washing, direct contact with food, low educational level, and male sex, were found as independent characteristics of street vendors. Fecal contaminations were found in (65%) of drinkable water samples, in (91%) dishwater sample, and in (100%) of ice cubes in these restaurants and vendors samples. These results were additional support for the role of the personal hygiene practices, and that public health interventions

should focus on general hygienic measurements to reduce transmissions of food borne illness like hand-washing with soap, and adequate food handling hygiene.

### **2-2-2 Gloves using by food handlers**

Human hands are important source of microbial contaminations of food, gloves using by food handlers protect the foods from cross-contamination by preventing the transmission of pathogens on hands from reaching foods and also gloves using by the handlers increases the positive perception of the consumers towards food safety and the cleanness of food establishment.

Green et al. (2005) by means of a telephone survey in the US showed that of the respondents who worked in restaurants, (60%) did not always wear gloves when touching ready-to-eat-food, and that (33%) did not change their gloves between, handling raw meat and handling ready-to-eat-food.

Bryan M et al. (2003) conducted a study to assess the food handling practices of 10 processing mobile food vendors operating in New York City. Ten processing mobile food vendors were observed for a period of 20 minutes each. A many different unsanitary food handling practices were recorded. And four vendors were observed vending with visibly dirty hands or gloves and no vendor once washed his or her hands or changed gloves in the observation period for the least on time. The researcher concluded that each of the diagnosed hygienic practices violates the New York City Code of Health and potentially attribute to the safety of these vendor-prepared foods.

Montville R et al. (2001) quantified the transformation rate of bacteria to foods through using gloves and compare that to bare hands rates. Five transfer rates were

determined: chicken to bare hand, chicken to hand through gloves, bare hand to lettuce, hand to lettuce through gloves (with low inoculum on hands), and hand to lettuce through gloves (with high inoculum on hands). Results showed that the transfer food to hands and from hands to food when subjects wore gloves was low at (0.01%) a 10% transfer was without a glove barrier. And even through that gloves are permeable to bacteria the transfer from hands to food through a glove barrier was less than without a glove barrier. Concluding that gloves might be reducing both bacterial transfer from food to the hands of foodservice workers and in subsequent transfer from hands back to food. Laura Green et al. (2005) conducted a study with the team of the Environmental Health Specialists Network (EHS-Net). In their telephone survey among several findings they reported that (60%) of workers did not always wear gloves while touching ready-to-eat (RTE), and that (23%) and (33%) respectively did not always wash their hands or change their gloves between handling raw meat and RTE food .

### **2-2-3 Infected food worker practice**

Food handlers are directly in contact with food production. Ill food handlers might transmit gastroenteritis pathogen through hands to equipments, utensils and then to foods. Many studies showed that the infected food handlers contribute in the transmission of pathogens like *E. coli*, hepatitis A virus, *Salmonella* spp., *Shigella* spp., and *Clostridium perfringens* from foods, contaminated equipment, and from their gastrointestinal tract through their hands to other foods and so spreading infectious diseases (LeBaron et al. 1990, Centers for Disease Control, 1990, British Medical Journal, 1990, Paulson, 1994. Restaino & Wind, 1990. Snyder, 1997).

Barrabeig I et al. (2010), conducted a research in the north east of Spain (Barcelona) to investigate a food-borne norovirus outbreak that occurred in the residential summer camp and in which the implication of a food handler was demonstrated by laboratory tests. Personal or telephone interview was carried out and food handlers were interviewed. Stool samples from symptomatic exposed residents and the three food handlers that prepared the suspected food tested for bacteria and noroviruses. And the attack rate of (55%). Concluded that in outbreaks of food-borne disease, the search for viruses in affected patients and all food handlers, even in those that are asymptomatic, is essential. The role of workers, the ill one mainly and role of hands as route of transmission of contaminations was as well, previously studied. Jack Guzewich et al. 1999, through his review of 72 articles describing 81 food-borne disease outbreaks in the US for the period 1975 to 1998 that are believed to have resulted from contamination of food by food workers which indicated that of (60% ) of these outbreaks were caused by hepatitis A and Norwalk-like virus, (93%) of outbreaks occurred to food workers who were ill either prior to or at the time of the outbreak, and that (89%) of the outbreaks occurred in food service establishments as compared to (11%) that were attributed to foods prepared in homes.

The same author in 1995 studied the contributing factors in outbreaks occurred in New York State during the period 1980 to 1993. Among these contributing factors he founded that infected food handlers were pointed in (17.6%) of the outbreaks.

Bean et al, (1996) as well reviewed the reports of outbreaks in the U.S during the period 1988 to 1992 published by the CDC and found that the two most commonly reported practices that contributed to food-borne diseases were improper holding temperatures of foods (59%) and (36%) poor personal hygiene of food handlers.

#### **2-2-4 Minimal bare hand contact with food practice**

Improper food handling by food workers is one of the causes of food-borne disease, through inadequate hand-washing the contaminated bare hands transmits the pathogen to the foods. Alternatively food handlers may use spatula, tongs, single use gloves, deli tissue to contact ready to eat food that decrease the possibility of food contamination.

Many studies show that hands-washing is the removal of soil and transient microorganisms from the hands and hygienic hand refers to the reduction of transient microorganisms with the use of antiseptic detergent, (Larson, 1995, Sheena and Stiles, 1982; Ayliffe et al.1987; Nicoletti et al. 1990).

#### **2-3 Cross- contamination of the food leading to food-borne diseases**

Humans are living in a microbial world that may be beneficial or harmful. Cross-contaminations as mean of transmitting harmful microbes are multi-factorial contributor to food-borne diseases, therefore prevention of cross-contamination is critical during the foods processing or serving.

Cross Contamination is the term used to describe the transfer of bacteria from a source to a high risk food. Sources of food poisoning bacteria are raw foods such as raw meat and poultry, humans, insects, animals and birds, rodents, dust, refuse and waste food. Hands might transmit microbes from raw to ready to eat food and direct contact with food using dirty chopping boards, knives and other cooking utensils can spread the contaminations of food. Incorrect storage raw foods in refrigerator by allowing it to come into direct contact with ready to eat food, or through raw meat juices drip to ready to eat food, fruits and vegetables that resulted in contamination.

William C et al. 1991 conducted a study to describe the epidemiology of food-borne disease outbreaks in nursing homes and to identify where preventive efforts might be focused. Reports by state and local health departments of food-borne disease outbreaks occurring from January 1, 1975, through December 31, 1987 were reviewed. . results indicated that of 52 outbreaks with a known cause, *Salmonella* was the most frequently reported pathogen, accounting for 52% of outbreaks and 81% of deaths and food vehicles in *S enteritidis* outbreaks were made with eggs or prepared with equipment contaminated with eggs which contribute in cross-contamination to food.

### **2-3-1 Sources of cross contaminations of food**

Sources of cross contamination of foods are multiple. Many studies showed different vehicles of food contaminations are serve as predominant to food-borne diseases.

Thomas J et al. 1997, conducted a study to investigate a large community outbreak of *Salmonella Typhimurium* infections in the U.S 1984. A total of 751 persons with Salmonella gastroenteritis associated with eating or working at area restaurants. Most cases were associated with 10 restaurants, and epidemiologic studies of implicated eating from salad bars as the major risk factor for infection. Where the ill employees may have contributed to the spread of illness by inadvertently contaminating foods and the outbreak of *Salmonellosis* was caused by intentional contamination of restaurant salad bars.

Franco C.M et al. 1995 conducted a study to investigate the presence of *Listeria spp.* in chicken drumsticks, wings, breasts, and livers taken from a poultry processing plant. Results showed that the drumstick meat and skin, with 96% of samples shown

to contain *Listeria spp*, and contamination were detected in the areas where of the final stages of meat processing. The author suggested that drumsticks are responsible for a large amount of the contamination of chicken carcasses, and that the surfaces that come into contact with these pieces of meat play an important source of cross contamination. The role of food contacts surfaces in contaminating food was studied by Dourou D et al. (2011) who evaluated *E. coli O157:H7* attachment, survival and growth on food-contact surfaces under simulated beef processing conditions. *E. coli O157:H7* attachment to beef-contact surfaces was influenced by the type of soiling substrate and temperature. The author concluded that needs to rendering the design of more effective sanitation programs to the surfaces of food contact surfaces was needed.

Erickson MC et al. (2007) who assess the prevalence and identify effective intervention and inactivation treatments for *Escherichia coli O157:H7* and other *Shiga* toxin-producing *E. coli* (STEC) pathogens. Suggested that there is a need to effective strategies to minimize contamination of foods with Shiga-toxin producing *E. coli* (STEC) and determining the role of handling practices and processing operations on cross-contamination between foods.

The role of food handlers was also indicated by Hassan A et al. (2005) who carried out a study to determine the incidence of *Staphylococcus aureus* in ready-to-eat (RTE) meals from military cafeterias in Ankara. Out of 512 samples, 9.4% had coagulase positive *S. aureus*. Samples of Russian salad, vegetable salad, and meatballs, which require more food matrix handling, were significantly more likely to contain *S. aureus* at higher levels (>4 log CFU/g) than were corresponding samples of hamburger patties, pizza, Turkish lahmacun, Turkish pide, and Turkish doner. The

study indicated that food workers may contribute to *S. aureus* contamination and that there are some handling practices resulted in cross contamination that require more attention by food handlers to prevent cross-contamination.

### **2-3-2 Rout of cross contamination**

Cross-contamination is the physical movement or transfer of harmful bacteria from one person, object or place to another. Preventing cross-contamination is a key factor in preventing food-borne illness. Cleaning and preventing cross-contamination are both essential to make sure the food is safe to eat. Sido D et al. (2007) conducted a study to determine the quantitative microbiological risk assessment of *Campylobacter* in the Netherlands. In his model for bacterial cross-contamination during food preparation in the domestic kitchen and the case of *Campylobacter*-contaminated chicken breast. The researcher found that cross-contamination can contribute significantly to the risk of *Campylobacter* infection and that cleaning frequency of kitchen utensils and thoroughness of rinsing of raw food items after preparation has more impact on cross-contamination. The author suggested that needs to verify more behavioral data on hygiene during food preparation for a comprehensive *Campylobacter* risk assessment to control the rout of transmission.

Josefa M et al. (2005) reviewed the reports of the CDC on the *E. coli O157*.outbreaks for the period 1982 to 2002 to bitter understand the epidemiology of these outbreaks. His review that included 350 outbreaks in 49 states found that transmission route was 52% of food-borne of the outbreaks, 21% unknown, 14% person-to-person, 9% waterborne, 3%animal contact, and 0.3% laboratory-related, the food vehicle for 41% food-borne outbreaks was ground beef.

The probability of contamination and the levels of *Salmonella* and *Campylobacter* spp. on salads as a result of cross-contamination from contaminated chicken carcasses via kitchen surfaces were studied by H.D. Kusumaningrum et al. (2004). Data on the prevalence and numbers of these bacteria on retail chicken carcasses and the use of unwashed surfaces to prepare foods were collected from scientific literature and the rates of bacterial transfer were collected from laboratory experiments and literature. The researcher concluded that the probability of *Campylobacter* spp. contamination on salads is higher than that of *Salmonella* spp and suggested that for the elimination of the cross-contamination route, it is important to use separate surfaces or to properly wash the surfaces during the preparation of raw and cooked foods or ready-to-eat foods.

#### **2-4 Temperature is critical for food safety**

Temperature control is important for food safety Temperature should be controlled in all process of the food preparation and production from the transportation until serving.. Keeping food at appropriate temperature plays a role in preventing the multiplication of the microorganisms in it, and also prevents its deterioration.

According to Food Code (2005) by FDA in the US most food poisonings are associated with foods held at temperatures between 41o°F (4°C) and 135o°F (57°C) for extended periods of time. Health department's inspections stress temperature control of potentially hazardous food. Maintaining safe food temperatures is vital to avoid contamination and creating an unsafe environment, allowing uncontrolled bacterial growth (Food Code 2005).

Deryck D. in 2005, conducted an observational study to verify the awareness of food safety practices in 350 households in Trinidad which indicated that about 95 percent of respondents did not know how to prepare, transport, store and serve food safely in

the home. Many respondents did not maintain the temperature requirement in cooking foods, in maintaining internal temperatures of cooked foods to verify doneness boiling when cooking or reheating. The researcher concluded that foods preparation practices in the surveyed households were below the generally acceptable standards for basic safe food preparation.

April K et al. (2004) surveyed a total of 385 restaurants in the U.S that served hamburgers. Sanitarians conducted interview and at site evaluation to determine ground beef handling and cooking practices and use of irradiated ground beef product. In restaurants receiving fresh ground beef, (64%) reported that they never measure the temperature upon delivery, and (50%) reported never measuring the final cooking temperature of hamburgers The median temperature of cooked hamburgers was 170°F (77°C) which was optimal.

#### **2-4-1 Cooking temperature of the food**

Bacteria can survive as result of inadequate cooking. They can also multiply with prolonged cooking at low temperatures, and some bacterial spores can even survive boiling. Examples of virulent bacteria that can be a problem in the cooking stage are *Staphylococcus aureus*, *Salmonella* and *Bacillus cereus*. All three organisms can be killed by cooking food according to proper times and temperatures, preventing cross-contamination and using proper hand washing techniques.

Harmful bacteria are the most common cause of food-borne illnesses. Some bacteria may be present on foods when you purchase them. Raw foods are the most common source of food-borne illnesses because they are not sterile; examples include raw meat and poultry that may have become contaminated during slaughter.

Zhonghua Yu et al. 2001 conducted study to study main risk factors that cause food-borne diseases in food catering business. Data from references and investigations

conducted in food catering units were used to establish models which based on Risk 4.5 with Monte Carlo method referring to food handling practice model (FHPM). Among results showed that the average probability by consuming contaminated meat without fully cooking was  $1.71 \times 10^{-4}$  which was 100 times of consuming fully cooked meat ( $1.88 \times 10^{-6}$ ). The researcher concluded that cooking process and cross contamination are important factors of catering food safety.

Gormley FJ et al. (2010) review the reports of outbreaks that reported in England and Wales from 1992 to 2009, cuisine-specific risk factors were examined. Of 677 restaurant outbreaks, there were 11795 people affected, 491 hospitalizations, and seven deaths; and Chinese, Indian, British and Italian cuisines were the most commonly implicated (26%, 16%, 13%, and 10%, respectively). Poultry meat was the most frequently implicated food vehicle in outbreaks associated with Indian (30%), Chinese (21%), and British (18%). Among many results showed that inadequate cooking (38%) and use of raw shell eggs in lightly cooked or uncooked food (35%) were more often associated outbreaks. The researcher concluded that by stratifying the risks associated with restaurants by cuisine type, specific evidence of food control failures can be used to target food-borne illness reduction strategies.

Smith KE et al. (2008) review reports of outbreaks from 1998 through 2006, four outbreaks of *Salmonellosis* associated with raw, frozen, microwaveable, breaded, pre-browned, stuffed chicken products were identified in Minnesota. Among many results showed that the majority of individuals affected thought that the product was precooked due to its breaded and pre-browned nature, most used a microwave oven, most did not follow cooking instructions, and none took the internal temperature of the cooked product. The researcher suggested that under cooking the main factors of

the outbreaks disease and needed to develop training program to consumers for safe food consumption.

#### **2-4-2 Hot holding temperature of the food**

Food has reached its proper cook temperature, such as 165°F (74°C) for reheated foods, it needs to be hot held at a temperature of 135°F (57°C) degrees or greater. The proper cook temperature will kill any bacteria that may have been present on the food and the hot holding at or above 135°F (57°C) will prevent any new bacteria from growing on the food (Food Code 2005). If temperature drops below this level The food is safe if for a short time while it is being eaten as the time frame is too short to allow for significant bacterial growth. On the other hand, food left for several hours in a hot holding case that isn't holding foods above the danger zone (>4°C to <57°C) temperature can turn into a big problem. Uyttendaele M et al. (2009) reviewed reports' of outbreaks to assess the Prevalence and challenge tests of *Listeria monocytogenes* in Belgian produced and retailed mayonnaise-based deli-salads, cooked meat products and smoked fish between 2005 and 2007. The results indicated that the prevalence of *L. monocytogenes* for mayonnaise-based deli-salads (6.7%) the pathogen was detected, and for cooked meat products it was 1.1%. The researcher concluded that hot holding of cooked meat temperature is critical to food safety and need to emphases in HACCP implementation in food establishment.

Greig JD et al. (2011) conducted a research to identify documented outbreaks, worldwide, of enteric illness in correctional facilities over the last 10 years to understand the epidemiology of the outbreaks and explicitly identify effective infection control measures. Computer-aided searches of literature databases and systematic searches of government websites were completed to identify relevant

outbreak reports. Reference lists were hand-searched to validate the electronic search method. Results showed that of the 72 outbreaks he identified 76% and 21% were associated with bacterial agents and viral agents, respectively. The researcher suggested that it is essential to monitor hot holding temperatures to prevent enteric outbreaks in prisons.

### **2-5 Certified kitchen manager the core of food safety in the restaurant:**

Kitchen manager is the person in charge of the kitchen who is responsible for all the activity in that kitchen. A certified kitchen manager who is qualified in food safety helps in controlling food workers activities to prevent violations and also provides the ability for internal inspection of the facility. Hedberg et al. (2006) conducted a study in the U.S to identify food safety differences between outbreak and non-outbreak restaurants. The researcher found that the presence of a CKM had a protective effect with respect to food-borne illness outbreaks. Thus, the presence of a CKM may help to improve food safety practices among food workers and ultimately reduce food-borne diseases. Sheryl et al. (2009) studied the relationship between the result of routine restaurants inspection and the presence of a certified kitchen manger (CKM). They analyzed data for 4,461 restaurants inspected in Iowa during 2005 to 2006, the analysis showed that restaurants with CKM present during inspection were less likely to have a critical violations (CV) for the personnel hygiene, food source or handling, facility or equipment requirements, ware-washing and other operations. Analysis by type of violation within the temperature and time control category revealed that restaurants with a CKM were less likely to have a critical violation (CV) for hot holding. The findings suggested that the presence of CKM is protective for most types of CVs, and helps in identifying areas for improving the training of CKMs.

Even though that CKM plays a major role in outbreak prevention such managers should become of the importance of knowing how to manage food workers illness, this was indicated by Craig et al. (2006) in his revision on the work of EHS-net, between June 2002 and June 2003. EHS-Net conducted systematic environmental evaluations in 22 restaurants in which outbreaks had occurred and in 347 restaurants in which outbreaks had not occurred in the U.S. Outbreak and non-outbreak restaurants were similar with respect to many characteristics, the major difference observed between the restaurants was in the presence of a certified kitchen manger. However, neither the presence of a CKM nor the presence of policies regarding employee health significantly affected the ability of restaurant identifying of an infected person or carrier as a contributing factor. These finding suggested a lack of effective monitoring of employee illness or a lack of commitment to enforcing polices regarding ill food workers.

## **2-6 Manger education contributes in food safety**

Studies showed that one of the factors that might affect the food safety in restaurants is the manger education. The manager can contribute in understanding the requirements of food safety and the importance of training, as well as helping by providing knowledge to the workers of the food establishment. Food handlers can be more receptive to the information and consolation from health inspectors in order to be applied .Food managers training and certification programs may be an effective way to improve the sanitary conditions of restaurants and reduce the spread of food-borne illnesses (M Cotterchio, et al. 1998).To determine the extent to which prerequisite and HACCP programs were implemented in independent restaurants, and to assess potential barriers to implementing food safety practices Kevin R, et al. 2003,

conducted a research In Iowa State, questionnaire was mailed to a sample of the state restaurant managers. Results indicated for a positive relationship between managers education and the number of food safety practices implemented.

The safety score might be affected by the education level of the restaurant manager through training program and certification in food safety .Mathias RG et al. (1995) implemented a research to determine the effectiveness of restaurant inspections and food handler and manger education on the safety score. Thirty restaurants from seven health units in Canada were studied by means of a questionnaire. Restaurants in which the manager had completed educational courses had better inspection scores than those without. Suggesting that food service education should be offered to the supervisors as well as to the food handlers.

The effectiveness of a food manager training and certification program in increasing compliance with restaurant sanitary codes was studied by M Cotterchio,et al. (1998) ,compared pre- and post-training inspection scores for 94 restaurants falling into three groups: a "mandatory" group (managers' attendance was mandated for these restaurants); a "voluntary" group (managers attended the training voluntarily); and a control group (no staff attended the training program). A difference in safety score for each group was detected. Managers who were mandated to attend a training and certification program demonstrated a significant improvement in inspection scores, an improvement that was sustained over a two-year follow-up period.

The Philadelphia Health Department requires that all food establishments have at least one food safety certified person on each shift. A study evaluated the impact of this training on employee knowledge of key issues addressed in the food safety training. The results indicated a positive correlation between training and knowledge on proper

food handling and also suggested that training may have a positive impact on sanitation conditions in restaurants (Kay Everett 2000).

## **2-7 Food handling practices**

Food workers are closely related to the foods in every stages and any time of processing. Handling foods appropriately should be kept by the workers to prevent the cross-contamination and avoid violations that lead to food-borne illnesses.

