

An- Najah National University

Faculty of Graduate Studies

**Evaluation of Food Safety Awareness
and Practices Among Restaurants Food
Handlers in Northern of West Bank
Palestine**

By

Alaa Nazzal

Supervisor

Dr. Samer Mudalal

**This Thesis is Submitted in Partial Fulfillment of the Requirements for
the Degree of Master of Nutrition and Food Technology, Faculty of
Graduate Studies, An-Najah National University, Nablus, Palestine.**

2021

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Among Restaurants Food Handlers
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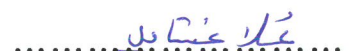
– Dr. Samer Mudalal / Supervisor

.....

– Dr. Fuad Al-Rimawi / External Examiner

.....

– Dr. Ola Anabtawi / Internal Examiner

.....

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Dedication

This thesis is dedicated to the soul of my second father, my husband's father Farouq Nazzal (Abu Saleh) may Allah have mercy on him and place him into his havens.

Acknowledgments

I would like to pay all praise and thanks to Almighty Allah the most gracious and most merciful who granted me the mind, health, strength, and patience to conduct this study.

I wish to express my deepest gratitude to my supervisor Dr. Samer Mudalal for encouraging me and supporting me in the development and writing of this thesis.

None of this work would have been completed without the moral support, patience, and encouragement of my husband ...Saleh, and my son and daughters (Jaleel, Rasha, and Joury).

My heart full of gratitude to my family (Dad, Mum,) and my husband's family, thanks for their love and support.

Finally, I appreciate all those helping me during my whole course work and for giving me support along this dissertation.

الاقرار

انا الموقع ادناه مقدم الرسالة التي تحمل عنوان:

Evaluation of Food Safety Awareness and Practices Among Restaurants Food Handlers in Northern of West Bank Palestine

أقر بان ما اشتملت عليه هذه الرسالة انما هي نتاج جهدي الخاص، باستثناء ما تم الاشارة اليه حيثما ورد، وان هذه الرسالة ككل، او اي جزء منها لم يقدم لنيل اي درجة او لقب علمي او بحثي لدى اي مؤسسة تعليمية او بحثية اخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualifications.

Student's Name:

اسم الطالبة: آلاء نزال

Signature:

التوقيع: 

Date:

التاريخ : 2021/9/14

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List of Abbreviations

WHO	World Health Organization
CDC	Centers for Disease Control and Prevention
HACCP	Hazard Analysis and Critical Control Points
MENA	Middle-East North African Countries
FDA	Food and Drug Administration
EFSA	European Food Safety Authority
Codex Alimentarius	A joint FAO and WHO commission established in 1961 responsible for implementing food Standards and programs.
USA	United States of America.
EU	European Union.
FAO	Food and Agriculture Organization.
GMP	Good manufacturing practices
UAE	United Arab Emirates.
CCP	Critical Control Point
GHP	Good Hygienic Practices
KAP	Knowledge, Attitudes, and Practices.
SFSP	Sharjah Food Safety Program
ANOVA	Analysis Of Variance
SD	Standard Deviation
SEM	Standard Error of Mean
CKMs	Certified Kitchen Managers

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Abstract

More and more people are eating away from home each year. Food service establishments and restaurants are becoming a major source of food-borne outbreaks. Globally, food borne illnesses are caused an almost 1 in 10 people in the world (estimated 600 million) fall ill and 420 000 deaths worldwide in 2010 (WHO, 2015). Food borne illnesses are mannerism a significant load, that making food safety an important public health. There are limited data available about the awareness of food handlers in food safety in Palestine. This study was conducted was to evaluate food safety awareness and practices among restaurants food handlers in northern Palestine and their relation with some demographic characteristics. Moreover, to assess current situation of food hygiene practices in restaurants. Around 140 Palestinian workers in restaurants have been randomly selected from three governorates (Nablus, Qalqilia, and Tulkarem). Food handlers were subjected to face-to-face interview to fill validated questionnaire related to food safety information and practices. Data from questionnaire were analyzed by descriptive statistics (mean, SEM, minimum and maximum values). Results were evaluated using the ANOVA test of SPSS software. Differences in food handlers' awareness of

food safety were not similar in the three studied governorates. On other hand, the percentage of food handlers receiving food safety training and courses was very low. Therefore, more attention must be given to food safety issue from policymakers and public health authorities sectors by training and proper health education messages are needed to raise the awareness of food handlers in general.

Keywords: Food safety, food handlers, awareness, training, demographic characteristics.

Chapter One

Introduction

Human beings are facing dramatic changes in lifestyle and demography. Nowadays, a large portion of the population in the world goes to eat outside the home and depends highly on processed ready-to-eat food because of rapid urbanization. Accordingly, food service establishments and restaurants are becoming a major source of food-borne outbreaks (DeBess et al., 2009). In this context, found that about 44% of American adults eat at a restaurant every day (Noble et al., 2009).

In another study, about 67% of Malaysians dine at restaurants at least once a week (Son R. et al., 2015). Accordingly, restaurants must have good quality and acceptable food hygiene level.

There are many sources of food-borne disease outbreaks reported to the Centers for Disease Control and Prevention during the period 1998–2004 was shown in Figure.1 (Angulo et al., 2006).

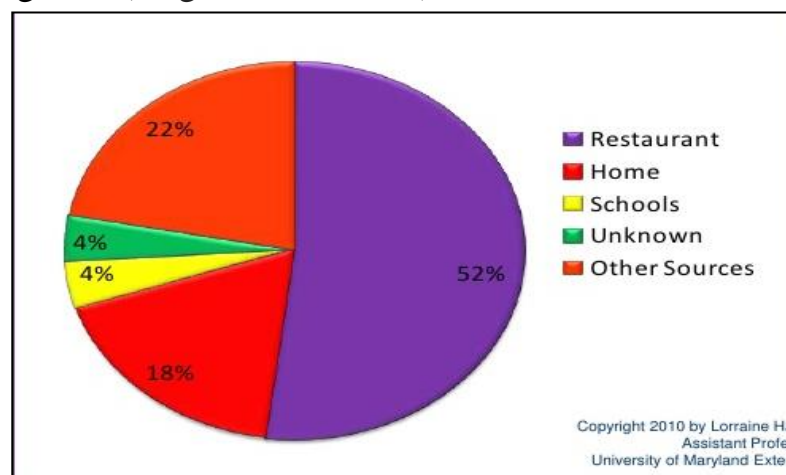


Figure 1. Sources of foodborne disease outbreaks reported to the Centers for Disease Control and Prevention during the period 1998–2004 “Restaurants” include delicatessens, cafeterias, and hotels (Angulo et al., 2006).

Food-borne diseases are caused by consuming contaminated drinks or food. Many toxic substances and microbes can contaminate foods. The majority of foodborne diseases (about 250) are contagious and are caused by 31 foodborne agents viruses (*Hepatitis*), bacteria (*Campylobacter* and *Salmonella*), parasites (fish-borne trematodes), chemicals (Heavy metals), and toxins (mycotoxins) (Gilmore, Brown, and Dana, 1998).

In the United States, 76 million people are annually affected by foodborne diseases

(DeBess et al., 2009). In addition, about 2.2 million people are dying every year in developing countries due to contamination of drinking water and food while more than one-third of the population experience food-borne illnesses according to the World Health Organization (Panchal et al., 2014; Mohamed et al., 2017). In the USA, the annual economic burden of the most common food-borne illnesses was estimated to be about \$6.5–\$34.9 billion (DeBess et al., 2009). Food safety is a social responsibility for restaurant owners and food handlers because food is a product where consumption is not just an issue of choice but is virtually an issue of life and death. It must be a priority for government's worldwide (Ababio et al., 2012).

The World Health Organization (WHO) the measures and conditions that are necessary during the processing, storage, production preparation, and distribution of food to ensure that it is safe, healthy and suitable for human consumption (WHO, 1984).

Applying good food safety practices by the food handlers is one of the most significant factors in decreasing foodborne illnesses, such as personal hygiene practice including, cleanliness of hands and uniforms, short and unpolished fingernails, use gloves and hairnet, avoiding smoking cigarettes while serving or preparing food, controlling temperature during preparation and storing foods, sanitizing of work surfaces, and good sanitation practices in restaurants to reduce cross-contamination of food (Khatib and Mitwalli, 2009).

Foodborne illness is life-threatening to some consumer groups, for example pregnant women, children, the elderly, and consumers who have an allergy or those with weak immune systems (de W Blackburn et al., 2009).

Effective control of food-borne illness is important to protect the food industry. There are several economic consequences for food-borne diseases including claims, lack of earnings and damage to trade and tourism through negative propaganda and professional confusion. Therefore, the challenge is to reduce continually the hazards and optimizing the using and application of food safety management systems in food establishments (restaurant, canteens, and cafeteria) (de W Blackburn et al., 2009).

The main aim for the education of food safety to all staff in food handling is to create behavioral changes besides the adoption of positive attitudes (Joseph, 2018).

Chapter Two

Literature review

Food safety is an old issue for humans. Although governments exert huge efforts to improve food safety in the world and strategies were developed to ensure that the foods are not harming, unsafe foods are still available in markets and food-borne diseases adversely affect millions of people.

The appearance of food-borne diseases in both developing and developed countries is considered a significant health issue. It has been estimated that each year 1.8 million people die as a result of diarrheal diseases and most of these cases can be referred to as contaminated food or water. Good food preparation can prevent a significant part of food borne-diseases (WHO, 2015).

Food-related infections shape a significant health problem in both developing and developed countries (Dugassa, 2007; Jacob, 1989). In 1997, Turkey has been reported 23,010 cases of dysentery (State Statistics Institute, 1999; Acikel et al., 2007). It was found that a single region in Italy, called Emilia-Romagna had 1564 cases of food-borne diseases between 1988 and 2000 (Legnani et al., 2004). Figures showed that about 76 million food-related illnesses are seen annually in the United States of America (Mead et al., 1999; Anding et al., 2007).

In 2017, there was a study in India to assess the practices of food safety for 100 foodservice personnel working in restaurants in Chennai city to assess

the effect of the awareness program on their knowledge. It was found that the good communication of knowledge on food safety would lead to preferable practices and attitudes to food safety (Joseph, 2018). This will lead to higher standards of food preparation, personal hygiene, and service, that way ensuring safe food for the consumers. Therefore, a positive attitude, right knowledge, and healthy food safety practices are helpful for food service personnel as it mainly helps to protect from foodborne illnesses (Joseph, 2018).

Another study was carried out in USA (Marion counties and Washington in Oregon) during April-September 2000 by including 407 food handlers working at 67 randomly selected restaurants to evaluate food handler's awareness about food safety and prevention of foodborne illness. The results showed that lack of knowledge in food safety may affect the transmission of food-borne pathogens to the consumers through food preparation. Accordingly, educational programs are very important to improve food handler's knowledge in food-borne diseases and their transmission (DeBess et al, 2009).

2.1 Foodborne diseases

Food infections result from the ingestion of viruses (4%), bacteria (66%), chemicals (26%), parasites (4%).or their toxins which may be present in already contaminated food, or during processing, food cross-contamination (equipment, surfaces, or catering staff hands), or less probably, from carriers (Khare et al., 2018).

More than 250 various food borne-diseases have been specified and most of these diseases are viral, bacterial, and parasitic infections and other diseases involve poisonings that are caused by chemicals or harmful toxins that have contaminated the food. For example, in many countries, people become ill after mistakenly eating poisonous mushrooms (CDC, 2005). These different diseases have many different symptoms, so there is no one "syndrome" that is foodborne illness. However, the microbe or toxin enters the body through the gastrointestinal tract, and often causes the first symptoms such as nausea, vomiting, abdominal cramps and diarrhea (CDC, 2005).

The most commonly familiar food-borne infections are those caused by a group of viruses called *calicivirus*, also known as the Norwalk- like and Norwalk as well as by the bacteria such as *E. coli O157:H7*, *Campylobacter*, and *Salmonella*. Some popular diseases such as *Shigella*, *Hepatitis A*, *Cryptosporidia*, and *Giardia lamblia* are sometimes foodborne, although they are usually transmitted in other ways. These diseases are caused by direct infection, but some foodborne diseases are caused by indirect infection the presence of toxins in the food that was produced by a microbe in the food. For example, botulism occurs when *Clostridium botulinum* grows and produces a powerful paralytic toxin in foods and the bacterium *Staphylococcus aureus* can grow in some foods and produce a toxin that may lead to acute vomiting. These toxins can produce illness even if the microbes that produce them are no longer there (CDC, 2005).

The nature of food-borne diseases is always changing. A century ago, typhoid fever and cholera were very prevalent food borne-diseases. Today, other food-borne infections have taken their place, including some that have lately been discovered. In 1996, foodborne disease suddenly appeared linked to Guatemalan raspberries and caused a diarrheal illness called the parasite *Cyclospora* (CDC, 2005). The wide majority of reported cases of foodborne illnesses are not part of known outbreaks, but occur as individual or "separate" cases that may be because many of these cases are part of unrecognized diffuse outbreaks (CDC, 2005).

Although illnesses and outbreak assessment are available for developed countries (Mead et al., 1999; Lynch et al., 2006; Malhotra et al., 2008), deficiency of effective observation systems obstructs the availability of similar assessment for developing countries (Malhotra et al., 2008).

In most developing countries, obtaining enough supply of nutritious and safe food is the main problem due to poor physical facilities, poor attention for sanitation, and low concern about aesthetic standards. As a result food and drinking water are frequently contaminated with pathogens and therefore the burden of foodborne illnesses in developing countries is considered to be significant and in worst conditions than developed countries as a result of inadequate food safety program (Dugassa, 2007).

Most of the food borne diseases are preventable. Prevention measures are needed to reduce the risk of contamination from farm to fork. There is no simple one-step prevention measure. A diversity of good agricultural,

manufacturing, and kitchen practices can prevent the contamination of foods and minimize the spread of microorganisms. An accurate review of the total food production process can recognize the principal hazards and the control points where contamination can be limited, prevented. A formal method can be used to estimate and control the risk in foods and it is called the Hazard Analysis Critical Control Point, or HACCP system (CDC, 2005).

2.2 Causes of foodborne disease outbreaks

Food-borne illnesses are usually a result of unsuitable food handling practices and many food poisoning outbreaks resulted from food that has been mistreated or mishandled during preparation or storage, contaminated working environment, high initial bacterial load, inadequate pretreatment, and so on (Dugassa, 2007).

The results of the numbers of food-borne disease cases in MENA (Middle-East North African Countries) from a review about Prevention and Control of Foodborne Diseases in Middle-East North African Countries was shown in Table.1 (Faour-Klingbeil et al., 2020).