There are general food safety procedures that should be followed to help reduce the risk of contamination and mishandling at all levels in food establishments. From the time the food is delivered to the minute it is served to the customer, food safety should be on the top of the list. Following the basic procedures can help keeping food safe and prevent food borne illnesses. Kagambega A et al. (2011) investigate the hygienic status and prevalence of *Salmonella* and *Escherichia coli* in retail meat sold at open markets in Ouagadougou. In total of 150 samples of beef collected from four local markets the prevalence of *Salmonella enterica* subsp. *enterica* was 9.3% and the prevalence for *E. coli* it was 100%. Food handling practices for the production, transportation, display, and vending of the meat revealed unhygienic conditions and suggested that the handlers were in dire need of education about safe food handling practices. Chukwuocha UM et al. (2009) conducted a research to determine knowledge, attitude and practice of food handlers towards food-borne diseases and food safety. A total of 430 food handlers were selected from Owerri Metropolis of Imo State Nigeria and interviewed using structured questionnaire. Results indicated 48.4% of the respondents had poor knowledge of food sanitation. The study concluded that might be important in planning health education intervention programs for food

handlers in order to improve their knowledge, attitude and practice towards food borne diseases and food safety.

Laura R. et al. (2005) explored food safety practices and beliefs about factors that impacted workers ability to prepare food safely in restaurants in the US. In her focus groups with food service workers and managers, participants reported un-safe food preparation practices, such as inappropriate glove use and not checking the temperatures of cooked, reheated, and cooled foods. Participants identified a number of actors that impacted their ability to prepare food safely, including time pressure; structural environments, equipment, and resources; management and coworker emphasis on food safety; worker characteristics and negative consequences for those who do not prepare food safely. The results suggested that food safety programs need to address the full range of factors that impact food preparation behaviors and the safe food handling practices.

Contaminated eggs are main source of Salmonella infection Healthy people in 2010 goals have addressed need to reduce egg association *Salmonella enterica*. In seven U.S states, an interview and brief site evaluation of the 153 restaurants that prepare eggs during all hours of operation was conducted by Environmental Health Specialists Network (EHS-Net) to determine the prevalence of food handler's practices. Results showed that some food handling violations are common; about 54% of restaurants in a forbidden practice pooled raw shell eggs not intended for immediate service. These pooled eggs were held a median of 4 hours for scramble eggs, and 6 hours for pancakes and French toast, and as well, 26% of the restaurants reported storing eggs at room temperature in violation of regulation. Employees reported sanitizing utensils, used to prepare eggs, less than once every 4 hours in 42% of restaurants. The study concluded that further emphasis might be needed to reduce egg-associated *Salmonella*

*enterica* (SE) infections in accordance with healthy people 2010 goals (Robin et al. 2004).

Kirkland E et al. reported in 2009 on an Environmental Health Specialists Network (EHS-Net) observation to examine tomato handling practices in 449 restaurants. Produce-only cutting boards were not used as required on 49% of tomato cutting observations, and gloves were not worn in 36% of tomato cutting observations. Although tomatoes were washed under running water as recommended in most (82%) of the washing observations, tomatoes were soaked in standing water, a practice not recommended by the U.S. Food and Drug Administration (FDA). In 18% of the observations, the temperature differential between the wash water and tomatoes did not meet FDA guidelines in 21% of observations. About half of all batches of the cut tomatoes in holding areas were held above the 41 degrees F (5 degrees °C), the temperature recommended by the FDA. The maximum holding time above 41 degrees F for most (73%) of these cut tomatoes held exceeded the FDA recommendation of maximum of 4 h for unrefrigerated foods.

## **2-8 Training of food worker is vital in food safety**

Training is part of increasing the knowledge of the workers in food establishments and reducing many handling procedures and violations of food safety codes. Worker training through an approved course of food safety and examining them to be qualified in this job helps to ensure the food safety during all the food processing, and to avoid cross-contamination. The impact of food handlers training program was studied by Chukwuocha UM et al. (2009) conducted a study to determine knowledge, attitude and practice of food handlers towards food-borne diseases and food safety. A total of 430 food handlers were selected from Owerri Metropolis of Imo State Nigeria

and interviewed. Results indicated that 48.4% of the respondents had poor knowledge of food sanitations. The related determinants for the knowledge was premise type (OR) = 4.0, educational level (OR) = 0.4, and job status of food handlers (OR = 0.5). The study concluded that such findings might be important in planning health education intervention programs for food handlers in order to improve their knowledge, attitude and practice towards food borne diseases and food safety. Park SH et al (2010) examined the extent of improvement of food safety knowledge and practices of employee through food safety training. The training program and questionnaires for evaluating employee knowledge and practices concerning food safety, and a checklist for determining food safety performance of restaurants were implemented. Employee knowledge of the intervention group showed a significant improvement in their food safety score, increasing from 49.3 before the training to 66.6 after training indicating the importance of training but also evaluation as an integral part of it. It was concluded that more continuous implementation of the food safety training and integration of employee appraisal program with the outcome of safety training were needed. The effect of training methods of food safety training was studied by Valerie k. P et al. (2008) who conducted a survey on foodservices employees (n=242) in the U.S, compared knowledge, behavioral antecedents, and behavioral compliance rates between two groups of food handlers, a one in which training is mandatory for all and the other one it was only for the shift manger. Results showed that mandating training to all food workers were associated with improve respondents with some food safety behaviors, and also the need of shift manger be knowledgeable about food safety appear to gain similarly to workers knowledge. Researcher concluded that training on the principals of the food safety to all food handlers is necessary and important to prevent food outbreak. Factors

affecting the knowledge besides training of handlers was also studied by Hislop N et al. (2009) made this by questionnaire distribution on both certified and non-certified food handlers. Effect of number of years since food safety certification and the number of years of experience of the non-certified food handlers had in the food service industry on the knowledge was also evaluated. Results indicated that certified food handlers had a greater knowledge of food safety information than did non-certified food handlers. The highest failure rates were observed among non-certified food handlers with more than 10 years of experience and as well less than 1 year of experience. The author suggested that the program of food safety training increase the perception of the food handlers towards food safety.

Zain MM et al. in 2002 studied the pattern of socio-demographic distribution of food handlers to determine knowledge, attitude and practice of food handlers towards food-borne diseases and food safety. About 430 food handlers were selected from Kota Bharu district. The results showed that 57.2% of food handlers had no certificate in food safety and only 61.9% had undergone routine medical examinations. As well he found that almost 48.4% had poor knowledge. The researcher concluded that the results can be used in planning health education intervention programs for food handlers in order to improve their knowledge, attitude and practice towards food-borne diseases and food safety.

### **2-9 Inspection methods are integrated part of food safety**

The inspection system of food establishment is an integrated part of its food safety with respect to the health inspectors whom provide consultation and education to food handlers. An inspection system helps in the public health intervention needed to decrease the probability of food-borne diseases and protect the public.

Many studies showed that the inspection of restaurants improve the food safety situation and protect the public from outbreak diseases through enforcement of legislations and the law by the responsible authorities.

Restaurants inspection might be based on routine inspection method or using HACCP scoring method that may convert to grades posted on restaurants.

### **2-9-1 Routine inspection method of restaurants**

Routine inspections of retail food establishments by public health inspectors serve as a major method of ensuring food safety. Many public health practitioner and researchers concluded that routine inspection of restaurant method was failed to predict the outbreaks disease that attributed to the restaurant.

M A Cruz et al. (2001) conducted a study to determine the usefulness of the routine restaurant inspections in predicting food-borne outbreaks in Miami-Dade County of Florida. Inspection reports of restaurants with outbreaks in 1995 were compared with those of randomly selected restaurants that had no reported outbreaks in 1995. Cases and controls inspected with this method did not differ by their overall inspection outcome or mean number of critical violations was detected except for, evidence of vermin which was associated with outbreaks (OR= 3.3). Concluding that routine inspection method of restaurant did not predict outbreaks and inspection practices may need to be updated. Such results were also found by Miguel A et al. (2002) studied the usefulness of restaurant routine inspections in predicting food-borne outbreaks in Miami-Dade County. Inspection reports of restaurants with food poisoning outbreaks in 1995 were compared with restaurants that had no outbreaks. Results showed that restaurants routine inspection did not predict food-borne outbreak. The study suggests that inspection practices may need to be updated.

Amanda K.G et al. (2007) conducted a research to determine whether customer complaints received by restaurants in Alexandria, VA, during 2004 predicted the number of critical violations issued on subsequent food safety inspections performed based on routine method. They counted the number of critical violations cited on food safety inspections conducted immediately after receipt of customer complaints (exposed restaurants) and on the first inspection conducted in 2005 (unexposed restaurants). The result showed that compared with unexposed restaurants, exposed restaurants were less likely to have received one or more critical violations, relative risk = 0.84, which suggested that restaurant inspections conducted specifically in response to customer complaints may not identify critical violations any more often than inspections conducted at restaurants free from such complaints.

Kassa H et al. (2008) conducted a study to evaluate the marginal utility of microbial testing for minimizing potential risks of food-borne outbreaks in restaurants and compare that results of visual traditional method, swab samples were taken from hand-washing sink faucets, freshly cleaned and sanitized food-contact surfaces, and from cooler or freezer door handles in 70 of 350 category-three (high-risk) food service operations in Toledo, Ohio. Results indicated that Enteric bacteria were found on food contact surfaces, on cooler or freezer door handles, and on hand-washing sink faucets in 86, 57, and 53%, respectively and 27, 40, and 33% of the restaurants received visual ratings of very poor to poor, fair, and good to very good, respectively. In comparison, 10, 17, and 73% of the restaurants received microbiological rating scores of very poor to poor, fair, and good to very good, respectively. Restaurants received poor rating scores by visual inspection more than by microbiological evaluation, the presence of fecal bacteria from different sites in more than 50% of the food service operations. The author recommends periodic microbiological evaluation

of high-risk food service operations, in addition to visual inspection, for minimizing the risk of food-borne disease outbreaks.

### **2-9-2 HACCP scoring inspection method of restaurants**

Alternative to the traditional inspection method is available; the HACCP scoring inspection method is a scientific system of control process for eliminating contaminants at critical areas in the food production, distribution and preparation and might help to prevent harmful contamination in the food supply. Buchholz U et al 2002 conducted a study to determinants of food safety of restaurants that might be associated with the restaurant subsequently having an IFBI of 10,267 restaurants inspected from 1971 July to 15 November 1997. They identified 158 case restaurants and 10,109 non-case restaurants. Results indicated that other factors were associated with the occurrence of an IFBI included a lower overall inspection food safety score, the incorrect storage of food, the reuse of food, the lack of employee hand washing, the lack of thermometers, and the presence of any food protection violation. The researcher suggested that evaluation of inspection data bases in individual local health departments and translation of those findings into inspection guidelines could lead to an increased efficiency and perhaps cost-effectiveness of local inspection programs. Timothy et al. (2004) examined restaurants inspections in the state of Tennessee which Implement HACCP system to determine whether the system there demonstrate and identify such characteristics known to affect food safety. Inspection records for January 1993 through April 2000 were examined for a total of 167,574 inspections. Results showed that food safety scores of restaurants experiencing food-borne disease outbreaks did not differ for restaurants from which no reported outbreaks. He suggested that such results might be due to issues related to reliability and uniformity

of inspections and suggested that policies related to training and standardization of inspections and evaluations can help in improving the system .

Kathleen et al. (1989) studied the association between the results of routine inspections and food-borne outbreaks in restaurants in Seattle-King County, Washington. Case restaurants were facilities with a reported food-borne outbreaks between January 1, 1986 and March 31, 1987 (N=28). Tow control restaurants with no reported outbreaks during this period were matched to each case restaurants on county health districts and date of routine inspection (N=56). Results indicated that case restaurants had a significantly lower average HACCP inspections scores (83.8 on a 100-point scale) than control restaurants (90.9). The study suggested those restaurants with poor inspections scores and violations of proper temperature controls of potentially hazardous foods were; respectively, five to ten times more likely to have outbreaks than restaurants with better results.

### **2-9-3 Restaurant grading system**

Grading systems for retail food facilities continue to be the one of the active methods to communicate restaurants inspection outcome with the consumers.

Paul A et al. (2005) assessed the impact of a restaurant hygiene grading system that utilizes the public posting the grade cards on food-borne-disease hospitalization in Los Angeles County. The findings indicated that restaurant hygiene grading, with public posting of results, is an effective intervention for reducing the burden of food-borne-diseases. As well, Simon PA et al. (2005) analyzed the hospital discharge data on food-borne-disease hospitalizations of Los Angeles County and, as a control, for the rest of California during the period 1993-2000, and his results indicated that the restaurant hygiene grading program was associated with a reduction 13.1 percent in

the number of food-borne-disease hospitalizations in Los Angeles County in the year following implementation the program i.e 1998. The researcher suggested that restaurant hygiene grading with public posting of results is an effective intervention for reducing the burden of food-borne disease.

## **2-10 Conceptual framework**

Different studies have researched the factors affecting food safety, so we have investigated it from the same dimension and other from different dimension. Reviewing such studies in the introduction and literature review chapters, it is clear that the factors that affect the food safety violations, high and low, and so the food safety score are multiple. Such factors mentioned in the studies included general manager education level, certification of general manager in food safety, CKM, new food handler training, food handling practices, hygienic practices, temperature control, frequency of inspection, certification of food handlers in food safety, time spent during inspection, feedback the results of food samples analysis, and other determinants. The diagram below (diagram 1) summarizes the hypnotized theoretical framework for this study of the connection between the different studied variables and the dependent variable of food safety score

Based on this frame in the study the variables are studied independently of each other related to their effect on the dependent variable since such study carried out for first time in Palestine but interactions are explored in the study analysis.

**Diagram (1): Theoretical and practical framework of the study**

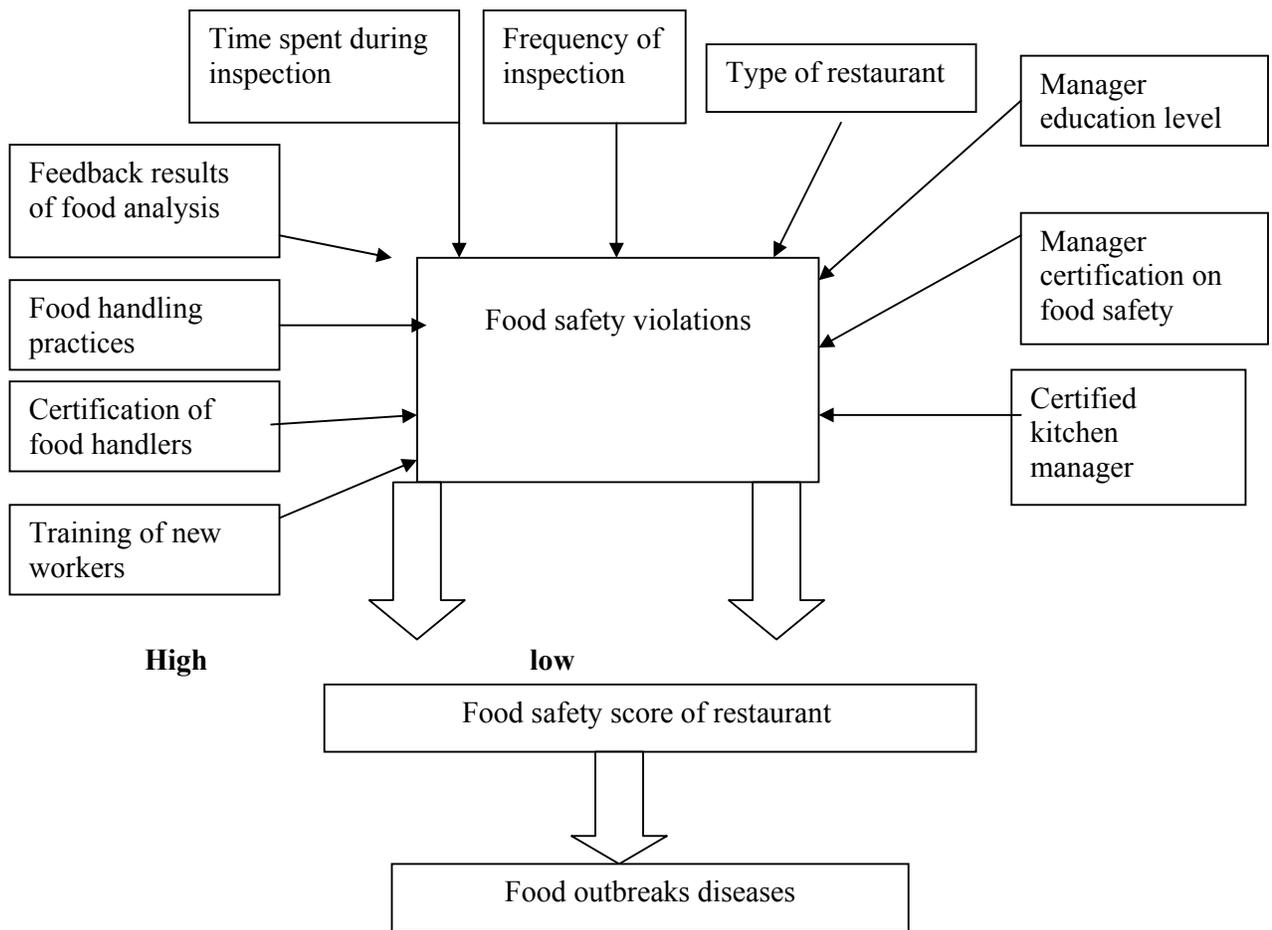


Diagram 1: conceptual framework

## **Chapter Three**

### **Methodology**

#### **3-1 Introduction**

This study describes the food safety status and characteristics in the restaurants of Ramallah, Bethlehem and Jericho districts. This was achieved through the use of inspection observations implementing an inspection form that contain a total of 61 inspection points on possible violations classified as high and low food safety violations in accordance to the HACCP system and that are weighted by scores using the scale of Tim F et al. 2006 (Appendix 1). In addition a structured questionnaire was developed by the researcher to investigate the determinants of the food safety in restaurants. In total 187 restaurants that have met the inclusion criteria were inspected in Jericho, Ramallah, and Bethlehem.

#### **3-2 Study design**

A cross sectional study design was used in the cities of the central area of the West Bank (Jericho, Ramallah, and Bethlehem), to achieve the study goals.

#### **3-3 Study population**

All the restaurants in the districts of Ramallah, Bethlehem and Jericho districts were targeted for the study. The MoH environmental unit in the governmental body in charge of inspecting licensing the restaurants; a list of restaurants registered at the files was obtained. A total of 239 restaurants were identified, all these restaurants were targeted for inspection and for filling the evaluation questioner through the interviews conducted with the management of each restaurant (Appendix 2). Out of these 239 restaurants only 187 (78%) restaurants approved and connected to participate in the study and so composed the surveyed population.

### **3-4- Study setting**

The central West Bank districts of Ramallah, Jericho, and Bethlehem were targeted to collect the data on their restaurants because easier to access by the researcher.

### **3-5 Measurement instruments and field work techniques**

The study data collection instruments composed of two parts of data collection tools questionnaires (Appendix 3) and inspection form of violations (Appendix 4).

#### **3-5-1 Collection of information on food safety determinants and restaurants characteristics**

The researcher developed a questionnaire that were categorized into groups to evaluate the food safety determinants which might be associated with the restaurants such as; restaurants features, management, inspection by MoH, and temperature measurements. The questionnaire was filled by the researcher by means of interviews conducted with the managers or other responsible person in charge of each restaurant. Temperatures of cooking, hot holding, cold holding, hot service, and cold service for different types of food in different operations of the processing and serving in the restaurants, using thermometers calibrated using ice and boiling water methods were measured and documented.

#### **3-5-2 Variable definition and measurement**

The operational definition of the variables was either developed by the researcher or the scientific variables definitions were adopted from the Food Code 9, 2005. These variables, definitions and measurements are shown in Appendix 5.

### **3-5-3 Weight of the food safety score and categorization of violations in the restaurants**

Five inspection forms that were previously validated and used by the States of Washington, Yakima Health District, Alabama Department of Public Health, NC Department of Environment & Natural Resources Division of Environmental Health, and the State of Connecticut for the purpose of food safety inspection and evaluation were surveyed for the selection of this study purposes . In these forms a numeric value was assigned for each violation as a score indicating its importance. About 80% of these inspection forms used the scale of 1 to 5 for items and sub-items as weighted scale. These inspection forms were prepared by the authorities referring to the 2005 Model Food Code Recommendations of the United States Public Health Service/Food and Drug Administration (FDA 2005). Since there is agreement on the scale 1-5 by the environmental health specialist in public health departments as resulted in the surveyed forms I used this scale as weight for the violations .Violations were categorized into critical (of high importance) and non-critical, a critical violation (Appendix 6) incurred a debit of 4-5 points from a perfect inspection score, where as non-critical violation (Appendix 7) incurred a debit of 1-2 points. A score of 1 means' low importance in food safety where as a score of 5 means 'extremely important'. The weight of "3" were not used in the scale in this study, as was the cases in many of the forms mentioned in the literature. Use of this weight might confuse the measurement process as it is a neutral weight between the high and low types of violations and so its use might not show the importance of values and differences. The total complete food safety score was as adding up to 173 scores in the inspection form. The study inspection form, developed based on the inspection forms implemented by many

states in U.S that are developed based on HACCP inspection criteria, included many items to be checked for each of the categories of possible violations.