Table 1. Foodborne disease (FBD) in the Middle East and North Africa (MENA) countries (Faour-Klingbeil et al., 2020).

Table 1. Foodborne diseases (FBD) in the Middle East and North Africa (MENA)		
Country	FBD	Number of Cases
Lebanon *	2003	
	Brucellosis	193
	Dysentery	158
	Food Poisoning	68
	Typhoid Fever	891
	Viral Hepatitis A	616
	2018	
	Brucellosis	242
	Dysentery	207
	Food Poisoning	459
	Typhoid Fever	237
	Viral Hepatitis A	899
Libya	2009–2013	
	FBD with the great majority due to salmonellosis	1747 including 4 deaths
	2001–2004	
	Food poisoning	297 (2001)
		278 (2002)
Oman		129 (2003)
		779 (2004)
	2002	
	Shigellosis	1158
	Amoebiasis	5440
Jordan	Acute gastroenteritis and diarrhoea	112,904
	2002 *	(cases per one month) ‡
	Salmonellosis	(271)
	Shigellosis	(1899)
	Brucellosis	(854)
	2011	
	Food poisoning	133
Jordan	2014	
	Food poisoning	250

Country	FBD	Number of Cases
Saudi Arabia	2003	(prevalence rate of FBD)
	Hepatitis A	(9.55)
	Typhoid and paratyphoid	(1.83)
	Amoebic dysentery	(10.57)
	Salmonellosis	(10.07)
	Shigellosis	(2.22)
	Food poisoning outbreaks	(16)
	2006	
	31 food outbreaks attributed to <i>Salmonella</i> and <i>S. aureus</i>	251
Dubai	2011	
	FBD	1663 (suspected)
	2013	
	FBD	1120 suspected (518 confirmed)
	Amoebic dysentery	214
	Typhoid/paratyphoid	137
	Hepatitis A	43
	Giardiasis	20
	Shigellosis	10
	<i>Campylobacter</i> spp.	1
	<i>E. coli</i>	1
	<i>Campylobacter jejuni</i>	3
	Bacillary dysentery	5
	2018	
	Salmonellosis	200 (first half of 2018)
Morocco	2001–2006	
	FBD with 28% of the cases attributed to <i>C. perfringens</i>	630
	<i>Staphylococcus aureus</i>	9
Tunisia	2017	
	Food poisoning	1015
	2018	
	Food poisoning	1855

The reported cases in Lebanon comprise food and waterborne diseases. Estimated cases per one month (late summer) based on the total population of Jordan (5.3 million people in 2002) and laboratory surveys; most of the information on foodborne illnesses are reported based on physician diagnosis and pathogen isolation from clinical specimens without

corroborative evidence of consumption of contaminated food (Faour-Klingbeil et al., 2020).

2.3 Food contamination

There are three routes of food contamination are shown in Table 2.

Table 2. Types of hazards.

	Type of hazard		
	Biological	Chemical	Physical
Considerations	Organisms that can cause harm through infection or intoxication	Chemicals that can cause harm through toxic effects, either immediate or long-term	Items that can cause harm through direct injury or choking
Examples	Pathogenic bacteria, e.g. <i>Escherichia coli</i> , <i>Bacillus cereus</i> , <i>Campylobacter jejuni</i> , <i>Clostridium botulinum</i> , <i>C. botulinum</i> (non-proteolytic), <i>C. perfringens</i> , <i>Salmonella</i> spp, <i>Shigella</i> spp, <i>Staphylococcus aureus</i> , <i>Vibrio parahaemolyticus</i> ; Viruses, Protozoan parasites, e.g. <i>Cryptosporidium parvum</i> , <i>Giardia intestinalis</i> ,	Mycotoxins, e.g. aflatoxins, patulin, vomitoxin, fumonisin; pesticides, allergenic materials, heavy metals, PCBs dioxins, cleaning chemicals	Glass, metal, stones, wood, plastic, pests, intrinsic natural materials, e.g. bone, nut shell

2.3.1 Biological contamination

Biological contamination includes bacteria, pathogenic microorganisms, or macroparasites. Microbial hazards in food have different eukaryotic microorganisms like prion, viruses, fungi, and protozoa (e.g. *Sarcocystis species*, *Toxoplasma*, *Cyclospora*, *Cryptosporidium*, and *Giardia*) (Untermann, 1998).

Viruses, prions, and Protozoa cannot multiply in food. They are either present by contamination of food or in raw food of animal origin like meat.

Amongst virus species for which foods can serve as vectors:

1. Various gastroenteritis viruses like *rotavirus*, *astrovirus* as well as *caliciviruses*, which include Norwalk and Norwalk-like viruses.
2. Hepatovirus (*hepatitis A*)
3. Poliovirus

Man is the tank for these agents and transmission is via the faeco-oral route. The foods can be contaminated either directly by man or indirectly by way of contaminated water. Human infection with pathogenic protozoa too is via faeco-oral routes e.g. *Giardia lamblia*, *Cryptosporidium parvum* infections, and *Entamoeba histolytica* (Untermann, 1998).

Bacteria and fungi can multiply in food if conditions are appropriate. Food-borne diseases from Fungi are usually in the form of mycotoxin. Mycotoxins generated by fungi in foods or raw materials are toxigenic for humans and must be considered as hazards. They can also be eaten by animals via feed and are then excreted; into milk, e.g. Aflatoxin B is eaten by livestock and is passed into the milk. Some species of bacteria cause illness by their toxins. These toxins can be heat-stable (e.g. *Staphylococcus enterotoxins*) or heat-labile (e.g. *Botulinus toxin*).

Infectious pathogens play a more important epidemiological role. The special importance of bacteria as microbial hazards in food because of their

survival, growth, and complex kinetics of inactivation. Some of these bacteria as *Mycobacterium Bovis*, *Vibrio cholera*, *Salmonella spp.*, *Campylobacter jejuni*, *Shigella spp.*, *Escherichia coli* (EHEC), and *Brucella melitensis*. The greatest worry to health inspectors and food service managers is microbial hazards because they are the reasons for most foodborne illness outbreaks (Untermann, 1998; Wilson, C. L. (Ed.). 2007).

2.3.2 Chemical contamination

Food can be contaminated by toxic chemicals through the production chain. It may happen through environmental pollution of air, water, and soil as well as by dioxins and toxic metals. In addition, it may happen through the deliberate use of different chemicals like veterinary drugs, pesticides, other agrochemicals, and adulterants.

The deliberate or accidental addition of excessive amounts of toxic chemicals to food can reason illness or death. No dangerous or toxic materials should be used that are not suitable or direct necessary for the cleaning or sanitizing of utensils or equipment, the control of insects or rodents, the maintenance of the establishment. Chemicals must be used in conformity with manufacturers' recommended instructions (FDA, 2005).

2.3.3 Physical contamination

Physical contamination is objects that are not a part of food, never was intended to be food, but somehow got into the food. Examples are pieces of

metal, glass or stone, cigarette butts, pebbles, hair, jewelry. A physical hazard can enter a food product at any stage of production. Eating these can cause injury, sharp or hard objects are potential physical hazards and can cause damage to gums or teeth cuts to the mouth or throat, damage to the intestine (Olsen, 1998).

2.4 Food contamination in restaurants:

There are many opportunities for food to become contaminated during preparation and production because we live in a microbial world. The Animal's intestine often is a host for food-borne microbes, although animals that are raised for human consumption may be healthy and it can be dangerous especially during slaughtering. The risk of contamination in poultry and meat carcasses is very high from small amounts of intestinal content. Likewise, fresh vegetables and fruits can be contaminated if they are washed and irrigated with contaminated water with human sewage or animal dropping.