### **3-5-3-1 Categorization of food safety violations**

The HACCP system categorizes violations into major groups. In this study each category was developed and classified according to its importance and contribution in food safety as in Food Code (9) (2005). These are food at arrival, food protection, food temperature control and procedure, personnel hygiene, hygiene practice, cross contamination, food equipments and utensils maintenance and sanitation, water source, toilet and hand-washing facilities, insect-animal-rodent control, physical facilities and other operations. Each category is divided into specific items and sub-items to meet the criteria needed for each category measurement or operational process during inspection to determine the violation and be reported by health inspectors.

### **3-5-3-2 Food safety score calculation**

There are two methods of converting the finding of inspection into safety score of the restaurants using the percentage scoring method for food establishment sanitation, Using the 1976 FDA Model (FDA 1993), and the categorical debit score (FDA 1976). In this study the percentage scoring method was used as it meets the criteria of the Total Quality Management of sanitation that suggested by Emmanuel et al. (1995) as following:

- 1- A food safety score must provide a representative measure of the overall hygienic conditions.
- 2-A food safety score must be easily computed by inspectors and conveyed to establishment operators in the field.

3-A food safety score must be easily understood by both establishment operators and consumers.

4- A food safety score must be able to provide a benchmark from which operators are able to progress toward improving the sanitation of their establishments.

5- A food safety score must be able to provide a benchmark from which inspector improvement or food program improvement progress may be made.

6- A food safety score must have the ability to be used in statistical analysis.

Based on this method the food safety scores for this study were calculated as follows:

$100\% - [(Total\ Violation\ Points / Base\ Score\ of\ 100 + Additional\ Violation\ Point\ Deductions) \times 100] = \% \text{ Score.}$  (Emmanuel et al. 1995).

### **3-5-3-3 Food safety score converted into grades**

Some of the Environmental Health Departments in the U.S used to communicate the inspection results to the consumers by posting letters on the food establishment for easier understanding. The sanitation scores are converted according to this system into grades of A, B, C as following:

\*A score range of 90 to 100 of the restaurants is awarded Grade A.

\*A score range of 80 to 89 of the restaurants is awarded Grade B.

\*A score range of 70 to 79 of the restaurants is awarded Grade C.

Restaurants that recorded less than 70 percent food safety score did not receive a grade but rather it should be revoked of permission or re inspected and advised for voluntary closure (New York department of health and mental hygiene 2008, Los Angeles public health department 1998, New Mexico public health department 2010, Santa Clara public health department 1999, California public health department 2007). In this study the system was adapted for identifying numbers

and percentage of restaurants according to their degree of achievements in the safety scores they have as means of communicating results.

### **3-6 Inspection process**

After consenting the restaurants management for their restaurants voluntary participation each restaurant management was interviewed by the researcher to answer for the questionnaire and a physical inspection was implemented for equipments, toilet room, garbage containers, medical aid, and general safety condition in the restaurant. Then, the evaluation of scoring form was filling by the researcher standing in a corner for watching such hygienic behaviors like hand washing, glove using and changing, protecting food and the rest of the inspection form. Temperature was measured using metal thermometer. All inspections were prepared by the researcher himself except for the inspection performed in the Jericho district where the researcher is the official MoH inspector, in that district; to avoid bias a field worker was trained and implemented the inspection.

### **3- 7 Pilot testing**

A pilot testing was conducted in Ramallah district selecting 10 restaurants. These restaurants were visited while operating and the questionnaires were administrated. The inspection form, developed to measure the violations in restaurants, was filled by the researcher based on observations and measures made. Based on the results some modifications were made in the final versions of the questionnaire and inspection forms.

### **3-8 Ethical consideration**

A consent form of approval to participate in the study (Appendix 8) was submitted to each of the restaurants manager or owners for permission to inspect his restaurants and filling of the evaluation questioner and inspection form. The form informed them

about the goal, the objectives and the methodology of the study to ensure interaction and corporation. Confidentiality and freedom of withdrawal was assured in the form. Feedback with restaurants manger was granted to discuss the results if possible.

### **3-9 Data analysis**

Data obtained were filled in, cleaned and analyzed using SPSS program, version 15, whereby descriptive analysis was performed on the obtained data. Scores were calculated and, where need, categorized into categories according to severity. T-test and ANOVA analysis were conducted to compare categories of the potential determinants for their means of the safety score as measures of relationships with food safety score of restaurants. Differences between the groups of studied variables that were identified have been compared using Tukey test for multiple comparison. Multivariate analysis (ANACOVA) was carried out to find out the joint effect and to control for potential confounders of the variables on the food safety score. A p-value of 0.05 or less was used as indicator for the level of significance.

## **Chapter Four**

### **Results**

#### **4-1 introduction:**

In total 239 restaurants in the areas of Jericho, Ramallah, and Bethlehem were targeted during the period from the first of May to the tenth of August 2010. In this chapter the results of the study are presented, they are divided into two sections the first describes the basic characteristics of these restaurants are, including the features of the restaurants, management, inspection methods implemented by them, and temperature control measurements and the results of the evaluation of hygienic conditions and type of violations are presented. The second section deals with the food safety determinants and the percentage score of restaurant are summarized and comparisons are made by variables categories.

#### **4-2 Characteristics of the restaurants**

The study population composed of 239 restaurants in the districts of Jericho, Ramallah and Bethlehem. Only 187 (77.5%) restaurants agreed to participate in the study and so were inspected. In this part I summarize the distribution of the restaurants by location, district, type of the restaurant, and number of work shifts per day in each restaurant, length of shift, food menu, and delivery service.

##### **4-2-1 Distribution of the restaurants by district**

Of the 187 restaurants who participated 69% were in Ramallah district, 24.1% were in Bethlehem district and only 7% were in Jericho district, as shown in the table 1.

**Table (1): Distribution of the restaurants by district**

District of the restaurants	Frequency	% from total
Ramallah	129	69
Bethlehem	45	24.1
Jericho	13	7
Total	187	100

#### **4-2-2 Distribution of the restaurants by location**

As shown in the table 2, the restaurants were distributed as 79.1% in the cities areas, 18.2% located in sub urban areas, and 2.7% located in camp areas.

**Table (2): Distribution of the restaurants by area location**

Locations of restaurants	Frequency	% of total
City	148	79.1
Sub urban	34	18.2
Camp	5	2.7
Total	187	100

#### **4-2-3 Distribution of the restaurant by the their classification**

The restaurants distribution according to the classification granted to them by the licensing authorities and according to the food menus that they serve is shown in table 3. Of the 187 restaurants 62% were classified as popular restaurants,19.3% classified

as fast food restaurants, 13.9% as hotel restaurants, and only 4.8% were classified as touristic category.

**Table (3): Distribution of the restaurant by the type of the restaurant**

Type of restaurants	Frequency	% of total
<b>Popular</b>	116	62
<b>Fast food</b>	36	19.3
<b>Hotel</b>	26	13.9
<b>Touristic</b>	9	4.8
Total	187	100

#### **4-2-4 Classification of the restaurants by presence of food menu**

Food menu represents the types of food served by restaurants to guide consumers for choices to avoid un-favorite foods as well it determine types of processes implemented also might define risks in the restaurants. As shown in the table 4 the majority of restaurants (78.6%) had a menu of the food that they serve according to it but 21.4% did not had such a list of food types served

**Table (4): classification of the restaurants by presence of food menu**

Presence of Food menu	Frequency	% of total
<b>Yes</b>	147	78.6
<b>No</b>	40	21.4
Total	187	100

#### **4-2-5 Classification of the restaurants by food delivery service**

Risks passed to food safety might be defined by the restaurants activities; part of these activities is food delivery. As shown in table 5, of the 187 study inspected restaurants 62% serve food outside the restaurant, and 38% did not serve food outside the restaurant.

**Table (5): Classification of the restaurants by food delivery service**

<b>Delivery outside the restaurant</b>	<b>Frequency</b>	<b>% of total</b>
<b>Yes</b>	116	62
<b>No</b>	71	38
<b>Total</b>	187	100

**4-2-6 Distribution of the restaurants by the number of shifts they work**

Work period is important for food safety and for food handlers. It might be related to stress associated with wrong behaviors and attitude. Of the 187 restaurants the majority (84.5%) reported that they work in tow shifts, 15% reported working in one shift, and only 0.5% works in three shifts per day, as show in the table 6.

**Table (6): Distribution of the restaurants by the number of shifts**

<b>Number of shifts</b>	<b>Frequency</b>	<b>% of total</b>
<b>1 shift</b>	28	15
<b>2 shifts</b>	158	84.5
<b>3 shifts</b>	1	0.5
<b>Total</b>	187	100

**4-2-7 Distribution of the restaurants by the length of the work shift**

Shifts length, related to the activities implemented during the day by the food handlers might be a barrier for the sanitary conditions in food establishments. Table 7 shows

that of the 187 restaurants the majority (92.5%) reported that they work within the normal limits of 8 hours or less per shift and only 7.5% reported that they work more than 8 hours per shift.

**Table (7): Distribution of the restaurants by the length of the shift**

<b>Length of the shift</b>	<b>Frequency</b>	<b>% of total</b>
<b>Less than or equal to 8 hours</b>	173	92.5
<b>More than 8 hours</b>	14	7.5
<b>Total</b>	187	100

**4-2-8 Distribution of the restaurants by the number of food handlers working in them**

Food handlers are in close contact with food during processing, preparation, serving and their number might affect the food safety score as a result of high activities implemented by them. The average mean of the food handlers per restaurants was 9.05 with a standard deviation of 6.971 with a maximum of 30 workers and the minimum value of 2 as shown in table 8. Table 9 shows the number of restaurants distributed by number of food handlers working in the restaurants during all shifts. Of the 187 restaurants 1.1% hires less than 5 food handlers, 36.9% hires between 5 and 9 food handlers, 32.6% hires between 10 and 14 food handlers, 18.6% employ 15 to 19 food handlers and 10.7% of the restaurants had more or equal to 20 food handlers.

**Table (8): mean and standard deviation of the number of the food handlers**

<b>Number of food handlers per restaurant.</b>	<b>Number of restaurants</b>	<b>Mean</b>	<b>Standard deviation</b>	<b>Maximum</b>	<b>Minimum</b>
Total	187	9.05	6.97	30	2

**Table (9): Distribution of the restaurants by their number of food handlers**

<b>Food handlers number</b>	<b>Frequency of restaurants</b>	<b>Of total %</b>
<b>Less than 5</b>	2	1.1
<b>5-9</b>	69	36.9
<b>10-14</b>	61	32.6
<b>15-19</b>	35	18.6
<b>More or equal 20</b>	20	10.7
Total	187	100

### **4-3 Characteristics of the restaurants personnel**

Food production is operated by food handlers and supervised by restaurant management. Characteristics of these food handlers and their management, and their compliance with food safety regulations affect food safety in food establishment through knowledge, attitude, and behavior they carry within these characteristics. Below are details of such characteristics.

#### **4-3-1- Distribution of the general manager educational level**

The general manager is responsible for all activities of the restaurant and is considered the key link between the authorities, the public and the restaurant staff. In the 187 restaurants only 25.7% of the managers had a bachelor education, the next

were distributed as 19.8% had a diploma education, 40.1% had secondary education, and 14.4% had only primary education, as shown in table 10.

**Table (10): Distribution of the restaurants related to the general manager educational level.**

Degree of the general manager education	Frequency	% of total
Bachelor	48	25.7
Diploma	37	19.8
Secondary	75	40.1
Primary	27	14.4
Total	187	100

**4-3-2 Distribution of the restaurants by having a general manager certificated in food safety**

Presence of a general manager who is knowledgeable of the consequences of food borne-diseases and of the burden these diseases might hold on the food safety score is very important. Therefore, to explore this managers where asked about their certification in food safety. Table 11 shows that only 31% of the restaurants general managers declared that they have a kind of certification in food safety, and that the majority (69%) of the managers did not have any kind of food safety certification.

**Table (11): Distribution of the restaurants by having a general manager certificated in food safety**

Certification of the general manager in food safety	frequency	% of total
Yes	58	31
No	129	69
Total	187	100

#### **4-3-3 Distribution of the restaurants by having a Kitchen manager**

Kitchen manager presence helps in controlling the activities conducted by food handlers and in managing communication with these food handlers. Many studies showed that presence of a kitchen manager improved food safety score, therefore in this study the restaurants were asked about the presence of kitchen manger in there. Of the 187 restaurants only 86.1% reported hiring a kitchen manager and 13.9% did not have a kitchen manager as described in table 12.

**Table (12): Distribution of the restaurants related to having a Kitchen manager.**

<b>Having a kitchen manager</b>	<b>Frequency</b>	<b>% of total</b>
<b>Yes</b>	161	86.1
<b>No</b>	26	13.9
<b>Total</b>	187	100

#### **4-3-4 Distribution of the restaurants by presence of a certification of a kitchen manager in food safety.**

Many studies showed that presence of a certified kitchen manager (CKM) in food safety affect food safety score and might enhance and improve behaviors related to food handlers and represent a close monitoring to activities through internal inspection. Of the 187 restaurants who participated in the study only 164 restaurants reported to this variable, of these 164 restaurants only 53% reported that their kitchen manager had such a kind of certification in food safety, and 47% reported that they did not have any kind of certification, as shown in table 13.

**Table (13): Distribution of the restaurants by the presence of a certification of a kitchen manager in food safety**

<b>Certification of kitchen manager in food safety</b>	<b>Frequency</b>	<b>% of total</b>
<b>Yes</b>	88	53
<b>No</b>	76	47
<b>Total reported</b>	164	100
Did not report	23	-----

**4-3-5 Distribution of restaurants related to training of new food handlers in food safety by the management.**

Since several studies showed that food handlers training might affect food safety score of the restaurants, the study explored this and management of the restaurants was asked about this variable. Of the 187 restaurants only 38.5% reported that they train their newly employed food handlers on the food safety issues, and 61.5% reported they did not train them at the beginning of their work in the food establishment as described in table 14.

**Table (14): Distribution of restaurants by training of new food handlers by management in food safety**

<b>Training of new food handlers on food safety by the management</b>	<b>Frequency</b>	<b>% of total</b>
<b>Yes</b>	72	38.5
<b>No</b>	115	61.5
<b>Total</b>	187	100

#### **4-3-6 Distribution of restaurants by presence of food handler's certification in food safety**

Certified food handlers who are knowledgeable of food safety might enhance food safety score through the increase in positive perception toward food safety issues. Therefore to explore this variable in my study I asked the restaurant management on the presence of food handlers who are certified in food safety in their restaurants. Of the 187 restaurants only 27.3% of the manager reported that their food handlers have attended a kind of approved course in food safety and holds a certification of food safety, and 72.7% reported that they did not have workers who hold any kind of certification in food safety, as shown in table 15.

**Table (15): Distribution of restaurants related to food handlers certification in food safety**

<b>Certification of food handlers</b>	Frequency	% of total
<b>Yes</b>	51	27.3
<b>No</b>	136	72.7
Total	187	100

#### **4-4 Ministry of health inspection profile**

Each restaurant was asked about inspections implemented by MoH inspection during the last year including number of inspection visits, time spent during inspection, food sampling, frequency of food sampling, and feedback with results. This section describes the results obtained from the restaurants themselves.

##### **4-4-1 Number of inspection visits by MoH during the year (2009)**

The MoH inspection visits might affect food safety at restaurants through increasing the consultation and supervision. The mean number of the inspections by MoH in the

year 2009 was calculated for all the restaurants and found to be 7.29 inspections per restaurant with a standard deviation of 3.72 / restaurant as show in table 16. Of the 187 restaurants 28.3% reported that they were inspected between 0 and 4 times per the last year, 43.9% being inspected of 5 to 9 times , 24.1% from 10 to 14 times , and 3.7% from 15 to 19 times per the last year, as shown in table 17.

**Table (16): Mean and standard deviation for the number of inspection visits by MoH during year 2009**

<b>Number of inspection visits by MoH the year (2009).</b>	<b>Number of restaurants</b>	<b>Mean of inspection</b>	<b>Standard deviation</b>
Total	187	7.29	3.72

**Table (17): Distribution of restaurants by the number of inspection visits by MoH in the year 2009**

<b>Number of inspection visits by MoH the year (2009)</b>	<b>Number of restaurants</b>	<b>% of total</b>
<b>0-4 visits by MoH</b>	53	28.3
<b>5-9 visits by MoH</b>	82	43.9
<b>10-14 visits by MoH</b>	45	24.1
<b>15-19 visits by MoH</b>	7	3.7
Total	187	100

#### **4-4-2 Time spent by MoH inspectors during the last inspection.**

Time spent inspecting can increase the interaction between inspectors and restaurant management for food safety issues. The average time spent by the MoH inspectors during their last inspection, as reported by the restaurants themselves was 26.40 minute/restaurant with a standard deviation of 18.705 as shown in the table 18. About 62% of the 187 inspected restaurants reported that MoH inspectors spent less than 30 minute, 27.3% of the restaurants a time from 30 minutes to 59 minutes and 10.7% reported a time for 60 minute or more during their last inspection as shown in table 19.

**Table (18): Mean and standard deviation of time spent by MoH inspectors during their last inspection**

<b>Time spent by MoH inspectors in during the last inspection.</b>	<b>Number of restaurants</b>	<b>Mean time in minute</b>	<b>Standard deviation</b>
Total	187	26.40	18.70

**Table (19): Distribution of the restaurants by the time spent by MoH inspectors during their last inspection**

<b>Time spent by MoH inspectors in the last inspection</b>	<b>Number of restaurants</b>	<b>% of total</b>
<b>Less than 15 minute in the last inspection</b>	43	23
<b>15-29 minute in the last inspection</b>	73	39
<b>30-44 minute in the last inspection</b>	36	19.3
<b>45-59 minute in the last inspection</b>	15	8
<b>More or equal to 60 minute</b>	20	10.7
<b>Total</b>	<b>187</b>	<b>100</b>

#### **4-4-3 Distribution of restaurants by occurrence of food sampling by MoH**

Food sampling is part of the surveillance system implemented by MoH to monitor food safety at restaurants that might enhance food safety; therefore we asked the restaurant management about this variable if it accounted at all during 2009. Of the 187 restaurants 94.1% reported that the MoH collected food samples from their restaurants, and only 5.9% reported that MoH did not take food samples from their restaurants as described in table 20.

**Table (20): Distribution of the restaurants by the sampling of food by MoH**

<b>Food samples collection by MoH in the year 2009.</b>	<b>Number of restaurants</b>	<b>% of total</b>
<b>Yes</b>	176	94.1
<b>No</b>	11	5.9
<b>Total</b>	<b>187</b>	<b>100</b>

#### **4-4-4 Frequency of inspections with food sampling by MoH inspectors in the year 2009**

Information collected from restaurants on sample collection for food samples testing, indicated that on the average restaurants had a 4.40 visits with samples collected during the last year 2009 with standard deviation of 2.7 as shown in the table 19. Only 176 of the 187 inspected restaurants had reported for this variable, of these restaurants 9.7% declared that the MoH inspectors collect food samples less or equal to 5 times per the last year 2009, 46 % reported that the inspectors collected samples between 5 and 9 time per last year, 25% indicated that the MoH collected food samples from 10 to 14 times, 11.9% reported that samples were collected between 15 and 19 times, and 7.4% reported that the MoH collected food samples more or equal to 20 times, as shown in table 21.

**Table (21): Mean and standard deviation of inspection with food sampling by MoH inspectors during the year 2009**

<b>food sampling by MoH inspectors in the last year 2009</b>	<b>Number of restaurants</b>	<b>Mean number of visits</b>	<b>Standard deviation</b>
Total	176	4.40	2.7

**Table (22): Distribution of the restaurant by frequency of food sampling by MoH inspectors during the year 2009**

<b>Frequency of food sampling by MoH inspectors in the year 2009</b>	<b>Number of restaurants</b>	<b>% of total</b>
<b>Less than 5 inspection visits with food samples collected</b>	17	9.7
<b>5-9 inspection visits with food samples collected</b>	81	46
<b>10-14 inspection visits with food samples collected</b>	44	25
<b>15-19 inspection visits with food samples collected</b>	21	11.9
<b>More than or equal 20 inspection visits with food samples collected</b>	13	7.4
Total report	176	100
Did not report did for the variable	11	-----

**4-4-5 Distribution of the restaurants by feedback on the food samples results.**

When asked about receiving feedback for the MoH inspections over the results of the food samples from the 187 restaurant only 178 reported to this question, of these only 37.6% said that they received such results from the MoH inspectors or that inspectors discussed these results with them, the remaining 62.4% restaurants reported that they did not receive any feedback on the results, as shown in table 23.

**Table (23): Distribution of the restaurants by feedback on the food samples results**

<b>Feedback the food samples results with restaurants management</b>	<b>Number of restaurants</b>	<b>of total %</b>
<b>Yes</b>	67	37.6
<b>No</b>	111	62.4
Total reported to the question	178	100
Did not reported of the variable	9	-----

#### **4-5 Food safety violations in the restaurants**

Violations are classified into two categories, high importance (critical) violation category and low importance violation category, according to the severity and the possible contribution of such violations to food-borne diseases. This classification is in accordance to the weight of each violation related to being directly associated with food illness or as a contributing factor; in this section I summarize the frequency and type of the violations in accordance to this classification.

##### **4-5-1 Distribution of the critical violations in the restaurants**

Critical violations are risk factors cited as to be associated with food-borne illness, table 24 show the frequency occurrence of the high violation that are deemed of high importance and danger for food safety. The top five violations in the study were poor personnel hygiene-hands that were detected in 86.6% of the restaurants , not using the sanitizer and appropriate rinse of (hot water-chemical), temperature, appropriate exposure time detected in 79.1% of the restaurants, lack of certification and knowledge of food handlers was in 72.7% of the restaurants, improper hand washing procedure was in 64.7% of the restaurants and processing area for raw and cooked

food is not separated which was observed in 52.5% of the restaurants. Other violations described by the CDC as critical violation associated with food poisoning were also detected in this study but not within the top five violations were these; Inappropriate cooking time and temperature, improper holding temperature, contaminated equipment and usage of food obtained from unsafe source. In our study it was found that poor personal hygiene was recorded in 86.6% of the restaurants; inappropriate cooking time and temperature was recorded in 44.9% of the restaurants, improper hot holding temperature was recorded in 32%, contaminated equipment was found in 26.7% , and lack of obtaining food from a safe source was recorded in 15% respectively.

**Table (24): Relative frequency of the critical violations in the restaurants**

N	Critical violations	Frequency of violations	
		N	%
1	Hands washed and cleaned and frequency (personal hygiene)	162	86.6
2	Sanitizer rinse (hot water-chemical), temperature, concentration, exposure time	148	79.1
3	Demonstration of knowledge: approved course, other requirement meet like certification examination in food safety for employees, and Successfully completed approved food safety training	136	72.7
4	Improper hands-wash procedure	121	64.7
5	Processing area for raw and cooked food not separated	98	52.5
6	Facility maintaining product temperature during receiving, storage, preparation, holding, and serving	87	46.5
7	Proper cold serving temperature keep at 4°C or below	84	44.9
8	cooking time and temperature	84	44.9
9	Proper hot serving temperature maintained at 57°C or above	80	42.8
10	Proper hot holding temperature maintained at 57°C or above	60	32
11	The hazardous food meets temperature requirements during preparation	51	27.3
12	Food contact surfaces used for raw meat thoroughly cleaned and sanitized after processing (at least every 4 hours)	50	26.7
13	Presence of insects, rodents-outer openings protected, no birds, other animals	49	26.2
14	Proper cooling procedure 21°C at 2 hour or 4°C at 4 hour	46	24.6
15	Raw foods below or away from RTE food in preparation and storage area	44	23.5

16	Food received at proper temperature	38	20.3
17	Toxic items, first aid material, medicine, properly stored, labeled and used	37	19.8
18	Number of toilet convenient, accessible, designed, installed and maintained	34	18.2
19	Unwrapped and potential hazardous food not re-served	34	18.2
20	Safe source food, certificated as law, no deterioration	28	15
21	Separation of equipment for ready to eat and raw food	28	15
22	Personnel with infectious or communicable disease restricted	24	12.8
23	Handling of raw and cooked food properly separated	23	12.3
24	Medical checking of workers regularly every year and at acceptance	19	10.2
25	Cross-contamination, back siphonage, backflow, not leaking	19	10.2
26	Safe source water, hot & cold water available under pressure	14	7.5
27	Sewage and water disposal, maintained, located	6	3.2

#### 4-5-2 Distribution of low food safety violations in the restaurants

Low violations are contributing factors to food illness; table 25 shows the frequency of the low food safety violations. The top five low violations were, checking of food temperatures which was recorded in 100% of the restaurants, 69.5% do not use gloves and change them as required, in 39% the garbage container was not covered neither available in adequate numbers, in 35.3% lighting provided was not fixed or shielded, and in 34.8% of the restaurants workers wore dressing rings, jewelry and other decoration with long nails/ polish.

**Table (25): Relative frequency of the low violations in the restaurants**

N	low violations	Frequency of violations	
		N	%
1	Thermometers provided, using, accurate	187	100
2	Gloves using, changed as required	130	69.5
3	Approved garbage containers, adequate number, covered	73	39
4	Manual washing three or more compartment, tow drain boards, enough size	68	36.4
5	Lighting provided, fixtures, shielded	66	35.3
6	Dressing rings, jewelry and other decoration, Long nails/ polish	65	34.8
7	Refrigeration temperature fixed and maintained	58	31

8	Eating , smoking while working	58	31
9	Proper thawing method, clean drinkable running water at 21C, using, a pane, change the drips, adequate time in refrigerator, or microwave for immediate cooking	55	29.4
10	Appropriate, Clean outer cloths, hair restraints, uniform clothes	53	28.3
11	Garbage and refuse disposal, Containers or receptacles, covered, adequate, insect and rodent proof, frequency and clean	51	27.3
12	Wiping hands on apron/ clothes/ wiping clothes	51	27.3
13	Food-contact surfaces of equipment and utensils clean, free of abrasives', Detergents	49	26.2
14	Wiping cloths clean use once unless , keep in clean water or sanitizer use restricted	45	24.1
15	Toilet room enclosed, self-closing doors fixture good repair ,clean, hand cleanser, sanitary towels, hand-drying device, proper waste receptacles, and location	45	24.1
16	Ventilation, room and equipment vented	45	24.1
17	Shelf stock identification , labeling by date of expiry and production , and storage	44	23.5
18	Garbage disposed of in an approved manner, at approved frequency	41	21.9
19	Improper sink used for hand washing	41	21.9
20	Proper Labeling of original containers, packaging, free of corrosive	39	20.9
21	Proper washing of fruit and vegetables	38	20.3
22	Refrigeration and freezer capacity sufficient	38	20.3
23	Food in a good transportation condition, safe and unadulterated	36	19.3
24	Non-food contact surfaces of equipments and utensils clean	29	15.5
25	Food protection during storage, preparation, display, service, and transportation	29	15.5
26	Separation of raw and cooked food during storage	28	15
27	Proper disposal of unsafe or contaminated food, kept in leak proof and rodent proof containers, covered, disposed frequently	28	15
28	Storage, handling of clean equipment	27	14.4
29	Floors, constructed, drained, clean, good repair, covering, instillation, dustless cleaning method	21	11.2
30	Plumbing location ,Installed, maintained	20	10.7
31	Minimal bare hand contact with food, using deli paper, spatula tongs, dispensing equipments or gloves	20	10.7
32	Walls, ceiling, attached equipment, constructed, good repair, clean surfaces, dustless cleaning method	20	10.7
33	Adequate equipment for temperature-monitoring or time temperature indicators in temperature control devices	19	10.2
34	Non-food contact surface designed constructed, maintained, installed, located	17	9.1

#### **4-5-3 Distribution of food safety violations by category of violations**

Violations are categorized into groups that represent the overall operations required for hygienic conditions and food safety quality control. Table 26 show the distribution of these violations in each category. In the food at arrival category 20.9% of the food was not in a good transportation condition, not safe and adulterated. In the food protection category 100% did not use thermometer, and in 79.1% of the restaurant's the facility was not suitable to maintain food temperatures. In the food temperature and control category 44.9% did not maintain the cooking time and temperature ,44.9% did not have proper cold serving temperature and 42.8% did not maintain hot temperature during serving. In the personnel hygiene category 86.6% did not maintain hands washing, cleaning and frequency, 69.5% did not use gloves or change as required, and 56.9% did not wear appropriate clean outer cloths, hair restraints, or uniform cloths. In the hygienic practice category 64.7% had improper hands-wash procedure, in 31% of the restaurants their workers eats and smokes while working . In the cross contamination category 52.4% of the processing areas for raw and cooked foods were not separated. In the food equipments and utensils maintenance and sanitation category 46.5% were not using sanitizer rinse (hot water-chemical), temperature of water , concentration of sanitizer or exposure time were not suitable. In the toilet and hand-washing facilities category 39% had an un-approved garbage containers, inadequate number, or containers were not covered. And in the physical facilities category 27.3% of the garbage and refuse disposal, Containers or receptacles were not covered, or there were no adequate, insect and rodent proof, frequency or they were not clean.

**Table (26): Distribution of the violations by the category**

N	Food at arrival	%
1	Safe source, certificated as law, no deterioration	15
2	Proper Labeling of original containers, packaging, free of corrosive	19.3
3	Food in a good transportation condition, safe and unadulterated	20.9
4	Food received at proper temperature	20.3
N	Food Protection	%
6	The hazardous food meets temperature requirements during preparation,	27.3
7	Facility maintaining product temperature during receiving, storage, preparation, holding, and serving	79.1
8	Thermometers provided , using, accurate	100
9	Unwrapped and potential hazardous food not re-served	18.2
10	Food protection during storage, preparation, display, service, transportation	15.5
11	Separation of raw and cooked food during storage	15
12	Proper washing of fruit and vegetables.	20.3
N	Food temperature control and procedures	%
13	Adequate equipment for temperature-monitoring or time temperature indicators in temperature control devices	10.2
14	Proper thawing method, clean drinkable running water at 21C, using, a pane, change the drips, adequate time in refrigerator, or microwave for immediate cooking	29.4
15	cooking time and temperature	44.9
16	Proper cooling procedure 21°C at 2 hour or 4°C at 4 hour	24.6
17	Proper hot holding temperature maintained at 57°C or above	23.1
18	Proper hot serving temperature maintained at 57°C or above	42.8
19	Proper cold serving temperature keep at 4°C or below	44.9
20	Refrigeration and freezer capacity sufficient	20.3
21	Refrigeration temperature fixed and maintained	31
N	Personnel hygiene	%
22	Personal with infectious or communicable disease restricted,	12.8
23	Hands washed and cleaned and frequency	86.6
24	Appropriate, Clean outer cloths, hair restraints, uniform clothes	56.9
25	Dressing rings, jewelry and other decoration, Long nails/ polish	34.8
26	Gloves using, changed as required	69.5
27	Minimal bare hand contact with food, using deli paper, spatulas, tongs, dispensing equipments or gloves.	10.7
28	Demonstration of knowledge: approved course, other requirement meet like certification examination in food safety for employees, and Successfully completed approved food safety training	72.7
29	Medical checking of workers regularly every year and at acceptance	10.2
N	Hygienic practices	%
30	Improper hands-wash procedure	64.7
31	Wiping hands on apron/ clothes/ wiping clothes	27.3
32	Eating , smoking while working	31

33	Improper sink used for hand washing	21.9
N	cross contamination	%
34	Food contact surfaces used for raw meat thoroughly cleaned and sanitized after processing (at least every 4 hours)	26.7
35	Raw foods below or away from RTE food in preparation and storage area	23.5
36	Shelf stock identification , labeling by date of expiry and production , and storage	23.5
37	Proper disposal of unsafe or contaminated food, kept in leak proof and rodent proof containers, covered, disposed frequently	15
38	Handling of raw and cooked food properly separated	12.3
39	Separation of equipment for ready to eat and raw food	15
40	Processing area for raw and cooked food separated	52.4
N	<b>Food equipments and utensils maintenance and sanitation</b>	%
41	Non-food contact surface designed constructed, maintained, installed, located	9.1
42	Manual washing three or more compartment, tow drain boards, enough size	36.4
43	Sanitizer rinse (hot water-chemical), temperature, concentration, exposure time.	46.5
44	Wiping cloths clean use once unless , keep in clean water or sanitizer use restricted	24.1
45	Food-contact surfaces of equipment and utensils clean, free of abrasives', Detergents.	26.2
46	Storage, handling of clean equipment	14.4
47	Non-food contact surfaces of equipments and utensils clean	15.5
N	<b>Toilet and hand-washing facilities</b>	%
48	Number, convenient, accessible, designed, installed, and maintained	18.2
49	Toilet room enclosed, self-closing doors fixture good repair ,clean, hand cleanser, sanitary towels, hand-drying device, proper waste receptacles, and location	24.1
50	Approved garbage containers, adequate number, covered	39
51	Garbage disposed of in an approved manner, at approved frequency	21.9
N	Water	%
52	safe source, hot & cold water available under pressure	7.5
N	<b>Insects, Rodent, animal control</b>	%
53	Presence of insects, rodents-outer openings protected, no birds, other animals	26.2
N	<b>Physical facilities</b>	%
54	Sewage and water disposal, maintained, located,	3.2
55	Plumbing location ,Installed, maintained	10.7
56	Cross-contamination, back siphonage, backflow, not leaking	10.2
57	Garbage and refuse disposal, Containers or receptacles, covered, adequate, insect and rodent proof, frequency, clean	27.3
58	Floors, constructed, drained, clean, good repair, covering, instillation, dustless cleaning method	11.2

59	Walls, ceiling, attached equipment, constructed, good repair, clean surfaces, dustless cleaning method	10.7
60	Lighting provided , fixtures, shielded	35.3
61	Ventilation, room and equipment vented	23.5
N	<b>Other operations</b>	%
62	Toxic items, first aid material, medicine, properly stored, labeled, used	19.8

#### 4-6 Food safety score of the restaurants

Food safety score is a numeric value used as a proxy measure of food safety in the restaurants. In this part I summarize the food safety score as percentage, then I determine the percentage of restaurants above the cutoff food safety score of 70 recommended in the US for voluntary closure, and their distribution according to the grading score into letters is also presented.

##### 4-6-1 Overall safety score of the restaurants

Food safety score is a proxy of food safety that might be attributed to hygienic conditions in a food establishment. The research yielded an average inspection score of 71.18% for the 187 restaurants with the minimum value of 39% and a maximum of 94%, the standard deviation was 10.836, as shown in table 27.

**Table (27): Distribution of the food safety score of restaurants.**

<b>distribution of the restaurant score</b>	Number of restaurants	Minimum Value %	Maximum Value %	Mean value %	Standard deviation
<b>Score of restaurant</b>	187	39	94	71.18	10.836

##### 4-6-2 Distribution of the restaurants according to the score 70 as a cutoff value for voluntary closure

In the U.S many states use the food safety score of 70% as a cutoff point according to which the restaurant owner may be advised to voluntarily close their door, his permits

may be revoked, or the food establishment will be re-inspected. Table 28 show that according to this criteria of the 187 restaurants inspected, only 55.1% should continue working and the restaurants 44.9% should be voluntarily closed, their permits revoked or they should be re-inspected.

**Table (28): Distribution of the restaurants by the cutoff food safety score of 70% for voluntary closure**

<b>Restaurant score</b>	<b>Number of restaurants</b>	<b>% of total</b>
<b>Equal to or more than 70%</b>	103	55.1
<b>Less than score 70%</b>	84	44.9
<b>Total</b>	187	100

#### **4-6-3 Distribution of the restaurants by the grading letters**

Changing the food safety score into a grade (A, B, C,) communicate the results of the restaurants inspection in an easy way and guide the consumers for the safe food establishment. Table 29 shows the grads the scope range they cover and distribution of restaurants and then restaurants that reported less than 70% food safety score are not graded as they are deemed not safe. Of the 187 restaurants only 1.1% of restaurants would be posted the highest grad of A, 26.2% would be posted a grade B, 27.8% posted a grade C, and 44.9% of the restaurants did not meet the criteria of grading, as described in table 31.

**Table (29): Distribution of restaurants by the grading letters**

<b>Distribution of grades (covered range)</b>	<b>Number of restaurants</b>	<b>% of total</b>
<b>Grade (90-100) A</b>	2	1.1
<b>Grade (80-89) B</b>	49	26.2
<b>Grade ( 70-79) C</b>	52	27.8
<b>Without grade (liable for closure)</b>	84	44.9
<b>Total</b>	187	100

#### **4-7 Determinants of the food safety score of the restaurant**

In this section I summarize the relationships between the food safety score of the restaurants and the study variables in order to determine which of these variables affect the food safety score and so might be considered in any future planning to improve the scores.

##### **4-7-1 Food safety score and the type of restaurant**

Tables 30, 31, indicated an effect of the restaurants classification to its type on its food safety score the higher the classification type was the higher the score ( $F=11.837$ ,  $P=0.0001$ ). Restaurants that were classified as hotel type got higher food safety score average of (81.54%) than restaurants classified as touristic type who got an average score of 74.22%), restaurants that were classified as fast food type who got a score of (70.64%) or the restaurants classified as popular type who got a score of 68.78% respectively.

**Table (30): Frequencies, Means, and standard deviations of food safety scores of the restaurants by their types**

<b>Type of the restaurant</b>	<b>Number of restaurants</b>	<b>Mean of safety score</b>	<b>Standard deviation</b>
<b>Hotel</b>	26	81.54	6.140
<b>Touristic</b>	9	74.22	5.954
<b>Fast food</b>	36	70.64	9.445
<b>Popular</b>	116	68.78	11.011
<b>Total</b>	187	71.18	10.836

**Table (31): One-Way ANOVA test of the differences between the mean food safety score and of the different type of the restaurants**

Sources of variability	Sum of squares	Degree of freedom (df)	Mean squares	F-statistic	Sig.
Between Groups	3549.241	3	1183.081	11.837	0.0001
Within Groups	18289.9347	183	99.945		
Total	21839.179	186	-----		

To find out if the differences between the groups were consistent in the dual comparison Tukey test for multiple comparisons was made as shown in table 32. Regardless the positive effect of the classifications of the restaurants on its food safety score, the differences persisted between the restaurants that were classified as hotel type and the restaurants classified as popular type and between the hotel type and the fast food type.

**Table (32): Tukey test (multiple comparisons).**

Dual Comparison	Mean difference	Sig.
Fast food category <b>and</b> popular category	<b>1.854</b>	<b>0.397</b>
Fast food category <b>and</b> touristic category	<b>3.583</b>	<b>0.771</b>
Fast food category <b>and</b> Hotel category	<b>10.900*</b>	<b>0.0001</b>
popular category <b>and</b> touristic category	<b>5.438</b>	<b>0.765</b>
popular category <b>and</b> Hotel category	<b>12.754*</b>	<b>0.0001</b>
touristic category <b>and</b> Hotel category	<b>7.316</b>	<b>0.235</b>

\* The mean difference is significant at the .05 level

#### **4-7-2 Food safety score of the restaurant and management.**

The management and personnel of the restaurant, whom may differ in education and certification in food safety, play a major role in implementing activities in the food establishments. In this section the effect of these variable of the safety score are explored.

##### **4-7-2-1 Food safety score and educational level of the general manager.**

Even though that the overall average food safety score for all restaurants was low table 33 and 34 show a clear positive effect of the educational level of the general manager of the restaurant on its food safety score, the higher the educational level was the higher the average food safety score become ( $F=32.078$ .  $P= 0.0001$ ). Restaurant that reported their general manager have a bachelor degree got higher food safety score than restaurants who reported that the manger had only a diploma, a secondary, or a primary education. Restaurants with a manager having a bachelor degree had an average score of 79.58%, compared to 73.46% for the diploma level holders, 68.77% for the secondary level educated, and only 59.78% for the primary level educated respectively.

**Table (33): Frequencies, Means, and standard deviations of food safety score by the degree of the manger education**

<b>Manager educational level</b>	<b>Number of restaurant</b>	<b>Mean safety score</b>	<b>Standard deviations</b>
<b>Bachelor</b>	48	79.58	7.906
<b>Diploma</b>	37	73.46	9.734
<b>Secondary</b>	75	68.77	8.485
<b>Primary</b>	27	59.78	10.070

**Table (34): One-Way ANOVA test of the differences in food safety score by degree of the manger education**

Sources of variability	Sum of squares	Degree of freedom (df)	Mean squares	F-statistic	Sig.
Between Groups	7526.507	3	2508.836	32.078	0.0001
Within Groups	14312.669	183	78.211		
Total	21839.176	186	-----		

Tukey test of multiple comparisons was carried out to test if these differences between the average score persisted between groups. Table 35 shows that regardless the comparison made a positive significant difference persisted between the lower and the higher educational level, the higher the education the higher mean safety score, and that highest difference was between manager with a primary education and the manager with a bachelor degree.

**Table (35) : Tukey test (multiple comparisons )**

Dual Comparison	Mean difference	Sig.
Primary degree <u>and</u> Secondary degree	<b>8.996*</b>	<b>0.0001</b>
Primary degree <u>and</u> Diploma degree	<b>13.682*</b>	<b>0.0001</b>
Primary degree <u>and</u> Bachelor degree	<b>19.806*</b>	<b>0.0001</b>
Secondary degree <u>and</u> Diploma degree	<b>4.686*</b>	<b>0.045</b>
Secondary degree <u>and</u> Bachelor degree	<b>10.810*</b>	<b>0.0001</b>
Diploma degree <u>and</u> Bachelor degree	<b>6.124*</b>	<b>0.01</b>

\* The mean difference is significant at the 0.05 level

#### 4-7-2-2 Food safety score and manager certification in food safety

Table 37 shows that certification of the manager of the restaurant in food safety had a positive impact on the food safety score of the restaurant; restaurants that had a manger certified in food safety got higher food safety score their restaurants who did not have such as certified manager (P=0.0001).Restaurants with a certified manager got an average score of 81.29% compared to 66.63% for restaurants that did not have a certified manager.