Contamination can also occur by *Vibrio* bacteria infecting filter-feeding shellfish because they are naturally concentrated in seawater. Another potential source of contamination is *salmonella* infecting a hen's ovary even before the shells formed and other microbes that are present in human sewage dumped into the sea (CDC, 2005).

Contamination is potential during food processing, by cross-contamination from some other raw agricultural product or humans who handle the food. *Shigella* bacteria, Norwalk virus, and *hepatitis A* virus can be transmitted

by the unwashed hands of infected food handlers and microbes can be transferred from one food to another in the kitchen by ways such as using the same cutting board, knife, or other utensils to prepare different food without washing the utensil or surface. In addition, food that is well cooked can be contaminated again if it touches other raw foods or drippings from raw foods that contain pathogens (CDC, 2005).

The method of food handling after it is contaminated can be affected if an outbreak occurs or not. Food cause disease when bacterial microbes are multiplied to a large number by given moist, warm conditions and plenty of supply of nutrients. For example, one bacterium in 12 hours can be replicate by dividing itself every half hour and produce 17 million progenies (CDC, 2005). As a result, softly contaminated food left out overnight can be highly infectious by the next day. However, if the food were refrigerated immediately, the bacteria would not multiply at all. In general, freezing or refrigeration prevents substantially all bacteria from growing. The two exceptions to this rule are the food-borne bacteria *Yersinia enterocolitica*, and *Listeria Monocytogenes*, which can grow at refrigerator temperatures. High acid, high sugar or high salt levels prevent bacteria from growing, which is why jam, salted meats, and pickled vegetables are traditional preserved foods (CDC, 2005).

Heating food to an internal temperature over 78 °C, for even a few seconds, is enough to kill bacteria, viruses, and parasites. Nevertheless, *Clostridium* bacteria is an exception, because it produces heat-resistant spores. *Clostridium* spores are killed only at temperatures above boiling, which is

why in canning process at a high temperature under pressure must be part of the processing for canned food (CDC, 2005). Bacteria produced different toxins that vary in heat sensitivity. The *staphylococcal* toxin, which causes vomiting, for example, is not affected by boiling. On the contrary, boiling completely inactivates the vigorous toxin that causes botulism (CDC, 2005). Raw foods of animal origin, like raw poultry and meat, unpasteurized milk, raw eggs, and raw shellfish, are the most likely to be contaminated (Figure. 2). Hazardous foods that mix the products of individual animals, including pooled raw eggs, bulk raw milk, or ground beef, animals could contaminate the whole batch if pathogens present in anyone. (CDC, 2005). A poultry carcass can be risky to the juices and drippings of many thousands of other birds that went through the same cold-water tank after slaughter. A restaurant omelet may contain eggs from hundreds of chickens. A single burger pie may contain meat from hundreds of animals. A glass of milk may contain milk from hundreds of cows (CDC, 2005).

Vegetables and fruits consumed raw should have special attention. Because contamination cannot eliminate, although washing can decrease it and thus consumers can do little to protect themselves. lately, several outbreaks have been traced to fresh vegetables and fruits that were processed under less-than-sanitary conditions, by using contaminated water, boxes of produce, and the quality of the water used for washing and chilling the produce after it is harvested is critical (Choung, 2010). Fresh compost used to fertilize vegetables can also contaminate them. Unpasteurized fruit juice is also a

risk, as it can become contaminated if there are pathogens in or on the fruit that is used to make it. Raw sprouts pose a particular challenge because they are eaten without being cooked and the conditions under which they are sprouted are ideal for growing microbes, and that means that small amounts of bacteria found on the seeds can grow to high numbers of pathogens on the sprouts (CDC, 2005).

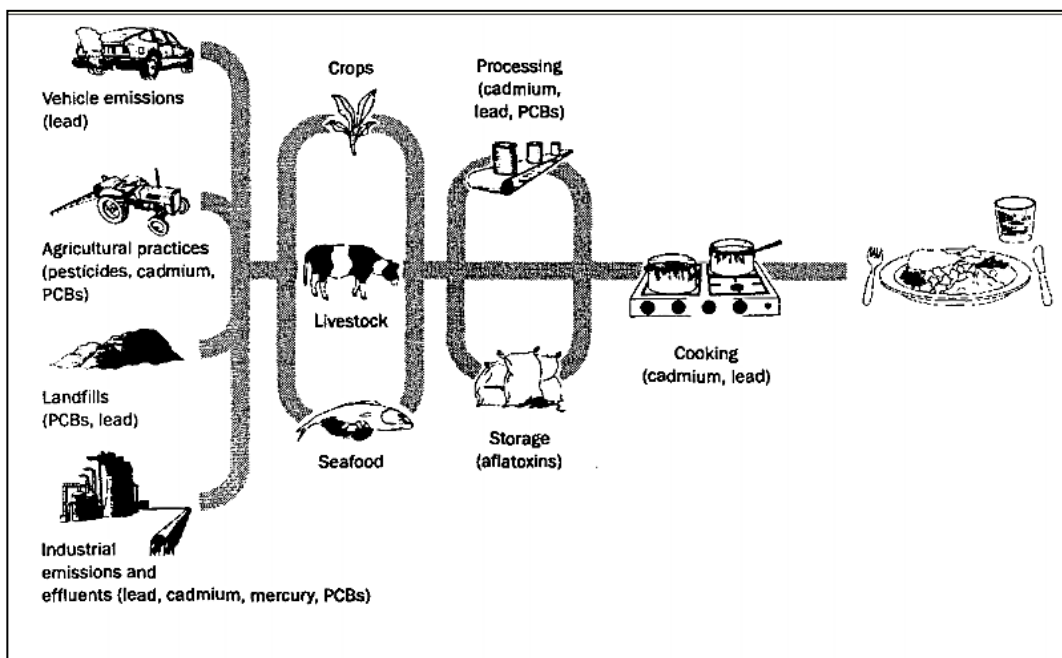


Figure 2. Common sources of some important food contaminations (WHO, 1999).

2.5 Food safety

Food safety is defined by the World Health Organization (WHO) as the measures and conditions that are necessary during processing, storage, production preparation, and distribution of food to ensure that it is safe, healthy, and suitable whether in the short term or long term to anyone who consumes products (WHO, 1984).

There is a significant positive correlation between food safety practices, attitudes, and knowledge of food handlers. This generates the need to prioritize the improvement of the food safety knowledge practice and attitudes of food handlers through intensive training programs on basic and advanced food safety programs. These programs promote the use of safe food handling practices. Food safety training programs should focus on editing the unwanted practices such as working surfaces hygiene, poor hand, tableware, habits (for example sneezing and coughing over food), and unsuitable refreezing and thawing techniques of food. Food safety laws should be revised to comprise demands for managers in the foodservice sector to provide frequent food safety training to food handlers. The results of a study conducted in Zimbabwe in 2020 self-reported their food handling practices underestimate the magnitude of undesirable food handling practices and restaurant managers should commit themselves to build a positive food safety culture between food handlers (Ncube et al., 2020). Another study in Bolzano (Panchal et al., 2014) demonstrated low food safety knowledge between restaurant food handlers and knowledge gaps were observed in all the major food safety categories, including temperatures required for holding, cooking, and cooling foods, risk of consuming improperly cooked and raw ground beef, hand hygiene, and cross-contamination .