**Table (36): T-test for the differences in food safety score by the general manager certification in food safety**

Certification in food safety	Number of restaurants	Mean score	Std. Deviation	df	t	Sig.
Yes	58	81.29	6.052	185	-12.830	0.0001
No	129	66.63	9.332			

#### 4-7-2-3 Food safety score and effect of having a kitchen manager

As shown in table 37 a kitchen manger presence had a positive effect on food safety score. Restaurants that hire a kitchen manager got higher food safety score than restaurants who did not hire a kitchen manager (p=0.0001), restaurant with a kitchen manager got an average food safety score of (72.86%) which was higher than the score of (60.73%) for the restaurant without a kitchen manager.

**Table (37): T-test for the differences between mean food safety score related to having a kitchen manager**

Having of kitchen manager	Number of restaurants	Mean score	Std. Deviation	df	t	Sig.
Yes	161	72.86	10.334	185	-5.733	0.0001
No	26	60.73	7.634			

#### 4-7-2-4 Food safety score and certification of the kitchen manager in food safety

Of the 187 restaurants only 164 reported for this variable and the analysis was made only on these people. The analysis showed that certified kitchen manager had a positive relationship with the food safety score of the restaurants, as shown in the table 38; restaurants that had a certified kitchen manager got a higher food safety score than restaurant that did not have such a manager (. P=0.0001). Restaurants with a certified kitchen manager got an average food safety score of 79.6% compared to 65.21% for those who did not have a certified kitchen manager.

**Table (38): T-test of the difference between food safety score related to certified kitchen manage**

Presence of a Certified kitchen manager	Number of restaurants	Mean score	Std. Deviation	df	t	Sig.
Yes	86	79.6	6.401	163	-0.624	0.0001
No	78	65.21	8.338			

#### 4-7-2-5 Food safety score and the number of working shifts

When inquiring with the restaurants on their number of working shifts, only one restaurant reported working 3 shifts per day and therefore was excluded from the analysis. For the remaining 186 restaurants the number of shifts implemented by the restaurants had a positive relationship with the food safety score of the restaurants (P=0.0001). As described in tables 39, restaurants that work for two shifts on average got a higher food safety score of 72.54% compared to restaurants who work for one shift that got a score of 62.68%.

**Table (39): T-test of the differences between food safety score by number of shifts**

Number of working shifts	Number of restaurants	Mean score	Std deviation	df	t	Sig
One	28	62.68	10.471	184	-4.731	0.0001
Tow	158	72.54	10.109			

**4-7-2-6 Food safety score and the length of the working shift**

Length of working shifts might differ between restaurants from the standard 8 hours of work per shift and so the length of the shift in hours was studied as a potential predictor of the food safety scores. Shift length in hours had a positive effect on food safety score of the restaurant. As described in table 40 restaurants that work less or equal to 8 hours/shift got a higher food safety score on average than restaurants who work more than 8 hours per shift (P=0.017). Restaurants that the shift works up to 8 hours got an average food safety score of 71.71% compared to 64.57% for restaurants who work more than 8 hours/ shift.

**Table (40): T-test of the differences between the mean food safety scores by length of shifts**

Length of shifts in hours	Number of restaurants	Mean Score	Std. Deviation	df	t	Sig.
Less than or equal to 8 hours	173	71.71	10.599	185	2.401	0.017
More than 8 Ours	14	64.57	11.953			

#### 4-8 Food safety score and food handlers

Food handlers are the operators of food production in food establishments and who are in direct contact with the food. This section summarizes the relationships between the food safety score and the characteristics of food handlers in the restaurants.

##### 4-8-1 Food safety score and certification of food handlers in food safety

Certification of food handlers in the food safety through their attendance at an approved course of training had a positive effect on the food safety score as shown in table 41. The table shows that restaurants with certified food handlers, as detected by the management received on the average a higher food safety score of 80.12% compared to 67.82% for the restaurants that did not have such certified food handlers ( $P = 0.0001$ ).

**Table (41): T-test for the difference in food safety score by certification of food handlers in food safety**

Presence of certified handler	Number of restaurants	Mean score	Std. Deviation	df	t	Sig.
Yes	51	80.12	9.872	185	-7.993	0.0001
No	136	67.82	9.173			

##### 4-8-2 Food safety score and training of new food handlers by management

Table 42 shows that training of newly employed food handlers by the management had a positive effect on food safety score of restaurants. Restaurants that reported training their new food handlers when accepted at work got a higher food safety score 79.64% compared to restaurants that did not train their food handlers when they start working 65.88%, this positive relationship was a significant one ( $P = 0.0001$ ).

**Table (42): T-test for the differences between food safety score by training of new food handler in food safety**

Training of food handler	Number of restaurants	Mean score	Std. Deviation	df	t	Sig.
Yes	72	79.64	8.676	185	-10.737	0.0001
No	115	65.88	8.435			

#### **4-9 Food safety score and affect of Ministry of Health inspection**

The MoH have the authority of inspecting restaurants and licensing them, in this section I describe the relationship of food safety score to the number of inspection visits, number of food inspections with food sampling and testing, time spent during inspection, and feeding back the results of food samples testing with the restaurants management.

##### **4-9-1 Food safety score and effect of the number of MoH inspection visits**

The number of MoH inspection visits per the last year 2009 on the safety score was inspected; higher number of inspections seems to have a positive effect on food safety score of restaurants, as shown in tables 43, 44. Restaurants that were inspected by the MoH within the year, 2009, for 0 to 4 times got a food safety score of 67.49%, restaurants that were inspected 5 to 9 times got a food safety score of 70.38%, restaurants that were inspected 10 to 14 times got a food safety score of 72.20%. The food safety score increased significantly to 82.57% for restaurants that were inspected at an average of 15 to 19 times (F=7.566. P=0.0001). This trend of a positive association paralleled to a correlation coefficient of (r =0.337) when the number of visits was calculated as a continuous variable indicating a moderate strength of the association.

**Table (43): T-test for the differences between food safety score by number of restaurants inspection performed on it by MoH in the year (2009)**

Number of visits	Number of restaurants	Mean score	standard deviations
1-4	53	67.49	11.008
5-9	82	70.38	10.326
10-14	45	75.20	9.940
15-19	7	82.57	4.894

**Table (44): One-Way ANOVA test for the differences of food safety score by the number of inspections performed on the restaurants by the MoH last year (2009)**

Sources of variability	Sum of squares	Degree of freedom (df)	Mean squares	F-statistic	Sig.
Between Groups	2409.736	3	803.245	7.566	0.0001
Within Groups	19429.440	183	106.172		
Total	21839.176	186	---		

Table 45 shows that regardless the comparison made, the positive significant difference in food safety score persisted between the low number of inspections and the higher number of inspections except between the group of 1 to 4 visits and 5 to 9 visits and of 10 to 14 visits and 15 to 19 visits.

**Table (45): Tukey test (multiple comparison)**

<b>Dual Comparison</b>	<b>Mean difference</b>	<b>Sig.</b>
(1-4 visits) <b>and</b> (5-9 visits)	<b>2.887</b>	<b>0.387</b>
(1-4 visits) <b>and</b> (10-14 visits)	<b>7.709*</b>	<b>0.002</b>
(1-4 visits) <b>and</b> (15-19 visits)	<b>15.081*</b>	<b>0.002</b>
(5-9 visits) <b>and</b> (10-14 visits)	<b>4.822*</b>	<b>0.060</b>
(5-9 visits) <b>and</b> (15-19 visits)	<b>12.193*</b>	<b>0.016</b>
(10-14 visits) <b>and</b> (15-19 visits)	<b>7.371</b>	<b>0.296</b>

**\*The mean difference is significant at the level .05 level.**

**4-9-2 Food safety score and effect of the time spent by the MoH inspector inside the restaurant during the last inspection**

As shown in tables 46 and 47 times spent by MoH inspectors inspecting the restaurant during the last inspection as reported by the restaurants themselves, had a positive effect on the food safety score of the restaurants. Restaurants that were inspected for a time less than 15 minute got only 65.93% compared to 67.55% for restaurants that were inspected for a time ranging from 15 to 29 minute, restaurants that were inspected for a time ranging from 30 to 44 minute got a food safety score of 75.28%, restaurants that were inspected for a time ranging from 45 to 59 minute got a food safety score of 77.78%, the score become higher for restaurants that were inspected for a time more or equal to 60 minute who got an average safety score of 83.30% (F=6.555 P= 0.0001). This trend of a positive association compared to an intermediate correlation coefficient of (r = 0.485) when calculated for the number of time of inspection in spent minute by MoH during the last inspection as continuous variable.

**Table (46) Food safety score related to the time spent by the MoH inspector in the last inspection**

<b>Time spent by MoH inspector inside the restaurant during the last inspection</b>	<b>Number of restaurants</b>	<b>Mean score</b>	<b>Standard deviation</b>
<b>Less than 15 minute</b>	43	65.93	8.013
<b>15 - 29 minute</b>	73	67.55	10.289
<b>30 - 44 minute</b>	36	75.28	10.598
<b>45 – 59 minute</b>	15	77.78	6.379
<b>More or equal to 60 minute</b>	20	83.30	5.886
<b>Total</b>	187	71.18	10.836

**Table (47): One-Way ANOVA test for the differences between food safety score of the time spent time during the last inspection by MoH inspector**

<b>Sources of variability</b>	<b>Sum of squares</b>	<b>(df)</b>	<b>Mean squares</b>	<b>F-statistic</b>	<b>Sig.</b>
<b>Between Groups</b>	7598.403	14	542743	6.555	0.0001
<b>Within Groups</b>	14240.733	172	82795		
<b>Total</b>	21893	186	---		

On the dual comparison, table 48 shows that the differences persisted between the interval time more or equal to 60 minutes, 45 to 59, and 30 to 44 minutes compared to the lowest time interval of less than 15 minutes and the interval of 15 to 30 minutes. As well as for difference between the groups of 30 to 44 minutes and more or equal to 60 minutes. No increase in the deferent between the groups of less than 15 minute and 15 to 29 minute, 30 to 44 minute and 45 and 59, 45 to 59 minute and more or equal to 60 minute respectively was observed.

**Table (48 ): Tukey test (multiple comparisons).**

<b>Dual Comparison</b>	<b>Mean difference</b>	<b>Sig.</b>
Less than 15 minute <b>and</b> 15 to 29 minute	<b>1.618</b>	<b>0.892</b>
Less than 15 minute <b>and</b> 30 to 44 minute	<b>9.384*</b>	<b>0.001</b>
less than 15 minute <b>and</b> 45 to 59 minute	<b>11.936*</b>	<b>0.001</b>
less than 15 minute <b>and</b> more equal to 60 minute	<b>17.370*</b>	<b>0.001</b>
15 to 29 minute <b>and</b> 30 to 44 minute	<b>7.730*</b>	<b>0.001</b>
15 to 29 minute <b>and</b> 45 to 59 minute	<b>10.319*</b>	<b>0.001</b>
15 to 29 minute <b>and</b> more or equal to 60 minute	<b>15.752*</b>	<b>0.001</b>
30 to 44 minute and 45 to 59 minute	<b>2.589</b>	<b>0.891</b>
30 to 44 minute and more or equal to 60 minute	<b>8.022*</b>	<b>0.018</b>
45 to 59 minute and more or equal to 60 minute	<b>5.433</b>	<b>0.421</b>

\* The mean difference is significant at the .05 level

#### **4-9-3 Food safety score of the restaurants and effect of feedback on the results of food samples analysis**

Table 49 shows that feedback on the results of food sample analysis made by the MoH inspectors had a positive effect on food safety score of the restaurants. Restaurants that have received feedback on the results of food samples analysis report got higher food safety score (76.91%) compared to restaurants who did not received feedback on food samples analysis report who got a 67.93% (p=0.0001) .

**Table (49): Food safety score and affect of feedback with the management on the results of food samples analysis**

<b>Feedback on the results analysis with the restaurant management</b>	<b>Number of restaurants</b>	<b>Mean score</b>	<b>Std. Deviation</b>	<b>df</b>	<b>t</b>	<b>Sig.</b>
Yes	67	76.91	9.040	176	-5.913	0.0001
No	111	67.93	10.257			

#### **4-10 Multivariate analysis**

A one way analysis of covariance (ANCOVA) was conducted to test for the joint effect of the variables on the food safety score (the dependant variable). Only variables that were significantly associated with the dependant in the bivariante analysis were included in the multivariate model. The independent variables inserted were degree of the manager education, certification of the manager in food safety, presence of certified kitchen manager, number of working shifts, certification of food handlers in food safety, having a kitchen manager, type of the restaurant, length of working shifts in hour, feedback the results with management by the MoH on sample analysis and training of new food handler by the manager. The dependent variable was the food safety score and the covariates were number of inspection visits by MoH on the restaurants in the year 2009 and time spent by MoH during the last inspection. Evaluating the homogeneity of variances assumption needed for the model using Leavens test indicated that the relationships between the covariate variables and the dependent variable did not differ significantly as a function of the independent variables ( $F=1.048$ ,  $P=0.422$ ) confirming homogeneity of variances and that the assumption was met as shown in table 50. Table 51 shown the results of the assumption testing on lack of co-variability effects of the covariates on the categorical

independent variables (homogeneity of slopes ) the table indicated that the number of inspection visits performed by MoH covaried with the variables of having a kitchen manager and number of working shifts there for this covariate number of inspection visits was removed from the final model which is shown in (table 52 ) where the total variability( i.e. effect size) explained by the remaining variables was not affected by the variable removed compared to before its removal (tables 52 ). This final model in table 52 shows that the variables associated with the food safety score were degree of the manager education, certification of the manager in food safety, certified kitchen manager, number of working shifts, certification of food handlers in food safety, time spent by MoH during the last inspection. The table as well shows that the variables of having a kitchen manager, type of restaurant, length of working shift, training of new food handler by management, and feedback the results of the food samples analysis by MoH with the restaurant management were insignificant in their association with the safety score. The effect size in the final model indicated that this model could explain 71% of the variability in the safety score after adjusting for the joint effect of the variables and that the variable that was most effecting on the food safety score was the degree of the manager education that alone contributed to 23% of the variability followed by CKM that individually contributed to 22% of the variability. The variables of certification of the manager in food safety, number of working shifts, and certification of food handlers in food safety affected the score but there effect on its variability ranged from 3.5% to 6% only.

**Table (50): Leavens test of equality of errors variances for the food safety score**

F	df1	df2	Sig
<b>1.048</b>	<b>87</b>	<b>69</b>	<b>0.422</b>

**Table (51): Test of between subjects effects the dependent variable food safety score**

Source	Type III sum of squares	Df	Mean square	F	Sig	Partial Eta squared
Corrected model	11633.161a	32	363.536	9.401	0.0001	0.708
Intercept	65237.041	1	65237.041	1687.006	0.0001	0.932
Degree of manager education* Number of inspection visits by MoH on the restaurants in the year 2009	33.746	3	11.246	0.291	0.832	0.007
Certification of the manager in food safety* Number of inspection visits by MoH on the restaurants in the year 2009	1.416	1	1.416	0.037	0.849	0.0001
Having a kitchen manager* Number of inspection visits by MoH on the restaurants in the year 2009	202.694	1	202.694	5.249	0.024	0.041
Presence of a certified kitchen manager* Number of inspection visits by MoH on the restaurants in the year 2009	1.683	1	1.683	0.044	0.835	0.0001
Type of restaurant* Number of inspection visits by MoH on the restaurants in the year 2009	194.050	3	64.683	1.637	0.176	0.039
Number of working shifts* Number of inspection visits by MoH on the restaurants in the	186.936	2	186.936	4.834	0.030	0.038

year 2009						
Length of working shift in hour* Number of inspection visits by MoH on the restaurants in the year 2009	32.381	2	32.381	0.837	0.362	0.007
Feedback the results with management by the MoH on sample analysis* Number of inspection visits by MoH on the restaurants in the year 2009	103.517	1	103.517	2.677	0.104	0.21
Certification of food handlers in food safety * Number of inspection visits by MoH on the restaurants in the year 2009	57.617	1	57.617	1.490	0.225	0.012
Training of new food handler by the manager* Number of inspection visits by MoH on the restaurants in the year 2009	54.439	1	54.439	1.408	0.238	0.011
Degree of manager education* Time spent by the MoH during the last inspection	266.748	3	88.916	2.299	0.81	0.053
Certification of the manager in food safety* Time spent by the MoH during the last inspection	67.991	1	67.991	1.758	0.187	0.014
Having a kitchen manager* Time spent by the MoH during the last inspection	133.887	1	133.887	3.462	0.65	0.027
Presence of a certified kitchen manager* Time spent by the MoH during the last	104.253	1	104.253	2.696	0.103	0.021

inspection						
Type of restaurant* Time spent by the MoH during the last inspection	56.563	3	18.854	0.488	0.692	0.012
Number of working shifts* Time spent by the MoH during the last inspection	88.030	1	88.030	2.276	0.134	0.018
Length of working shift in hour* Time spent by the MoH during the last inspection	0.848	1	0.848	0.022	0.883	0.0001
Feedback the results with management by the MoH on sample analysis* Time spent by the MoH during the last inspection	49.258	1	49.258	1.274	0.261	0.010
Certification of food handlers in food safety* Time spent by the MoH during the last inspection	2.185	1	2.185	0.056	0.813	0.0001
Training of new food handler by the manager* Time spent by the MoH during the last inspection	58.489	1	58.489	1.513	0.221	0.012
Error	4795.119	124	38.670	-----	----- -	-----
Total	847688.000	157		-----	----- -	-----
Corrected total	16428.280	156		-----	-----	-----

a, R squared = 0.708, (Adjusted R squared = 0.633)

**Table (52) : Test of between-subjects effects on the dependent variable food safety score**

Source	Type III sum of squares	Df	Mean square	F	Sig	Partial Eta squared
Corrected model	12194.608a	17	717.330	23.551	0.0001	0.742
Intercept	13413.803	1	13413.803	440.402	0.0001	0.760
Degree of manager education	1319.257	3	439.752	14.348	0.0001	0.238
Certification of the manager in food safety	238.027	1	238.027	7.815	0.006	0.052
Having a kitchen manager	79.762	1	79.762	2.619	0.108	0.018
Certified kitchen manager	1198.956	1	1198.956	39.364	0.0001	0.221
Type of restaurant	19.434	3	6.478	0.213	0.887	0.005
Number of working shifts	234.338	2	117.169	3.847	0.024	0.052
Length of working shift in hour	137.265	2	68.632	2.253	0.109	0.031
Feedback the results with management by the MoH on sample analysis	52.265	1	52.265	1.716	0.192	0.012
Certification of food handlers in food safety	269.286	1	269.286	8.841	0.003	0.060
Training of new food handler by the manager	5.539	1	5.539	0.182	0.670	0.001
Time spent by the MoH during the last inspection	153.126	1	153.126	5.027	0.027	0.035
Error	4233.673	139		-----	-----	-----
Total	847688.000	157		-----	-----	-----
Corrected total	16428.280	156		-----	-----	-----

a, R squared = 0.742 (Adjusted Squared =(0.711))

#### 4-10 Studied non associational variables to the food safety score of the restaurants

In the previous section of the bivairiate analysis the affect of variables significantly associated with food safety score was described, whereas effect of additional variables was studied and these variables were not significantly associated with the food safety score. Table 53 summarizes these variables that were presence of the food menu, outside service (delivery), number of the restaurants workers, number of food sampling by MoH, the restaurants years in business, and the region of restaurants.

**Table (53): Non associational variables to the food safety score of the restaurants**

Variable	Categories	Mean	P-value	F-value
Presence of food menu	Yes	70.76	0.317	-----
	No	72.70		
Outside service (delivery )	Yes	71.14	0.972	-----
	No	71.20		
Number of food sampling by MoH	Less than 5 time	68.76	0.171	1.621
	5 to 9 time	73.35		
	10 to 14 time	68.89		
	15 to 19 time	70.43		
	More or equal to 20 time	72.38		
Number of food handlers	Less than 5 worker	73.50	0.351	1.099
	5 to 9 worker	69.91		
	10 to 14 worker	71.44		
	15 to 19 worker	70.89		
	More or equal to 20 worker	74.95		
	Less than 10 years	72.05		
	10 to 19 years	71.96		

Restaurant years of businesses	20 to 29 years	66.67	0.225	1.403
	30 to 39 years	65.00		
	40 to 49 years	66.75		
	More or equal to 50 years	71.18		
Restaurants region	Ramallah	72.03	0.252	1.387
	Bethlehem	70.38		
	Jericho	68.96		

## **Chapter Five**

### **Discussion**

#### **5-1 Introduction**

This study is one of the few studies that investigated the food safety situation in the restaurants of the targeted area (Jericho, Ramallah, and Bethlehem). According to our knowledge it is the first one that estimated the food safety score of the inspected restaurants, and worked to determine the determinants of this score in these restaurants. The current criteria of inspection followed by the Palestinian Ministry of health (MoH) is based on the traditional method of restaurant inspection which is limited in its ability to recognize the violations, in this study the mean percentage food safety score for the restaurant that reflects the public health situation in it was measured by means of HACCP inspection and scoring system. In addition was measured the main five high violations, alongside the top five low violations were identified. The study strived to uncover the determinants that affects food safety score of the restaurant such as the general manager education, his qualification in food safety, presence of kitchen manager, certification of the kitchen manager in food safety, number of inspection visits by MoH, training of food handlers, certification of food handlers on food safety and the type of the restaurant.

#### **5-2 The food safety score of the restaurants**

A restaurant that reported low food safety score or have violations classified as high may become associated with food-borne diseases. Our inspection is based on 61 item check list, 27 were classified as high critical violations and 34 as low violations. In the study it was found that the average percentage food safety score of the inspected restaurants was 71.18% which is relatively low suggesting an overall poor situation.

Timothy F et al. (2004) conducted a study in Tennessee in the U.S in which he found that the mean food safety score was higher in restaurants where HACCP in the inspection basis than the food safety score of restaurants that are inspected based on the routine inspection, he referred the difference to the application of HACCP scoring system which requires restaurants to meet the requirement of licensing criteria that allow the public health inspectors to note and define the critical violations to be cited in the inspection form and corrected, compared to the routine inspection that varies substantially over time, by region, and by person performing the inspection and that depend on the judgment of the health inspectors, as well the frequency of the violations (high and low) are more frequent. This might be one of the reasons the safety score in the study was low as it applies the traditional inspection procedure and so the HACCP might be a contribution to improving the situation.

#### **5-2-1 Food safety score 70 as cut score for voluntary closure**

When the low safety score calculated in this study is compared to the restaurants voluntary closure criteria of 70% applied in parts of the US (Los Angeles county 1997) one can reach a conclusion on how poor the situation is in the restaurants as based on this criteria only 44.9% of the restaurants should pass the inspection to remain in the business and the remaining 55.1% should be voluntary closed as that might contribute in the food-borne diseases prevention. Such a high proportion of the restaurants who were out of compliance of the safety condition of food production might be due to the weakness of the inspection system in the WB that is mainly dependent on the traditional inspection. However as analysis showed the score was affected by a number of additional factors that are discussed with in the section of the determinants of the food safety score.

### **5-2-3 Restaurants classification by the grading system**

Restaurants that had a safety score above 70% can be classified into categories of A, B and C as is the case in some states of the U.S (Owen H et al.2000), which facilities communicating the results to the consumers and made the owners putting efforts not to lose profit. Such classification was used in this study to further explore the situation of the restaurants that passed the 70% which also shows that there is need for more efforts in the WB to interrupt the situation. Only 1.1% of the total inspected 187 restaurants could be posted with grade A, 26.2% of the restaurants got grade B and 27.8% of the restaurants got C grade. In addition to the results in the previous tow section, these findings as well suggest that much needs to be done before implementing the 70% as a cut off value in the WB but that one can began with a gradual implementation and training on HACCP. Posting these grades as card on the restaurants doors would communicate the hygienic conditions in each restaurants and the level of the safety that might contribute to the prevention of the food-borne illness, this would provide the consumer with full information about overall food safety situation in each restaurants, therefore consumers be aware of restaurants that have low grade to avoid the probability diseases related to food.

Many States in the U.S communicate such results via the internet on each environmental public health department web site to guide the consumers and increase their perception toward food safety issue; this might be a long term target for the WB.

### **5-3 The high critical food safety violations**

The points allocated for a particular violation depend on the health risk it poses to the public. Any type of violation that holds a high point value can cause the food consumers to fall in the danger of food-borne infection according to its severity and frequency in the restaurant. In this discussion and since the safety score is low only

the high violations are discussed in details separately as priority. The top five high violations in the study and additional important high violations, according to the CDC criteria, were discussed in this section.

### **5-3-1 The top five violations in the study**

In this section I discussed the top five violations with the highest relative occurrence in the study that were poor personnel hygiene-hands detected in 86.6% of the restaurants, lack of use of the sanitizer and rinse (hot water-chemical), temperature, concentration, or exposure time reported in 79.1% of the restaurants, lack of certification and knowledge of food handlers detected in 72.7% of the restaurants, improper hand washing procedure found in 64.7% of the restaurants and processing area for raw and cooked food not separated reported in 52.5% of the restaurants.

#### **5-3-1-1 Poor personnel hygiene**

Food handlers contact food in most operations at food establishments and so can be a determinant in its safety score, in this study 86.6% of the respondent restaurants had poor hygienic conditions violation of food handlers hands on the physical inspection, as well, a number of restaurants were identified with other hygiene conditions such as lack of appropriate supervision by the manager, incorrect hand washing procedure which is participated by 64.7%, wiping hands with on apron, clothes or wiping clothes that was found in 27.3% of the restaurants, eating or smoking while working detected in 31%, improper sink used for hand washing (21.9%), lack of availability and maintenance of toilet rooms (24.1%), Dressing rings, jewelry and other decoration or Long nails/ polish that were found in 34.8% of the restaurants and non-using of gloves or their change as required which was detected in 69.5% as showed in table 24 and 25. The high frequency of some of these violations, and not only the poor hygiene of hands, are clear indication for the poor personnel hygiene. Guzewich et al. (1995),

Montville et al. (2002) and Michaels et al. (2004) noted the importance of personal hygiene in the food-borne illnesses prevention, for its improvement can reduce the transmission of pathogen from hands to food and other objects. Personnel hygiene is the first line of defense for prevention of the transmission of pathogenic microbes to food during the processing operations of the food at the restaurants. Such wrong actions can also be reduced when workers are educated and managers well supervise them.

#### **5-3-1-2 Sanitizer rinse (hot water-chemical), temperature, concentration, exposure time**

A mix of hot water sanitizers and enough time is used for effective cleaning purposes, followed by clean water to remove the detergent residue. In this study 79.1% of the restaurants did not use the proper method of sanitizing and rinse, as well a number of restaurants (7.5%) were identified with conditions like unsafe source water, hot and cold water not available and no enough water pressure as shown in table 24. The concentration of the sanitizers is important to reduction of the harmful .microorganisms but too little of sanitizer will results in inadequate reduction.

This finding suggests a weakness in the inspection system implemented in the WB that might be able to recognizing such violations and the lack of the food handler's knowledge about using of such cleaning and sanitization process needed to reduce the transition of FBIs.

#### **5-3-1-3 lack of certification and knowledge of food handlers**

Knowledge and certification of food handlers are important to food safety practice and to reducing the risk of food-borne illness. In the study 72.7% of the restaurants reported that their food handlers did not have any kind of food safety certification. This finding might refer to the lack of the educational institutes that can produce

qualified individuals in food safety, weakness of regulations, the low proportion of restaurants that in the study have a CKM who can transfer knowledge and information to food handlers, and the probability that a certified food handlers might be of additional cost to the owner of the food establishment with their higher salaries.

#### **5-3-1-4 Improper hand washing procedure**

**Inadequate hand hygiene contributes to food-related illnesses.** In the study 64.7% of the restaurants had food handlers that practices improper hand washing procedure, as well as, a number of restaurants were identified with conditions such like 72.7% of the restaurants reported that their food handlers did not had any kind of food safety certification, dressing rings, jewelry and other decoration, Long nails/ polish were found in the 34.8% of the restaurants, and improper sink used for hand washing was found in 21.9% of the restaurants as showed in table 24 and 25. Low proportion of certified food handlers in the restaurants might be a proxy explanation for such on attitude and perception toward the hygienic practices implemented during food processing.

#### **5-3-1-5 processing area for raw and cooked food not separated**

Separations of raw and cooked foods areas are important to prevent contaminating the cooked foods. In the study 52.5% of the restaurant's the processing areas of raw and cooked foods are not separated. Lack of clear licensing criteria of the restaurants that recommends the separation of the areas of raw and cooked foods and the low proportion of the certified managers of the restaurants who might be able to divide the needed area to prevent the outbreaks diseases might be a contributor to such finding.

#### **5-3-2 Additional important high violations according to CDC criteria**

CDC classifies the violations according to their severity and contribution to food-borne illnesses as low violations and high violations (CDC 2005). The top five

violations according to this classification are poor personal hygiene-hands which was also the list of the top five in this study, inappropriate cooking time and temperature, improper holding temperature, contaminated equipment and usage of food obtained from unsafe source. . In our study it was found that poor personal hygiene was recorded in 86.6% of the restaurants; inappropriate cooking time and temperature was recorded in 44.9%, contaminated equipment was found in 26.7%, improper hot holding temperature was recorded in 23.1%, and lack of obtaining food from a safe source was recorded in 15% of the restaurants respectively. These findings are in line with De Waal et al. (1996) and FDA National Retail Food Team (2004), findings even though the proportional frequency of these violations occurrence in the study inspected restaurants might differ. Since the same above studies suggested the importance of these violations in food safety and FBI occurrence they should be in addition to the study main violations, on the priorities list of the concerned parties and authorities to start with in correction and improvement of the situation and so each, except for poor personal-hands which was discussed earlier, is discussed separately below.

#### **5-3-2-1 Inappropriate cooking time and temperature**

Harmful bacteria are the most common cause of food-borne illnesses. Some bacteria may be present on foods when one purchases them, with raw foods being the most common source of food-borne illnesses because they are not sterile (National Digestive Diseases Information Clearinghouse, 2010). The appropriate application of time and temperature formulas are important to kill pathogenic microbes. Time and temperature of cooking is an important value in its ratio for full cooking through reaching the optimal internal temperature for ensuring killing pathogens that might present in raw food to prevent food-borne diseases.

In this study about 44.9% of the inspected restaurants were detected as having inappropriate temperature and time of cooking, on top of that 100% of the inspected restaurant didn't have thermometer to measure food temperature, 20.3% did not receive food under temperature control and there was lack of adequate equipment for temperature-monitoring or time temperature indicators in temperature, or control devices in 10.2% of the restaurants. These findings on lack of such equipments even suggest that the real frequency of the violations of Time-Temperature might be higher. Zhonghua Yu et al. (2001) found, among several findings that time and temperature violation in cooking are risk factors of food-borne illness in the US restaurants.

#### **5-3-2-2 Improper hot holding temperature**

Hot holding temperature is critical to prevent multiplication of pathogens in the food once cooked and pending for services or storage. Uyttendaele M et al. (2009) concluded that hot holding of cooked meat temperature is critical to food safety and emphasized the need for HACCP implementation in food establishments to prevent food-borne diseases. In this study 23.1% of the restaurants had improper hot holding temperature, the inspection further revealed that 100% of the restaurants didn't have thermometer available at disposal of workers that would allow them to measure food temperature to make sure it is as required and there was lack of adequate equipment for temperature-monitoring or time temperature indicators of the temperature control devices in 10.2% of the restaurants.

The food is safe to be out of temperature for a short time while it is being eaten as the time frame is too short to allow for significant bacterial growth. On the other hand, food left for several hours in a hot holding case that isn't holding foods above the danger zone temperature can turn into a big problem. The findings of this study, their

frequency and the lack of equipment to monitor temperature is probably an indicator for the risk to human health in the industry in the WB and to the need for improvement of the inspection system implemented by the MoH.

### **5-3-2-3 Physically contaminated equipment**

The surfaces of equipments and utensils are the places where food contact might be raw or cooked. Surfaces of equipments might be contaminated by many contaminants such as microbes or chemicals and physical objects, and so would put contaminants with direct contact with foods when used for processing or in touch with it. Many harmful microbes can live and grow and multiply on these surfaces which can reach food during food processing and might cause outbreaks. Marler et al. (2008) reported that surfaces contamination was the most likely violation resulting in an *E. coli* outbreak in restaurants of Wisconsin in 2000. In this study 26.7% of the inspected restaurants had contaminated equipment surfaces, as found by visual inspection this would be explained by a combination factors suggesting inappropriate cleaning, protecting, and storage of such equipment as such as ; inappropriate sanitizing and rinse (hot water-chemical) and inappropriate temperature, concentration and exposure time to the sanitizers which was detected in ( 45.6%) of the restaurants, presence of insects, rodents, birds, and other animals that was detected in 26.2%, unclean wiping cloths was detected in 24.1% , and improper storage and handling of clean equipment that was found in 14.4% of the restaurants. These findings are indicators for the need to improve the general cleaning and sanitation procedures and their monitoring and as well the need for the better educational program for workers.

### **5-3-2.4 Food from unsafe source**

Receiving food from a safe source is one of the preventive measures against food-borne illnesses. In this study 15% of the respondent restaurants obtained food from

unsafe source and also 20.9% lacked proper labeling of the food original containers, packaging or these containers were corrosive as found in storage as well 19.3% of the restaurants lacked receiving at good transportation condition or unadulterated when received. Such violation hold risk to workers and costumers health by exposing them to food that might not be suitable for consumption due it being contaminated or expired or even below standards in limits of components. Alonso (2008) reported that raw ground beef suspected to be tainted with *E. coli O157:H7* bacteria was stolen and soled to restaurants who did not care about the sources putting consumers at grave risk for exposure to *E. coli* from cross-contamination that cause an outbreaks diseases. Unsafe sources of food participate in cross-contamination with many pathogens that threat consumer right of getting safe food away from food-borne illness. Increasing in the globalization of food and increase in the industry released several sources of the food therefore, purchasing the raw material from a safe source is critical to food safety and regulation would be needed on aspects like, origin, health, and analysis certification to ensure the compatibility of the safe source.

#### **5-4 Food safety determinants in restaurants**

In this section factors that were found to be associated with food safety score in restaurants such as manger education, manager certification, presence of kitchen manager, kitchen manger certification, training of food handlers, training of new workers, number of MoH inspection visits, time spent during last inspection, number of food sampling in the last year 2009 by MoH, type of the restaurant, feedback the results on food analysis, and internal inspection are discussed in relation to food safety score.

#### **5-4-1 Food safety score of the restaurants and the degree of the manager education**

Restaurant manager is the person in charge of all the activity in the restaurant related to the public or the restaurant workers. The manager education is important for these activities and probably the safety score. In this study it was found that 14.4% of the managers whom had only a primary level of education received a mean food safety score of 59.78% , restaurants that had a manager with only a secondary degree level of education composed 40.1% and their mean food safety score increased to 68.77% , the 19.8% of respondents who reported that the manager have only a diploma degree of education had a food safety score of 73.46% , but that the 25.7% who reported that their managers have a bachelor degree of education up surged in their food safety score to a mean score of 79.58% . This showed that the higher the educational level of the managers the higher would be the safety score. These findings were in line with and Kevin R et al. (2003) who suggested a positive relationship between mangers education and the number of food safety practices implemented in Iowa restaurants. This trend of increase in score with better education was also confirmed in the multivariate analysis of the study but also appeared to be the highest contributor to the food safety score when controlled for other variables as it explained 23% of the score variability. Even though that such an association was not well studied previously still it makes sense as well educated managers can play a role in training their workers and supervising their activities. When one considers this finding and a line it with the poor personal hygienic conditions detected in many restaurants and the low percentage of the managers with post school education probably it won't feel strange that no association was found with training of the workers at their acceptance for work but that such an association was found with already having workers at work that are

knowledgeable, since a manager who is not knowledgeable himself cannot be able to properly train his worker at acceptance.

#### **5-4-2 Food safety score of the restaurant and manager certification in food safety**

Qualification of the manager on food safety and its requirements might improve the hygienic situation in the restaurants and decrease the opportunity of food poisoning. In this study we found that certification of the manager in food safety had a positive impact on the food safety score of the restaurant, restaurants with manager having certification in food safety (31% of the total inspected restaurants) received a mean food safety score of 81.29% and restaurants that their manger did not have such a certification ( 61% of the restaurants) reported a lower food safety score of 66.63%, a trend was also confirmed by the multivariate analysis. These finding were in line with Cotterchio et al. (1998) findings, who found that the food safety score might be affected by the education level of food safety of the restaurant manager through a training program and his certification in food safety. Potential explanation for such a relation could be that educated mangers receive and understand more consultation from public health inspector's information's which can be communicated with his food handlers, as well his perception of safety issue might be better.

#### **5-4-3 Food safety score of the restaurant and having a kitchen manager and his certification in food safety**

The kitchen is the most important part of the restaurant and the main reason customers patronize the restaurant, and so managing the kitchen properly plays a role in workers performance, and part of such management is managing the food safety issue in addition to the quality. The kitchen manager or chief is the supervisor of all the activity that is carried out in the kitchen from food receiving until food serving, as well as communicating these activities with the food handlers and so might have an

effect on the food safety score of the restaurant. In this study 86.1% of the restaurants had a kitchen manager or a chef and these got an average food safety score of 72.86% compared to the 60.73% kitchens that did not have such for managers or chef. Regardless this apparent association at the bivariante level of analysis in the multivariate analysis this association had disappeared but rather the kitchen manager certification in food safety appeared to be an effector. Certification of the kitchen manager or chef and his training on food safety would booster his knowledge and awareness and improve food safety practices and thus prevent food-borne illness. In the U.S application of systems like HACCP and the food code legislations would require the presence of kitchen manager and his certification in food safety through an approved course of training and examination (FDA 2002).

In this study only 47.1% of the total inspected restaurants, had a certified kitchen manager or chef but these restaurants had a mean food safety of 79.6% compared to the score of 65.21% for the ones who did not which meant a significant improving effect of the certification. This finding was confirmed by multivariate analysis. Similar finding were detected by Hedberg et al. (2006) who indicated that presence of the CKM had a protective effect with respect to FBI outbreaks. Sheryl et al. (2008) found that the presence of CKM is protective against many types of violations and that the presence of a certified kitchen manager reduces the likelihood of an establishment being associated with an outbreak of food-borne illness. The finding that only 47% of the restaurants had a CKM probably can be attributed to the weakness of legislations related to the criteria of restaurants licensing in the WB for this issue that can ensure presence of a kitchen manager and his certification in food safety and as well indicates weakness in the application of the food code instructions.

#### **5-4-4 Food safety score and number of working shifts**

Number of work shifts in the restaurant during the day might affect the food safety score of the restaurants. Number of shifts depends on the amount of food production and amount of sales; the higher is the more number of shifts. In this study it was found that only one restaurant work three shifts, but that 84.49% of the restaurants work two shifts and 14.9% of the restaurants work one shift. Number of shifts in this study was positively associated with the food safety score of the restaurant, the higher the number of shifts of the restaurants then the higher food safety score. These findings were confirmed in the multivariate analysis. It could be that, and even though that higher number of shifts indicates a higher activity, increase in the number of shifts might divide the work load and so avoiding food handlers longer working hours and time stress which can be a barrier for implementing such sanitation activities like hand-washing, glove changing, cleaning of equipments and other hygienic practices.

#### **5-4-5 Food safety score and length of the working shift**

Length of the working shift could have a negative effect on the food safety score, bivariante analysis of this study showed that restaurants that worked up to 8 hours got a 71.71% food safety score compared to restaurants that work more than 8 hours who got a lower score of 64.57%. Laura R et al. (2005) found that among the factors that impact the food handler's ability to prepare safe food was the time pressure on them. Time pressure is important to food handlers and therefore might influence implementing food preparation safety and influence other hygienic activities like hand-washing, eating and smoking, glove changing and affect such behavioral compliance related to food safety. In the study, an even though that the bivariante analysis was in line with Laura R et al. (2005), the multivariate analysis have

excluded it as an effect or which suggest that such an association could be a result of confounding effect of other variables.

#### **5-4-6 Food safety score of the restaurant related to the number of inspection visits by MoH**

The Palestinian Ministry of Health is responsible for the inspection of the restaurants in the West Bank. In this study a positive trend was detected between number of visits conducted by the public health inspectors and the food safety score of the restaurants. The safety score had significantly increased from 67.4% for the restaurants with only 1 to 4 inspections per year to 82.6% for the restaurants inspected 15 or more times. Studies by Bader M et al. (1978), Kaplan OB (1978) and Allwood PB et al. (1999) have examined the effect of inspection frequency on restaurant sanitation they concluded that more frequent inspections improve sanitation condition. Mathias RG et al. (1995) found that the score worsened when the time elapsed since last inspection was greater than 12 months in suggestion of a low number of inspections/year. Increase of visits by public health inspectors should increase the supervision of food safety condition in the restaurants and reduce time between visits reflect following up on written violations to be corrected. The multivariate analysis in the study showed that this variable was covarated with other independent variable and so was removed from the final model; as a result this association cannot be confirmed for this study but requires additional future investigation.

#### **5-4-7 Food safety score of the restaurant related to feedback of the analysis results of food samples**

Review of the results of food samples analysis can increase the awareness of restaurant staff toward food contamination. Of the total 178 restaurant inspected in this study 62.4% reported not receiving feedback on the results of food samples

analyses performed by MoH. This was significantly associated with the food safety score as they got a low score of 67.9% compared to 76.9% for the ones that received feedback, . however; such a variable is reported for the first time. In the multivariate analysis it was excluded as an effector on food safety score as it lacked a significant association with the safety score which suggest that such an association could be a result of confounding effect of other variables.