Research in the domain of food safety and food handlers, both critical and complex subjects, is often methodologically restricted for several reasons. Like generalizations made from very low response rates, superficial questions or categories, a dependence on self-reporting often at a distance, and a lack of “discovery” (Taylor, 2008).

In 2018, an EFSA journal study talking about hazard analysis showed the application of a simplified food safety management system in restaurants and the stages are summarized in the flow diagram (Figure.3) (EFSA Panel on Biological Hazards (BIOHAZ) et al., 2020).

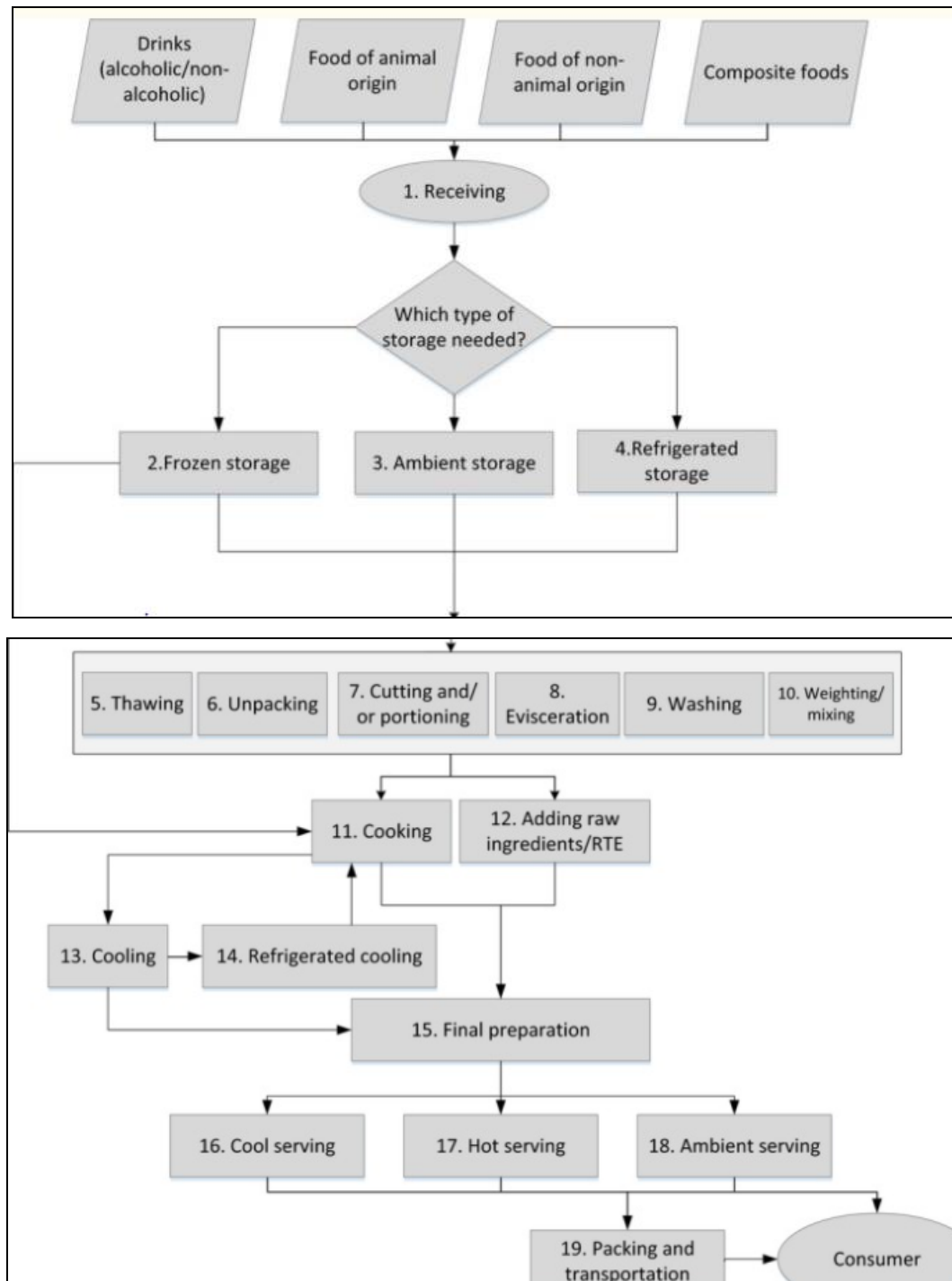


Figure 3. The stages of application of a simplified food safety management system in restaurants (EFSA Panel on Biological Hazards (BIOHAZ) et al., 2020).

2.6 Food safety in Palestine

There is very limited information, knowledge, and research studies about the current situation of food safety in Palestine. One study was published in 2009 and investigated the practices and knowledge about food safety by food-handlers in restaurants in Al-Bireh and Ramallah. A high ratio of food handlers in the restaurants had no experience in restaurant work and 63.4% had received no training on food safety and sanitation. Most of the restaurants in the towns, villages, and refugee camps had only one worker. Restaurants lacked basic conditions for food safety and sanitation, like cleaning materials, hot water, and many food handlers had poor personal hygiene practices. Training is needed for food handlers and restaurant owners to improve food handling standards and practices (Khatib and Mitwalli, 2009).

Globally, there is growing interest to improve food safety. Locally, food safety authorities should have the same interest by improving food handler's knowledge in food safety to avoid many food-borne illnesses and make our life healthier.

2.7 Restaurant inspection

The guidelines of the U.S. Food and Drug Administration state that “a principal goal to be achieved by a food establishment inspection is to prevent foodborne disease”. Therefore, health department personnel must inspect restaurants regularly. Food safety refers to the suitable practice of storing and preparing food to prevent food-borne illness. Food safety

guidelines are essential to maintain the health of customers, develop appropriate hazard management protocol (e.g. HACCAP), and maximize the longevity of food products. These restaurant food safety tips are not just for keeping customers safe but for coming back for more offerings (Jones et al., 2004).

2.8 HACCP

HACCP is a risk management protocol specifically designed for the food section by the Codex Alimentarius Commission (Codex, 2004), jointly established by the World Health Organization (WHO, 2003) and the Food and Agriculture Organization (FAO, 2003). HACCP stand-alone is not efficient unless or until it is not supported by GMP or prerequisite program that monitoring the environmental & hygiene condition of food procedures (Sperber, 1998). It assists companies in the beverage and food industry to identify their food safety risks, treating legal compliance, and preventing food safety hazards. The HACCP methodology is a structured, protective procedure for food safety that optimizes efforts to supply the consumer with safe food. It is mandatory in several countries as the USA, UAE, and within the EU (Taylor, 2010). Food operators must have deep knowledge in food preparation to estimate the potential hazards and related risks, and which are important to the safety of the end product. It needs further evaluation of each product and process to locate critical steps where each important hazard could emerge. It also includes a recording of variations, continual monitoring, and necessary action plans that can be put in place at

these critical points. The whole system must be validated, documented, and routinely proved (Taylor, 2010).

Worldwide, it is known that the application of the HACCP system to food production and preparation had obvious advantages, and prevented several cases of foodborne diseases (Bryan, 1988 & WHO, 1997). The major aims of these programs are to guarantee fair practices in food commerce and protect the health of consumers as well as the coordination and promotion of all food standards work assumed by international governmental and non-governmental organizations (Bell, 2008).

HACCP focuses on prevention strategies on recognized hazards and it is risk-based on food safety assurance system. Supporters of HACCP have a reason that the system can focus on the critical stages from producer to consumer in a cost-effective method. HACCP focuses on process and raw material control rather than structure and planning of food premises, it identifies wrong practices, and potential hazards at an early stage rather than interactive to deficiencies in end-product testing (Ehiri et al., 1996).

Although the application of HACCP demands additional resources like technical support, structure, training, etc., it is considered to be an investment on the long term in food safety, reduction food contamination, improvements of quality, and decrease consumer complaints by increased reliability (Motarjemi and Kaferstein, 1999).

A few studies have also been carried out to examine the understanding and attitude in food safety, food hygiene training, and HACCP for managers

(Mortlock et al., 1999; Worsfold and Griffith, 2003; Taylor and Taylor, 2004a, b). In the UK, Worsfold et al (1997) found that most managers realized their businesses below risk regardless of the foods they handle. In South Wales, it was found that half of the interviewed managers in a survey on perceptions and attitudes towards hygiene training were not skilled to train and oftentimes were not trained in basic hygiene themselves. Additionally, Taylor (2007) interviewed four medium and small project owners, who applied for HACCP, using an in-depth, discovery-based methodology. The study showed that the main obstructions that inhibited HACCP application was an underestimation of the importance of the system, complexity of the system as well as human resources as well as external problems.

Critical Control Point (CCP) is the point in time in which one must apply control to eliminate possible food safety hazards.

Common critical control points include:

1. Storing the food before preparation.
2. Preparing and handling food.
3. Cold or hot holding.
4. Cooking and reheating food.
5. Receiving foods from your supplier.
6. Transporting prepared food to a different location.

7. Holding cold or hot food during service.

Although health inspections can be a stressful and difficult experience, health inspectors do not come to shut down the operation. They make sure food products are prepared and handled according to local and global regulations to protect the public. Once food handlers understand the food codes and have a plan for cleaning the restaurant, health inspections become a routine experience. FDA created a health inspection checklist for restaurants that food handlers can use for their self-inspections (Figure.4).

Health Inspection Checklist

Date: _____

Food Storage:

- ☐ Food is kept at least 6" off the ground.
- ☐ Chemicals and food are separated.
- ☐ Food is stored in a clean, dry location that is not exposed to contamination.
- ☐ Food is stored using the FIFO (First In, First Out) method.
- ☐ Containers are labeled with the food name and delivery date.

Food Preparation:

- ☐ Food is protected from cross-contamination.
- ☐ Frozen food is thawed properly in a refrigerator or under running water.
- ☐ Staff uses gloves, clean hands, or utensils when handling food.
- ☐ Food is heated to the correct temperature to remove all bacteria before being placed in the hot holding area.
- ☐ Tasting utensils are not used more than once before being cleaned.

Sanitation:

- ☐ Washing station is organized into three sections for washing, rinsing, and sanitizing.
- ☐ Equipment is clean to sight and touch.
- ☐ Utensils are covered to protect them from dust and contaminants when stored.
- ☐ Food preparation area, shelving, and cabinets are all clean to sight and touch.
- ☐ Small equipment and utensils are cleaned between uses.
- ☐ Water temperature is heated to the correct temperature for sanitizing.
- ☐ The sanitizer is mixed to the correct concentration.
- ☐ Utensils are allowed to air dry after washing.

Refuse and Garbage Disposal:

- | | |
|--|--|
| <input type="radio"/> Garbage and refuse is properly disposed of. | <input type="radio"/> Outside receptacles have lids or covers. |
| <input type="radio"/> Garbage and recycling bins are emptied when full. | <input type="radio"/> The area around the dumpster is clean and free of pests. |
| <input type="radio"/> Garbage bins are cleaned regularly to prevent pests. | <input type="radio"/> The lid of the dumpster is shut. |

Employee Hygiene:

- | | |
|--|--|
| <input type="radio"/> Employees wear hairnets, and male employees cover facial hair. | <input type="radio"/> Eating and smoking are limited to designated areas away from food prep areas. |
| <input type="radio"/> Jewelry is limited to simple earrings, plain rings, and watches. | <input type="radio"/> Employees wash their hands after sneezing, coughing, blowing their nose, or using the restroom. |
| <input type="radio"/> Cuts and bandages are covered when handling food. | <input type="radio"/> Employees wash their hands after working with raw food, handling money, or switching between stations. |
| <input type="radio"/> Employees wash their hands regularly using proper hand-washing techniques. | <input type="radio"/> Employees wear clean clothes and proper, closed-toed shoes. |

Freezer and Refrigerator Maintenance:

- | | |
|---|---|
| <input type="radio"/> Thermometer is easily visible and displays the correct temperature. | <input type="radio"/> Food is stored at least 6" off the ground in walk-in refrigerators. |
| <input type="radio"/> Refrigeration temperature is within food safe range. | <input type="radio"/> Refrigerators and freezers are clean. |
| <input type="radio"/> Food is stored using the FIFO method. | <input type="radio"/> All food items are correctly labeled and dated. |

Notes:

Employee Signature:

Supervisor Signature:

Figure 4. FDA health inspection checklist for restaurants.

Food safety training programs targeting the food inspectors and food industry have been in place for several years in different countries of the MENA region such as Jordan, Palestine, Lebanon, and different emirates in UAE. Sometimes, these programs are initiated in response to major

incidences of food poisoning and scandals. Nonetheless, the outreach and effect of these programs are generally limited, like in other developing countries and unlike the developed countries, the governments of the MENA countries are generally not participating in developing and making available guidance documents or training packages for the industry and regulatory officers. In both Muscat and Oman, Al-Ghazali et al. (2020) indicated that most food handlers (70.4%) did not have an idea about Good Manufacturing Practice (GMP) and Hazard Analysis and Critical Control Point (HACCP) due to lack of formal training.

2.9 Food hygiene and Good Hygienic Practices (GHP)

Good hygiene practices (GHP) are all practices related to the measures and conditions necessary to ensure the suitability and safety of food at all stages of the food chain (Codex, 2004). European Commission (EC) defines food hygiene as the conditions and measures to control hazards and to guarantee the food suitability for human consumption taking into consideration its final use (EU, 2004). Food hygiene is much more than cleanliness, it includes all measures necessary to guarantee the safety of food during preparation, processing, making, packaging, distribution, handling storage, and display for sale or supply to the consumer (Richard, 2002). GHP is generally called the prerequisite measures upon which other Quality Management and Food Safety Systems are built. They include a detailed list of measures. For example, it includes staff personal hygiene and training. Food hygiene training is a legal requirement that guarantees safety

practices in the food preparation environment (Food Standards Agency, 2009). Reasons of deficiency of success in hygiene training were demographics of trainees, methods used, and their readiness to learn, deficiency of supervision after training, deficiency of resources to execute knowledge gained, and absence of refresher programs in areas with economic challenges (Gilling et al., 2001). Feglo et al. (2004) recommended supervision and training to be essential in areas where due to cost, the designing and establishment of acceptable utilities and infrastructure could take ages to ensue include restaurants. In Ethiopia, it was found that only 60.6% of the food handlers had good or proper hygiene practices (Kamboj et al., 2020).

The results of a study that was conducted to assess the pre-and post-food hygiene training on food safety's KAP level among food handlers in Kuala Terengganu and Kuala Nerus in these diagrams (Figure.5) and (Figure.6) (Has et al., 2018).