#### **5-4-8 Food safety score related to the time spent by MoH inspectors in the last inspection**

Time spent in inspection during restaurant inspection is important for recognizing violation and investigation of sanitary conditions. In this study data collected on inspection time showed that about 43% of the restaurants reported being inspected for less than 15 minute, about 73% of the restaurants reported that they were inspected for a time interval 15 to 29 minute, 36% of the restaurants reported being inspected for a time of 30 to 44 minute, about 15% of the inspected restaurants reported being inspected for a time of 45 to 59 minute, and 20% of the restaurants reported that being inspected for a time more or equal to 60 minute in the last inspection. The restaurants as well showed that in general the higher the time of inspection was the higher their food safety score become (increasing from 65.93% for less than 15 minute to 83.30% for more or equal to 60). This finding was confirmed in the multivariate analysis putting this variable as a covariate variable. This was in aline with the findings of Kathleen Irwin et el. (1989) who found that inspection lasting for 37 minute or more may be associated with food-borne outbreak because more time is need to record and identify the risk factors.

Time spent during inspection by public health inspector is considered as contact time between restaurant management and inspectors for inspection as well as a determinant

for recognizing and observation of violations to complete the inspection form. Enough time implemented by public health inspector increase the interaction and consultation between restaurant and inspector which provide knowledge and attitude.

#### **5-4-9 Food safety score of the restaurants related to the training of new food handlers by management**

Restaurant management is responsible for the employment of new food handlers according to their need and to their training in hygiene practices to avoid food-borne diseases. In my study I found that only 38.5% of the restaurants trained the new workers and those earned a mean food safety score of 79.64% on the other hand the 61.5% who reported that they don't train the new workers, earned a lower mean food safety score of 65.88%. This trend implicated that training of new food handlers by restaurant management significantly corresponded to a positive impact on food safety score of the restaurants. In support of this finding is the work of Young Gin Choi et al. (2010) who noted that behavioral critical violations were associated with new workers during inspection in Asian restaurants in Kansas. Mathias RG et al. (1995) reported that restaurants in which supervisors and food handlers had completed food handler education courses and had training on food safety had better inspection scores than those without. The same author as well in 1994 indicated lacking of reduction in reported food-borne illness in the US restaurants and that attributed to lack of effectiveness of food handler education and training in food safety to reduce violations which confirms the importance of training.

New food handlers may be limited in their information on food safety and don't have skills toward hygiene practice of the operations conducted inside the restaurants , lack of knowledge may allow for wrong practices that can lead to an increase in the opportunity of food-borne illness therefore un-controlled behavior may be associated

with critical violations. Hygiene practices need high attention and attitude and increase in perception toward implementation of food processing this might as well be limited to presence of certified manager or kitchen manager as an important element to satisfy the need of food handlers training during employments. In the study, and even though that the bivairiate analysis was in line with Mathias RG et al. (1995 & 1994), the multivariate analysis have excluded it as an effectors which suggest that such an association would be a result of effect of other variables.

#### **5-4-10 Food safety score of restaurants related to certification of food handlers in food safety**

Certified food handlers are qualified ready to work and dealing with food preparation and processing operations. In our study we found that 72.7% of the inspected restaurants reported that their food handlers don't have any certification in food safety. Certification of food handlers in food safety related positively to the food safety score, restaurants with certified workers had significantly a higher food safety score than the restaurants without such certified workers. In the study this findings was confirmed in the multivariate analysis. This resembles the findings on training, manager certification, and kitchen manager presence by Azmi et al. (2006) in Turkey who reported that certified food handlers enhanced food safety in restaurants. Turkish food code requested that all Turkish food businesses must train and certify food handlers in food safety activity (Saglam, 2000). Mathias RG et al. (1995) found that restaurants in which supervisors and food handlers had completed food handler education courses in food safety had better inspection scores than those without. Paul B et al. (2004) found that a significant association was present between correct hand washing demonstration, and the hand washing training methods of food handlers to avoiding food contamination.

In the U.S application of such system like HACCP are mandatory in food establishments and Food Code legislations that require certification of food handlers. In the WB there is absence of the application of HACCP system and Food Code instructions that require implementation of certification of food handlers and training in food safety also the implemented system is weak in legislations related to the criteria of licensing of the restaurants and also low socioeconomic status of food workers, that prevent them from qualification in food safety in specialized institute of food training and certification might be barriers for improvement at this level. On top of that specialized institutes of food training and certification are limited in numbers and are not geographically distributed overall West Bank to meet the availability and access to all food handlers.

In reducing food-borne illness gaining knowledge and understanding of the interaction of prevailing food safety beliefs, attitude and practices of food handlers (WHO, 2000) is critical .Certification and training of food handlers help them to gain behavioral knowledge and increase attention toward operations that need high attention for compliance to be implemented truly.

#### **5-4-11 Food safety score of the restaurant related to its types**

Restaurant types varied according to the type of menu served and licensing requirements as popular, fast food, touristic, and hotel as this reflects complexity, variability and diversity in activities carried out in these restaurants and also reflects the degree of control and requirements needed in each type, as well as importance assigned to each type in terms of internal and external control the lower in classification in the popular and the highest in the hotel restaurants. In the study popular restaurants had a food safety score of 68.78%, fast food had mean food safety score of 70.64%, touristic had mean food safety score of 74.22%, and hotel

restaurants had mean food safety score of 81.54% indicating a positive impact of the higher grade of the restaurant on food safety score as the more complex the type of menu and type of activity become the higher the safety score. This effect is reported for first time. The variation in food safety score might be due to licensing criteria required for each restaurant as hotel restaurants have criteria as part of the hotel licensing from MoH and also should have other certification from the ministry of tourism to satisfy the need of licensing. Touristic restaurants are licensed by MoH and also should have other certifications from the ministry of tourism to satisfy the need of licensing like certified manager and kitchen manager and food handlers. As well, large scale food production by these restaurants to satisfy the need of consumers vary by the type of restaurant which need high qualification in food safety to keep arbitration of restaurants and also the type of consumers whom visit the restaurants as popular food and touristic food consumers. In the study, and even though that the bivariate analysis indicated association, in the multivariate analysis this variable was excluded it as an effector which suggest that the association could be a result of confounding effect of other variables or that it needs further studying.

## **Conclusions and recommendations**

The food safety score was low for the inspected restaurants in the targeted areas, and if the criteria implemented some of in developed countries is implemented in Palestine a large number of the restaurants should be closed or is in need for serious efforts to improve their situation. The application of a better inspection and licensing system such as HACCP can help in identifying the problems and improving the current situation, however, it should be in a gradual mode as the study findings showed that about 44.9% of the restaurants should be voluntary closed or revoke permission, if 70% score applied as cutoff value, which is a large percentage. HACCP scoring system might be developed and converted to grading letters (A,B,C) to communicate the results of inspection for the restaurants in the WB and so might help to decrease the FBIs through orienting the consumers toward safe restaurants and therefore creating competition among the restaurants for improvement. The study found a high percentage of critical violations that might be of high importance to the contaminations of the food and put the consumers at risk of food-borne diseases threat and which should be set as priority to be improved in the restaurants that as well as to improve the food safety score in general pattern. Identifying the food safety violations, high and low, through drafting an inspection form that can be documented by public health inspectors and need for identifying and communicating points to be corrected in given time and reporting these violations, might help to develop strategic plan to improve food safety issues as such violations were identified in this study with its form which can simulate such needed form and can be starting point.

The educated and certified manager of the restaurants can improve the food safety score of the restaurants together with the training of the new food handlers as well as recruiting trained handlers. There is need to emphasis such considerations in

legislation and licensing and this would also require establishment of educational programs to meet this.

Kitchen manager and his certification in food was found to be a large contributor to the food safety score and since a low percentage of the restaurants had a such manager, establishing legislations that mandate the presence of CKM in the restaurants who can control the activities of the food handlers and handle the interaction with public health inspectors about the food safety issues can help improving the situation and therefore is recommended.

Presence of certified food handlers in the restaurants was found to improve food safety score and since a low percentage of such handlers and knowledgeable people of the food safety issues who can avoid wrong practices were reported in this study, therefore, introducing criteria of licensing of the restaurants that require certifying food handlers and adapting training program based on HACCP system for these handlers in food safety to would be recommended. Establishing institutes that can educate and train the food handlers in food safety to be ready to work in the restaurants would be a requirement for such action.

The Palestinian Ministry of Health plays a major role in the surveillance of the FBIs, time spent by inspectors in the restaurants can help in improving the situation much more than the number of inspection themselves alone so, there is a need to emphases on increasing the quality and depth of the inspection visits by MoH for the restaurant that report low food safety score, making feedback on the results of the analysis of food samples might help in improve the food safety.

In addition to the conclusions and recommendation mentioned earlier additional recommendation can be mad:

- Improving hygiene practices and personnel hygiene of food handlers through implementing effective training program to increase safe behavior related to food handling and preparation.
- Conducting periodic and at acceptance for workers medical checkup for food handlers to verify the sick ones and to avoid infection transmission of microbes to food items. Encourage self monitoring by restaurant management through internal inspection conducted by responsible person using clear criteria as check list.
- Considering additional preventive measurement for restaurant during licensing to avoid food contamination through unsuitable instructions.
- Enhancing surveillance system of food-borne disease to estimate the burden and the impact of sanitary conditions of restaurant on the transmission of diseases.
- Further evaluating factors important in food safety and how best to control them will be important in improving the inspection system.

### **Limitations of the study**

Even though that this study have clarified much of the food safety situation in the studied restaurants and its determinants some limitations of it is worth mentioning:

- Due to many logistical and time limitations the study included restaurants only in the central West Bank area.
- Out of the 239 restaurants registered in the files of the Ministry of Health which were all targeted only 187 restaurants (response rate of 78%) of the study population consented and participated in the study.
- Restaurants that were not included in the licensing files (not licensed) were not included in the study population; and since much of such unlicensed restaurants are street vendors that can't be tracked, the situation of the problem might be even worse than detected by the study
- Data collection tools were time consuming when conducting an interview with the restaurant management and also implementing the inspection process

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## Appendix 2

The number and classification of restaurants in the study area obtained from EHUs

Total	Restaurants				District
	Fast food	Touristic	Popular	Hotel	
17	3	2	10	2	Jericho
165	19	---	132	14	Ram-Allah
57	14	7	25	11	Bethlehem

## Appendix 3

### The study Questionnaire

#### Management and owner

Q1	What is the number of education years of the general manger?	.....year
Q2	What is the degree of the manger education?	1-primary 2-secondary 3-diploma 4-bachelor 5-other ;specify -----
Q3	Dose the manager have a certification in food safety?	0-No 1-Yes
Q4	Dose the restaurant or the plant has a kitchen manager or chef?	0-NO 1-Yes
Q5	If answer to Q4 is yes, what is the education of a kitchen manager or chief in number of years ?	.....year
Q6	What is the degree of education of the manager or chef ?	1-primary 2-secondary 3-diploma 4-bachelor 5-other;specify -----
Q7	Dose the kitchen manager or chef has a certification in food safety?	0-NO 1-Yes
Q8	Dose the restaurant have a medical checking up policy for the workers at acceptance?	0-NO 1-Yes
Q9	If answer to Q8 is yes, every how often do they re-check for health per year?	1-One 2-Tow 3-More
Q10	When was the last time they checked up?	-----Date

**Restaurant feature**

Q11	What is the type of the restaurant?	1-Popular 2-Hotel 3-Tourestic 4-fast food
Q12	What is the total area of the restaurant in square meter?	-----M <sup>2</sup>
Q13	Since which year is the restaurant in business?	-----year
Q14	How many shifts dose the restaurants work per day?	1-One 2-Tow 3-Three
Q15	What is the length of the shift per hours?	-----hrs
Q16	How many persons are working in restaurants in the total?	-----
Q17	Dose the restaurant have a written menu?	0-No 1-Yes
Q18	If answer to Q17 is yes, what is the kind of the menu served?	1-fixed 2-dailly prepared menu
Q19	Where is the restaurant located?	1-Rural 2-City 3-sub urban 4camp
Q20	Dose the restaurant serve food outside?	0-NO 1-Yes, delivery only 2-Yes, delivery catering

### Inspection

Q21	Is the restaurant inspected by the ministry of health inspectors?	0-NO 1-Yes
Q22	If answer to Q21 is yes, how many times was it inspected in the previous year?	.....visits
Q23	if answer to Q21 is yes ,at what time of the day do they inspect the restaurant in general?	Morning   Midday Evening  no specific time
Q24	If answer to Q21 is yes, when was the last time the restaurant was inspected by the MoH?	-----days ago
Q25	If answer to Q21 is yes, how much time did they spent in inspecting the restaurant during the last inspection?	-----min
Q26	Dose the MOH collect food sample from the restaurant for inspection regularly?	0-NO 1-Yes
Q27	If answer to Q26 is yes, how many time did the MOH inspectors collected samples at your restaurant during the previous year?	.....time
Q28	Did the inspectors of the MOH make feedback with the restaurant manger about the results of the food samples inspection?	0-NO 1-Yes
Q29	Do you receive an official report on violations from the MOH after the last inspection?	0-NO 1-Yes
Q30	If answer to Q29 is yes, dose the restaurant make a follow up on reported violations?	0-NO 1-Yes
Q31	Dos the restaurant hire services external voluntary inspection?	0-NO 1-Yes
Q32	If answer to Q31 is yes, who is responsible for the external inspection?	1-private individual 2-company
Q33	if answer to Q31 is yes, dose the inspector have clear criteria for the restaurant inspection known to you?	0-NO 1-Yes
Q34	if answer to Q31 is yes do you receive an official report on violations from the external inspection?	0-NO 1-Yes
Q35	if answer to Q31 is yes, dose the restaurant make a follow up on	0-NO 1-Yes

	violations after the last inspection?	
Q36	Is their internal inspection for the restaurant?	0-NO 1-Yes
Q37	If answer to Q36 is yes, who is responsible for the inspection?	.....
Q38	If answer to Q36 is yes, dose the inspector have clear criteria for restaurant inspection known to you?	0-No 1-Yes

**Policy**

Q39	Dose the restaurant serve food leftovers?	0-NO 1-Yes
Q40	if answer to Q39 is yes, for how long are they kept after service?	-----hrs/day
Q41	Are employees required to find replacement when they are to be excused for a sick leave?	0-NO 1-Yes
Q42	Is there a written hands-wash policy or procedures provided to the food workers?	0-NO 1-Yes
Q43	If answer to Q42 is yes, is hand-washing policy or procedure posted in the food preparation area?	0-NO 1-Yes
Q44	Dose the manger train the new workers in food safety?	0-NO 1-Yes
Q45	When was a new worker accepted for work at the restaurant for the last time?	... Date
Q46	if answer to Q44 is yes, since how long did they have attended a training course in food safety for the last time?	-----date
Q47	Is there a written cleaning policy or procedures provided to food workers?	0-NO 1-Yes

**Temperature control**

Q48	Dose the restaurant measure the food temperature regularly?	0-NO 1-Yes
Q49	If answer toQ48 is yes, are there records for monitoring temperature?	0-NO 1-Yes



## Appendix 4

### Food Service Establishment Inspection Form

#### Food at arrival

5	Safe source, certificated as law, no deterioration	1
2	Proper Labeling of original containers, packaging, free of corrosive	2
1	Food in a good transportation condition, safe and unadulterated	3
5	Food received under temperature control	5

#### Food Protection

5	The hazardous food meets temperature requirements during preparation,	6
4	Facility maintaining product temperature during receiving, storage, preparation, holding, and serving.	7
1	Thermometers provided, using, accurate	8
4	Unwrapped and potential hazardous food not re-served	9
2	Food protection during storage, preparation, display, service, transportation.	10
1	Proper washing of fruit and vegetables.	11

#### Food temperature control and procedures

2	Adequate equipment for temperature-monitoring or time temperature indicators in temperature control devices	12
2	Proper thawing method, clean drinkable running water at 21C, using, a pane, change the drips, adequate time in refrigerator, or microwave for immediate cooking	13
4	cooking time and temperature	14
4	Proper cooling procedure 21C at 2 hour or 4C at 4 hour	15
4	Proper hot holding temperature maintained at 57C or above	16
4	Proper hot serving temperature maintained at 57C or above	17
4	Proper cold serving temperature keep at 4C or below	18
1	Refrigeration and freezer capacity sufficient	19
1	Refrigeration temperature fixed and maintained	20

#### Personnel hygiene

5	Personal with infectious or communicable disease restricted,	21
5	Hands washed and cleaned and frequency	22
1	Appropriate, Clean outer cloths, hair restraints, uniform clothes	23
2	Dressing rings, jewelry and other decoration, Long nails/ polish	24
2	Gloves using, changed as required	25
2	Minimal bare hand contact with food, using deli paper, spatulas, tongs, dispensing equipments or gloves.	26
5	Demonstration of knowledge: approved course, other requirement meet like certification examination in food safety for employees, and Successfully completed approved food safety training	27
5	Medical checking of workers regularly every year and at acceptance	28

#### Hygiene practices

5	Improper hands-wash procedure	29
2	Wiping hands on apron/ clothes/ wiping clothes	30
2	Eating, smoking while working	31
1	Improper sink used for hand washing	32

### **Cross contamination**

5	Food contact surfaces used for raw meat thoroughly cleaned and sanitized after processing (at least every 4 hours).	33
5	Raw foods below or away from RTE food in preparation and storage area	34
2	Shelf stock identification , labeling by date of expiry and production , and storage	35
2	Proper disposal of unsafe or contaminated food, kept in leak proof and rodent proof containers, covered, disposed frequently	36
4	Handling of raw and cooked food properly separated	37
4	Separation of equipment for ready to eat and raw food	38
4	Processing area for raw and cooked food separated	39

### **Food equipments and utensils maintenance and sanitation**

1	Non-food contact surface designed constructed, maintained, installed, located	40
2	Manual washing three or more compartment, tow drain boards, enough size.	41
4	Sanitizer rinse (hot water-chemical), temperature, concentration, exposure time.	42
1	Wiping cloths clean use once unless , keep in clean water or sanitizer use restricted	43
2	Food-contact surfaces of equipment and utensils clean, free of abrasives', Detergents.	44
1	Storage, handling of clean equipment	45
1	Non-food contact surfaces of equipments and utensils clean	46

### **Water sources**

5	safe source, hot & cold water available under pressure	47
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### **Toilet and hand-washing facilities**

4	Number, convenient, accessible, designed, installed, and maintained	48
2	Toilet room enclosed, self-closing doors fixture good repair ,clean, hand cleanser, sanitary towels, hand-drying device, proper waste receptacles, and location	49
1	Approved garbage containers, adequate number, covered	50
1	Garbage disposed of in an approved manner, at approved frequency	51

### **Insects, Rodent and animal control**

4	Presence of insects, rodents-outer openings protected, no birds, other animals	52
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**Physical facilities**

4	Sewage and water disposal, maintained, located,	53
1	Plumbing location ,Installed, maintained	54
5	Cross-contamination, back siphonage, backflow, not leaking	55
2	Garbage and refuse disposal, Containers or receptacles, covered, adequate, insect and rodent proof, frequency, clean	56
1	Floors, constructed, drained, clean, good repair, covering, instillation, dustless cleaning method	57
1	Walls, ceiling, attached equipment, constructed, good repair, clean surfaces, dustless cleaning method	58
1	Lighting provided , fixtures, shielded	59
1	Ventilation, room and equipment vented .	60

**Other operations**

5	Toxic items, first aid material, medicine, properly stored, labeled, used	61
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## Appendix 5