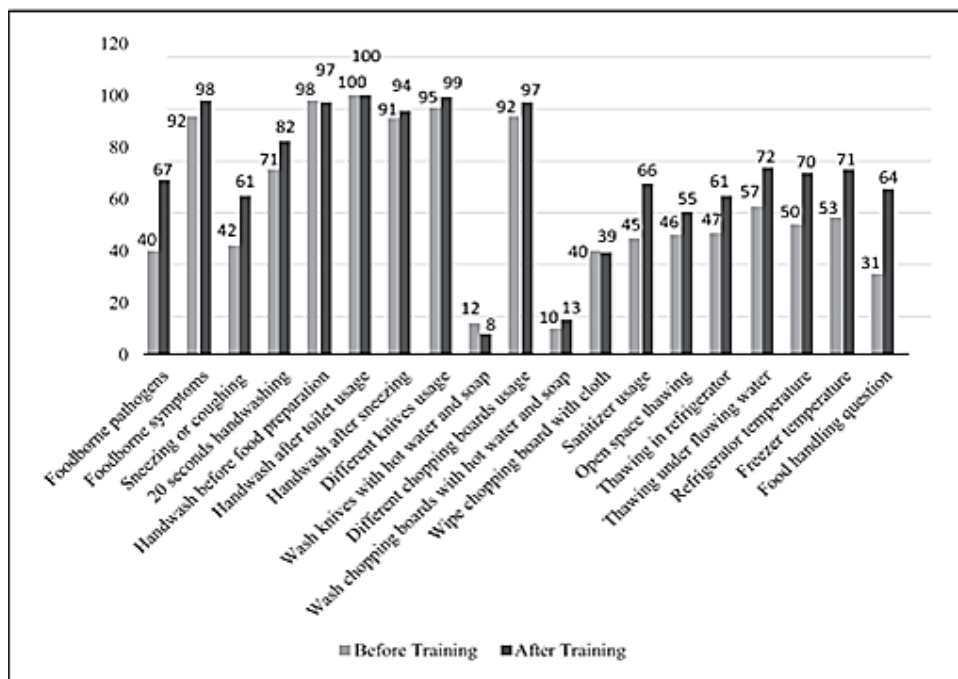


Figure 5. Percentage of correct answers pre-and post-training food handlers according to the item in food knowledge (Has et al., 2018).

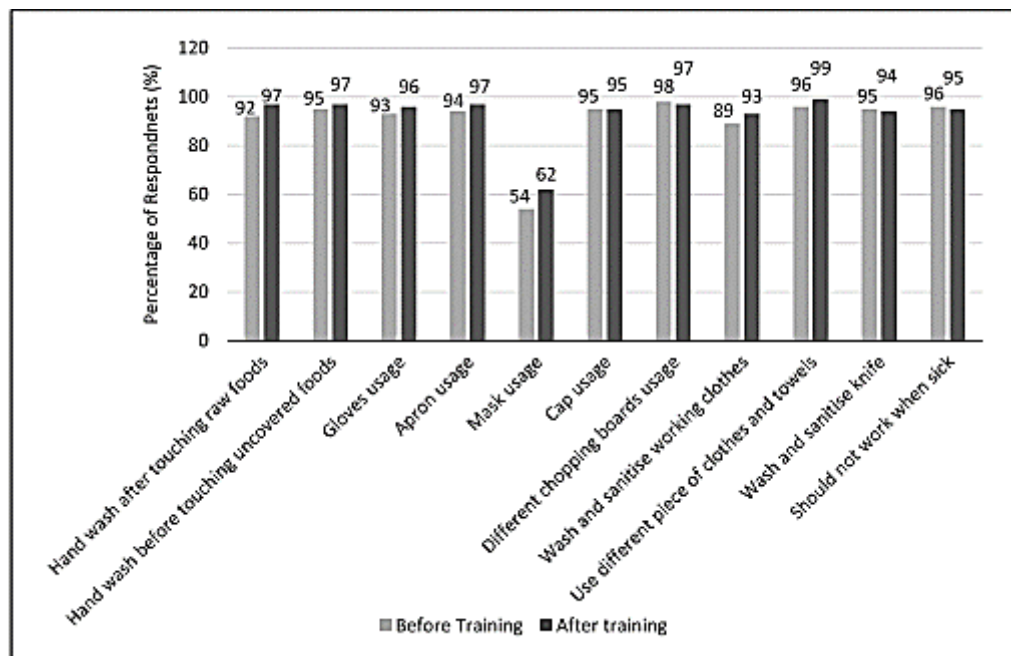


Figure 6. Percentage of correct answers pre-and post-training food handlers according to the item in food practice (Has et al., 2018).

2.10 Personal hygiene

Poor personal hygiene for food handlers can contaminate the food items with respiratory drippings, pus, infected excreta, or other infectious discharges. Food handlers may be a major source of contamination and health risks either through poor hygienic practices or as carriers of pathogens (Kaferstein, 2003).

Workers can carry microbial pathogens on their hands, hair skin, respiratory tracts, or digestive systems and they may unintentionally contaminate foods, equipment, and water supplies if they have not overall understanding and follow basic food hygiene principles, in that way creating suitable conditions for an outbreak of foodborne illnesses (Dugassa, 2007).

Poor personal hygiene practices are associated with a low socioeconomic level, poor educational level, literacy, rapid staff turnover, and language problems as well as poor motivation because of job status and low pay (Bertin et al., 2009). Food handlers have a very important role in preventing contamination during food preparation and distribution since there is compelling evidence that the food handler can be the cause of outbreaks. Therefore, all employees must be appropriate for work, they must wear clean protective clothing and keep their hair short or completely covered. If they have small cuts on their hands must be safely covered. Anyone with big wounds or septic cuts should be excluded. All employee's hands must be clean, no jewelry, fingernails are short, unpolished, and

clean. A study revealed that food and water safety awareness had a significant effect on food and water safety practices. A significant number of food handlers had poor awareness, outlook, and practice towards food and water safety such as only 39.4% of the food handlers had a proper practice of covering mouth with a tidy cloth when they cough, 71.2% of them used tidy clothes for cleaning food utensils regularly. Of the total respondents, whereas 32.79% cut their nails when it becomes tall, 82% washed their hands with soap and clean water before holding cooked foods. Moreover, 75.7% of the food handlers reported that they did not wear personal protective devices like white gowns and gloves during working time (Girmay et al., 2020).

Hands are one of the most prevalent sources of cross-contamination in food production areas. Bacteria spread easily and quickly because hands can become contaminated with bacteria from a wide variety of sources hot and cold water. Suitable hand-cleaning preparation should be provided. Where cold and hot water is available, mixing taps should be provided. There should be appropriate hygienic means of drying hands. Wherever paper towels are used, an adequate number of receptacles and dispensers should be provided neighboring each washing facility. Taps of a non-hand operable type are favorite. The facilities should be provided with duly trapped waste pipes leading to drains. Where adequate and conveniently located facilities for hand washing, drying, and hand disinfection should be provided, essentially the employee must completely wash their hands, including between fingers and under the fingernails and any portion of

uncovered arms that could be exposed to food. Almost 54% of food handlers in food restaurants did not show interest in washing their hands before cooking meals. About 32% of food handlers in Bangladesh used gloves and protective clothing when distributing or touching unwrapped foods, and none of them were found to wear any cap during touching and distributing unwrapped foods in the kitchen, whereas only 12% used a mask. This may be a possible outcome for the food handlers of this study who did not attend any training program associated with food safety (Hashanuzzaman et al., 2020).