### The variables operational and scientific definition

Safe source food	All foods must be obtained from source that comply with law, (Palestinian public health law) , all meat and poultry must come from WB approved source (with certificate) , home canned or foods prepared at home is not allowed, ice must be obtained from portable water of an approve source, no spoilage.
Proper Labeling	The original containers contains date of expiry and production, ingredient, and Arabic label in accordance to law
Food transportation condition and packaging	Delivery vehicle clean at proper temperature for cooled food at 4C or below , frozen food at -18C or below, hot food at 57C or hotter, avoid vehicle used for animal shipping, or harmful substances, unless sanitized and washed well, no damage or shrinking of original containers, safe and unadulterated
Hazardous food	egg, fish, meat, poultry, dairy products, heat processed food, combined ,cooled below 4C or hot above 60C in all the processes in restaurant
maintaining product temperature	using proper equipment during receiving, storage, preparation, holding, and serving to maintain and keep appropriate food temperature
Thermometers	A device used to measure temperature, thermocouple or metal stem , provided to check the internal temperature of food , accurate +/-1C and at the rang 0C to 105C
Unwrapped food	Un-covered food during storage, display.
Food protection	Prevent contamination during storage, preparation, display, service, transportation.
Washing of fruits and vegetables	hand washing before wash rinse sanitize dry all food contact surfaces equipment and utensils that will be in contact with fresh product wash all raw fruit and vegetables thoroughly before combining with other ingredients. And at arrival be washed and clean.
Receiving temperature	Temperature of food at arrival into the food establishment , for frozen food at -18C, for cold food at 4C, and for hot food at 57C.
equipment for temperature control	temperature-monitoring or time temperature indicators in temperature control devices, like Refrigerator, hot holding during service.
Cooking time and temperature	Beef, pork, seafood at 63C for15 second in the core. Ground product containing beef, pork, fish, fish nuggets or sticks and cubed or Salisbury steaks at 68C for 15 second. Poultry, stuffed beef, pork, or seafood, pasta stuffed with beef, pork, or seafood such as lasagna or manicotti at 74C for 15 second. Fresh frozen or canned fruit and vegetable, RTE food that has been commercially processed and comes directly from intact packaging from food processer served in accordance to instruction label of temperature.
Thawing procedure	Using a pane, change the drips, adequate time for small quantity one day while for large quantity several days like turkey , at 4C in refrigerator. Or the frozen food completely submerged under clean, drinkable tap water at 21C or below at sufficient velocity as to agitate and float off loose particles in an overflow. Or in microwave oven if it will be cooked immediately. Food temperature should not be allowed to rise above 4C for 4 hours.
Cooling procedure	Air circulation around the container, without cover until food is cooled then cover, stir food to cool it faster and more evenly, don't overload the capacity of refrigeration units/ freezers , the temperature should reach 21C within 2 hour and 5C within additional 4 hour.
	Any food that has been cooked and cooled, and will be reheated for hot holding or serving, and leftover reheated for hot holding or serving, and product made from

reheating procedure	leftovers, such as soup or casseroles, and precooked, processed foods that have been previously cooled, all reheated at 74C for 15 seconds rapidly. The total time - temperature of the food between 5C and 74C cannot exceed 2 hours, serve immediately or place in proper hot holding unit.
Microwave cooking	Cooked at 74C, the product must be covered, and rotated during the cooking, stand two minute prior to serving.
Personal with infectious or communicable disease restricted	The person (operator) in charge of the food establishment shall not schedule an employee to work if he/ she is aware that the employee is ill with vomiting, diarrhea or jaundice. The person (operator) in charge of the food establishment shall choose to restrict a food handler from food handling if the employee has: 1-cold symptoms (coughing, sneezing, fever, runny nose) 2-any skin lesion, wound, rash, or boil on a hands, wrists, exposed portions of the arms, or any part of the body. 3-any other illness that may negatively impact on food handling or customer service duties. The health officer shall order that the infected person be excluded from occupation involving food handling unless the risk of transmission is low. Identifying them through last absence, symptoms, or ill reporting,
Hands washed and cleaned	Food workers must wash their hands and exposed portions of the arm after touching bare human body parts, using of the toilet room, handling animals, coughing/ sneezing, using handkerchief, using tobacco, eating/drinking, handling solid equipment/ utensils, when switching raw and RTE food , before start to work, and after engaging in other activity that contaminate hands. Observe through watching from corner for at least 10 minute.
Protection of outer clothes	Appropriate, Clean outer cloths, hair restraints, uniform clothes used that cover arms, and preferable of cotton.
Minimal bare hand contact with food	Avoid direct contact with food by using deli paper, spatulas, tongs, dispensing equipments or gloves, except in decoration of dishes.
Glove used and changed	Its protective outer hand to prevent direct contact with food, change when contaminated, deteriorated, between process, change activity, and hand washing.
Demonstration of knowledge	Attendance of approved course and Successfully completion of approved food safety training, other requirements meeting like certification examination in food safety.
Medical checking	Used to check food workers health by making several tests approved by medical officer according to law every year to restrict those whom having communicable disease then identifying them with certificate before employment at any time of suspected cases during work and re-check them routinely while working.
hands-wash procedure	Food workers shall clean their hands and exposed portions of the arms in a properly equipped hand-washing facility by vigorously rubbing together the surfaces of the lathered hands and arms and thoroughly rinsing with clean water. Worker shall pay attention to areas underneath the fingernails and between the fingers. Using soap and towels for at least 20 seconds.
sink used for hand washing	Conveniently located, single lever or wrist type faucet handles recommended
Shelf stock identification	labeling by date of expiry, production , and storage
unsafe or	Food that contain harmful objects or food that may drop in temperature danger zone

contaminated food	beyond time limits, or expired and other spoilage outlook.
Non-food contact surface	Those surface not in direct contact with food used as to serving food like tables, chares, transport machines, and others, maintained, cleaned, repaired.
Dishwashing facilities	Hot water machine at 82C rinse temperature to achieve efficiency , requires drying space for three racks minimum. Low temperature machine requires drying space for five dish racks, and visual or audible warning device for monitoring sanitizing agent, a commercial ventilation required or adequate staging for dirty dishes
Manual dishwashing	Sink with three or more compartment (4-compartment bar sink), tow drain boards, sink large enough to accommodate largest equipment/ utensils, dish baskets for manual hot water sanitizing.
Food-contact surfaces	Is the Surfaces of equipments or utensils with which food normally comes into contact, drip or splash back into surfaces normally into contacts with food, as interior of microwave oven , cutting boards, dishes, and others, cleaned, maintained, repaired,
Equipment	All equipment (e.g: stoves, grills, refrigerators, tables, sinks, etc) are clean and well-maintained and any food contact surfaces are properly washed, rinsed, and sanitized.
Refrigeration & freezing temperature	Fixed the temperature of refrigerators according to the type of the food at 4C and deep freezing at -18C .maintained by checking up the outside temperature reader.
Raw and RTE food separation	Separation of raw food below or away from RTE in the preparation area for raw and area for RTE and not mixed in the same area. In storage (refrigerators) side for raw food and side for RTF.
Handling of raw and RTE food	Separation between raw and RTE food during handling, by using specific article for each one and do not mixed in the same article.
Washing of equipment and utensils	When using a proper detergents, cleaners, chemicals and abrasives, remove the remaining soil or dirt from equipment and utensils. This is a physical and chemical process, the soil and bacteria as well as cleaning compounds, are suspended in the wash water
Rinsing equipment and utensils	Remove most suspended soil, bacteria and cleaning compounds from the equipment and utensils after washing.
Sanitization equipment and utensils	When certain specific chemical concentration, temperature requirements, time requirement and water condition are satisfied, these condition are crucial for effective sanitization, that include exposure time, temperature, and chemical concentration.
Drying equipment and utensils	The only acceptable method of drying equipment and utensils is air drying, the use of towels for drying, polishing or any other purpose that would re-contaminate equipment and utensils with bacteria is not allowed.
Storage and handling of equipment and utensils	Stored in clean surfaces, and handled to minimize contamination of food contact surfaces, to prevent re-contamination prior to use
Wiping clothes	Used to wipe service counters, scales or other surfaces that may come into contact with food shall be used once unless kept in clean water with sanitizer
Water	Safe source that meet the Palestinian drinkable water recommendation criteria , as hot and cooled water under pressure
Toilet facility	Shall be maintained clean, sanitary and In good repair, separated by a well-fitting self-closing door. Toilet tissue shall be provided in a permanently installed dispenser to each toilet, the number of toilet shall be in accordance with local building and plumping ordinance(to the septic system), toilet shall be provided for patrons: in establishment with more than 20,000 sq ft, establishment offering on-site liquor consumption.(food code 9).

Hand- washing facility	Using soap and towels or drying device shall be provided in dispenser, dispenser shall be maintained in good repair, adequate facilities shall be provided for hand washing ,and at food preparation and equipment and utensils washing.
Garbage containers	All food waste rubbish shall be kept in leak proof and rodent proof containers. Containers covered all the time, all waste must be removed and disposed of as frequently as necessary to prevent a nuisance. The exterior premises kept clean and free of litter and rubbish.
Sewage and water disposal	All sewage and wastewater disposed of in an approved sewer or septic system.
Plumping	All plumping and plumping fixture shall be installed in compliance with local plumping ordinance, maintained to prevent any contamination, kept clean, fully operative, in a good repair.
Floors	Area are smooth where in food preparation, packaging, storage, utensils storage, garbage storage, janitorial facilities are located, toilet and hand washing facilities, and in area where worker change and storage (except costumer service area), durable, non-absorbent, and easily cleanable.
Walls/ ceiling	Have durable, smooth, non-absorbent, light-color, and washable surfaces, food facility shall be fully enclosed, kept clean and good repair .
Lighting	In all area to facilitate cleaning and inspection. Light fixture in area where open food is stored, served, prepared, and where utensils are washed shall be of shatterproof construction or shielded.
Ventilation	Exhaust hoods shall be provided to remove toxic gases, heat, greases, vapors, and smoke, all area shall have sufficient ventilations to facilitate food storage, toilet room vented to the outside air by screened open-able windows, an air shaft, or a light-switch activated exhaust van
Toxic items	All poisonous substances, detergents, bleaches, and cleaning compounds shall be separated from food, utensils, packing material and food contact surfaces. Labeling properly,
Interior premises	All of each food facility shall be kept clean, free of litters and rubbish, all clean, linen properly stored, non-food items shall be stored and displayed separated from food and food contact surface.
External premises'	Shall be clean and free of litter and rubbish.
Manager	The direct/ operator who is responsible for all operation in the restaurant.
Popular restaurant	Fast food restaurant serve traditional Arabic food like (humos, falafel, mashawi, salad, and other) to costumers
Hotel restaurant	Restaurants as part of hotel serve food to residents and other costumers
Touristic restaurant	Linseed by ministry of tourism with special l recommendation
Fast food	Restaurant serve ; hamburger, peeefe-burger, pteza , and moagnat
Fixed menu	Food list at restaurant that is not change over time during service
Daily prepared menu	Food list at restaurant that changed per day or week .

## Appendix 6

### List of critical violations of the restaurants

Number	Violation
1	Approved source of food
2	Unwrapped and potential hazardous food not re-served
3	Food received temperature
4	cooking time and temperature
5	Proper cooling procedure
6	Proper reheating procedure
7	Proper hot holding temperature
8	Proper hot serving temperature
9	Proper cold serving temperature
10	Cross- contamination: Food contact surfaces used for raw meat thoroughly cleaned and sanitized
11	Raw foods below or away from RTE food
12	Handling of raw and cooked food properly separated
13	Separation of equipment for ready to eat and raw food
14	Processing area for raw and cooked food separated
15	Personnel :infected person restricted
16	Demonstration of knowledge
17	Medical checking of workers
18	Hygienic practice (hand-washing procedure )
19	no glove over bandage, working with exposed injuries
20	The hazardous food meets temperature requirements during storage, preparation, display, service, transportation
21	Facility maintaining product temperature
22	Sanitization of equipment and utensils
23	Approved water source
24	Approved sewage disposal
25	No cross contamination, backflow
26	Hygiene facilities: toilet, sinks adequate
27	Insects, rodent, animal control
28	Toxic stored properly labeled

## Appendix 7

### List of Non-critical violation in the restaurant

Number	Violation
1	Food not protected in general, separation, storage preparation
2	Condition of food transportation, not adulterated
3	Thermometers provided
4	Food labeling, packaging free of corrosive
5	washing of fruit and vegetables
6	Adequate equipment for temperature-monitoring
7	thawing method
8	Refrigeration and freezer capacity sufficient
9	Refrigeration temperature fixed and maintained
10	Appropriate, Clean outer cloths, hair restraints, uniform clothes
11	Dressing rings, jewelry and other decoration, Long nails/ polish
12	Gloves using, changed as required
12	Minimal bare hand contact with food
13	Wiping hands on apron/ clothes/ wiping clothes
14	Eating , smoking while working
15	Improper sink used for hand washing
16	Shelf stock identification , labeling by date of expiry and production , and storage
17	Proper disposal of unsafe or contaminated food
18	Non-food contact surface designed constructed, maintained, installed, located
19	Dishwashing facilities designed, constructed, maintained, installed, located, operated, provided
10	Manual washing three or more compartment, tow drain boards, and large
11	Wiping cloths clean use once unless , keep in clean water or sanitizer use restricted
12	Food-contact surfaces of equipment and utensils clean, free of abrasives', Detergents.
13	Storage, handling of clean equipment
14	Non-food contact surfaces of equipments and utensils clean
15	Toilet room enclosed, self-closing doors fixture good repair ,clean, hand cleanser, sanitary towels, hand-drying device, proper waste receptacles, and location
16	Approved garbage containers, adequate number, covered
17	Garbage disposed of in an approved manner, at approved frequency
18	Plumbing location ,Installed, maintained
19	Garbage and refuse disposal, Containers or receptacles, covered, adequate, insect and rodent proof, frequency, clean
20	Outside storage area enclosed properly , constructed, clean, controlled incineration
21	Floors, constructed, drained, clean, good repair, covering, instillation, dustless cleaning method
22	Walls, ceiling, attached equipment, constructed, good repair, clean surfaces, dustless cleaning method

23	Lighting provided , fixtures, shielded
24	Ventilation, room and equipment vented
25	Dressing rooms clean, lockers provided, clean, washing bath, located.
26	Premises maintained free of litter, unnecessary articles, cleaning maintenance equipments properly stored. Authorized personal

## Appendix 8

### Consent form of the study

يقوم الطالب ضيف الله عطية إبراهيم سويدات من جامعة القدس كلية الصحة العامة بعمل دراسة ميدانية بعنوان تقييم سلامة الغذاء وخصائصها (Evaluation of the Food Safety situation and characteristics in the West Bank Central Area Restaurants) في المطاعم في منطقة

أريحا ,رام الله , وبيت لحم

وذلك لغرض استكمال أطروحته لدرجة الماجستير وتهدف هذه الدراسة إلى :  
1- التعرف على المخالفات, الأوضاع, المشاكل و النواقص التي قد تؤدي إلى أو تساهم في احتمال حدوث تلوث أو تسمم الغذاء داخل المطاعم و قياس مدى شيوعها وحدتها ودرجة تكرارها, وأيضا تقسيم هذه بالنسبة لدرجة خطورتها حسب إمكانية المساهمة في حدوث التلوث الغذائي.

2- قياس نقاط السيطرة و المراقبة الحرجة لكل مطعم وفق مقدار تطبيقه لشروط صحة و سلامة الأغذية و من ثم احتساب درجة (علامة) صحة و سلامة الأغذية لديه وذلك وفق نظام HACCP .  
3- تحديد العوامل المساعدة في حدوث المخالفات, الأوضاع, المشاكل و النواقص في صحة و سلامة الأغذية في المطعم , وفي تكرارها وتقسيم هذه العوامل حسب الأهمية.

4- لدراسة العلاقة بين صحة و سلامة الأغذية و درجتها (علامتها ) والعوامل المساعدة في انتشار الأمراض الخاصة بالغذاء.

لاتجاز أهداف الدراسة يقوم الباحث بعمل تفتيش صحي و بيئي على المطعم أثناء العمل الرسمي للمطعم وتعبئة استبيان بنتائج التفتيش والملاحظات التي يتم مشاهدتها وأيضا مقابلة شخصية مع مدير المطعم أو من يناوب عنه وفي حال عدم وجوده في المطعم يتم الاتصال به لاستكمال البيانات .  
هذه الدراسة تخدم أهداف البحث العلمي البحتة بحيث لكم الحق في عدم المشاركة فيها و/أو الانسحاب منها في أي وقت, ونحن على التزام كامل بسرية المعلومات المتعلقة بهوية مطعمكم المشارك في الدراسة و ذلك بعد موافقتكم على المشاركة .

لمعرفة المزيد حول طبيعة التفتيش و المعلومات التي سيتم جمعها في الدراسة من مطعمكم وذلك قبل موافقتكم على المشاركة بها طوعا فبالإمكان الاطلاع على الاستبيان قبل تعبئته و أيضا الاستفسار من الباحث او من ينوب عنه في التفتيش حول طبيعة هذا التفتيش و المعلومات التي سيتم جمعها.

توقيعكم على هذه الاستمارة يعتبر تصريحا باطلاعكم على و بمعرفتكم بأهداف و طريقة إجراء الدراسة و بموافقتكم على المشاركة بها طوعا و على إجرائها في مطعمكم

واقبلوا الاحترام

الاسم:

التوقيع:

التاريخ:



# FOOD SERVICE ESTABLISHMENT INSPECTION REPORT

## DEPARTMENT OF HEALTH

ESTABLISHMENT	FIELD NO.	CO. NO.	DATE	<b>SCORE</b> <span style="font-size: 2em; color: red;">829032</span>
LOCATION	STAFF ID	EST. NO.		<u>                    </u> /100
CITY, STATE, ZIP	TYPE ( ) Permanent      ( ) Mobile ( ) Temporary      ( ) Seasonal	PURPOSE ( ) 1. Complete      ( ) 4. Consultation ( ) 2. Follow-up      ( ) 5. Investigation ( ) 3. Complaint      ( ) 6. Other		
PERMITTEE	FOLLOW-UP ( ) YES REQUIRED ( ) NO	NO. SEATS	INSP LENGTH (Hrs/Min)	EMBARGOED

### FOOD

*	1. <b>Source, sound condition, no spoilage</b>	5
	2. Original container, properly labeled	1

### FOOD PROTECTION

*	3. <b>Potentially hazardous food meets temperature requirements during storage, preparation, display, service, transportation</b>	5
	4. <b>Facilities to maintain product temperature</b>	4
	5. Thermometers provided and conspicuous	1
	6. Potentially hazardous food properly thawed	2
	7. <b>Unwrapped and potentially hazardous food not re-served</b>	4
	8. Food protection during storage, preparation, display, service, transportation	2
	9. Handling of food (ice) minimized	2
	10. In use food (ice) dispensing utensils properly stored	1

### PERSONNEL

*	11. <b>Personnel with infections restricted</b>	5
	12. <b>Hands washed and clean, good hygienic practices</b>	5
	13. Clean clothes, hair restraints	1

### FOOD EQUIPMENT AND UTENSILS

	14. Food (ice) contact surfaces designed, constructed, maintained, installed, located	2
	15. Non-food contact surfaces designed, constructed, maintained, installed, located	1
	16. Dishwashing facilities designed, constructed, maintained, installed, located, operated	2
	17. Accurate thermometers, chemical test kits provided, gauge cock (1/4" IPS valve)	1
	18. Pre-flushed, scraped, soaked	1
	19. Wash, rinse water clean, proper temperature	2
	20. <b>Sanitization rinse clean, temperature, concentration, exposure time, equipment, utensils sanitized</b>	4
	21. Wiping cloths clean, use restricted	1
	22. Food-contact surfaces of equipment and utensils clean, free of abrasives, detergents	2
	23. Non-food contact surfaces of equipment and utensils clean	1
	24. Storage, handling of clean equipment, utensils	1
	25. Single-service articles, storage, dispensing	1
	26. No re-use of single service articles	2

### WATER

*	27. <b>Water source, safe, hot and cold under pressure</b>	5
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### SEWAGE

*	28. <b>Sewage and waste water disposal</b>	4
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### PLUMBING

	29. Installed, maintained	1
	30. <b>Cross-connection, back siphonage, backflow</b>	5

### TOILET AND HANDWASHING FACILITIES

*	31. <b>Number, convenient, accessible, designed, installed</b>	4
	32. Toilet rooms enclosed, self-closing doors, fixtures good repair, clean, hand cleanser, sanitary towels, hand-drying devices provided, proper waste receptacles	2

### GARBAGE AND REFUSE DISPOSAL

	33. Containers or receptacles, covered, adequate number, insect and rodent proof, frequency, clean	2
	34. Outside storage area enclosures properly constructed, clean, controlled incineration	1

### INSECT, RODENT, ANIMAL CONTROL

*	35. <b>Presence of insects, rodents — outer openings protected, no birds, turtles, other animals</b>	4
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### FLOORS, WALLS AND CEILINGS

	36. Floors, constructed, drained, clean, good repair, covering, installation, dustless cleaning methods	1
	37. Walls, ceilings, attached equipment, constructed, good repair, clean surfaces, dustless cleaning methods	1

### LIGHTING

	38. Lighting provided as required, fixtures shielded	1
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### VENTILATION

	39. Rooms and equipment — vented as required	1
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### DRESSING ROOMS

	40. Rooms clean, lockers provided, facilities clean, located	1
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### OTHER OPERATIONS

*	41. <b>Toxic items properly stored, labeled, used</b>	5
	42. Premises maintained free of litter, unnecessary articles, cleaning maintenance equipment properly stored. Authorized personnel	1
	43. Complete separation from living and sleeping quarters, laundry	1
	44. Clean, soiled linen properly stored	1

### ADMINISTRATION

**	45. Current Permit Posted	0
	46. Most current inspection report posted	0

Failure to correct any violations of critical items within ten (10) days may result in suspension of your food service establishment permit. Repeated violation of identical critical item category may result in revocation of your food service establishment permit. Items identified as constituting imminent health hazards shall be corrected immediately or operations shall cease. You are required to frame and post the food service establishment permit in a conspicuous manner and post the most recent inspection report in a conspicuous manner. You have the right to request a hearing regarding this report by filing a written request with the Commissioner within ten (10) days of the date of this report. T.C.A. Sections 68-14-305, 68-14-307, 68-14-308, 68-14-317, 68-14-318, and 4-5-320.

Signature of  
Person in Charge \_\_\_\_\_

By \_\_\_\_\_ Environmentalist

Date of Signature \_\_\_\_\_

Time in/out \_\_\_\_\_ a.m. p.m.

\* = Identifies critical items

\*\* = Identifies misdemeanor violations

Dist. List  
1st — Local File

2nd — Date Entry  
3rd — Operator, Manager