On the other hand, in the restaurants where implementation of food safety training programs for food handlers in Saudi Arabia showed a high level of personal hygiene practices, about 80–97% of food handlers were frequently wearing hand gloves, masks, and caps during handling food (Al-Shabib et al., 2016).

2.11 Cleaning

The kitchen must be organized and well cleaned to prevent cross-contamination. A clean supply of wiping cloths must be available and disposable cloths must be thrown away after use (SFSP, 2010). The food handlers must wash, sanitize, and dry the working surface correctly because the surface of equipment or a utensil, normally contact with food. It should be washed with detergent in a hot dishwasher (very hot water acts as a sanitizer) more preferable (Taylor, 2010). Food production areas and equipment must be kept clean and well maintained. Flies, polluted water,

pets, and animals, unclean pots and utensils (Dugassa, 2007) may contaminate food. Cross-contamination is also a very important concept in food safety. Failure in protecting food from contamination may occur when preparing cooked and raw foods on the same surface or equipment, food stored in polluted areas, and insufficient heat treatment before consumption (Dugassa, 2007). Cleaning materials must be stored safely far from food (SFSP, 2010). A suitable procedure must be made for the storage and removal of waste. Waste must not be allowed to accumulate in food storage, food handling, and other working areas and the neighboring environment (FAO/WHO, 2009). Food production areas must be kept clear and clean and waste must be removed regularly. Waste bins and areas must be well maintained and clean. In a study on Americans having meals at Mexican and Asian restaurants, it was also found the cleanliness of the kitchen to be the most important feature signaling food safety, and another study in Canada found the most important indicators for food safety in the restaurant were reported to be the cleanliness of the kitchen, dining area, utensils, and restrooms (Nguyen et al., 2016). Abdi et al. (2020) evaluated the commitment of food handlers in practicing food hygiene in Bole sub-city, Addis Ababa, Ethiopia was shown in Table 3.

Table 3. Food handlers observed practice on food hygiene in Bole Sub-City (n=394) (Abdi et al., 2020).

Food Establishments' and Participants' Observed Practices with Regard to Food Hygiene Issue		
	No	%
Hand washing safe practices	90	22.84
Personal hygiene safe practices	85	21.57
Cross-contamination safe practices	114	28.93
Cooked and Keep food at safe temperature	101	25.63
Good health practices	290	73.60
Keep clean and sanitized safe practices	120	30.45
Use safe water and raw materials	97	24.62
Presence of water storage equipment for water shortage	86	21.83
Presence of hand washing facilities	118	29.95

2.12 Food storage

❖ Storing and preparing

Food poisoning is repeatedly caused by bacteria from foods that have been incorrectly prepared and stored, so must:

- The freezer temperature should be below -18 °C e.g. for high-risk foods products to prevent bacterial food-borne diseases.
- Keeping high-risk foods products at refrigerator temperature and should be at 5 °C or below.
- Avoid refreezing thawed food
- Avoid storing raw food with cooked food and should be separate.

- Storage container must be strong and non-toxic food
- In dry storage, the temperature should be not exceeding 25 C; food must be stored in safe, undamaged containers and kept off the floor.
- Food must be re-labeled with important food safety information as expiry date if it is removed from its original packaging to another container
- Food items in the kitchen should be handled and stored correctly to minimize the risk of contamination and decrease the growth of the microorganisms already existing
- A refrigerator must be operated correctly to maintain a temperature of below 5° C to prevent the growth of pathogens. Cross-contamination of pathogens from raw products as meat, poultry, and fish to prepared foods in the refrigerator. Therefore, must be strictly separated and preferably by the use of different refrigerators.
- Storing raw poultry, meat, or fish on the top shelf in the refrigerator increases the possibility dripping of raw juices onto other foods stored under and the risk of cross-contamination
- Frozen poultry and meat should be thawed by placing in a closed package in cold water, putting in a refrigerator or microwave oven. Thawed frozen food items in warm water or at room temperature is a dangerous practice as temperatures 5° C and 60° C can lead to the growth of food-borne pathogens (Linda and Irma, 2005).

Figure.7 from the study in Malaysia showed the knowledge level of respondents about controlling food temperature (Norhaslinda et al., 2016).

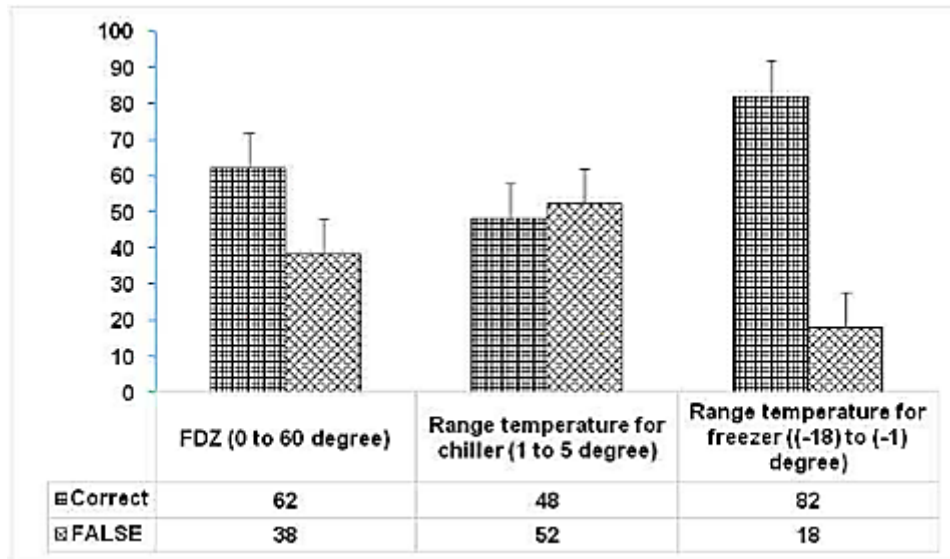


Figure 7. Knowledge level of respondents about controlled food temperature (N=50).

2.13 Food covering and separation

Different types of food must be preserved separately at all times: during storage, delivery, thawing, preparation, presentation, etc. For example, ‘high risk’ food and raw food should ideally be preserved in separate cold storage equipment (SFSP, 2010).

In the case where these foods must be stored in the same equipment (e.g. a general purpose’ fridge, the poultry, and raw meat should be preserved separately on the lower shelf. All foods should also be safely covered during storage. To prevent cross-contamination, all food must be safely covered. There is a study in Great Britain about the risk of contamination showed that handling of high-risk foods was the most common fault; this was observed in 46 buildings. The risk was more increased where staff

frequently transferred between cooked and raw food areas and in buildings where these areas were not separated (Tebbutt G. M., 1991).

2.14 Pest control

Rodents, birds, insects, and any other animals are capable of directly or indirectly contaminate food (Codex, 1997). Pests make a big threat to the suitability and safety of food. Pest invasion can occur where there are breeding sites and a supply of food. Good hygiene practices should be used to avoid creating an environment helpful to pests. Inspection of incoming materials, good sanitation, and good monitoring can minimize the probability of invasion and that way limit the need for pesticides (FAO/WHO, 2009).

Buildings should be preserved in good condition and maintenance continuously to remove possibility-breeding sites and to prevent pest access. Drains, holes, and other places where pests are probable to gain access should be kept locked. Wire mesh screens, for example on open doors windows, and ventilators will reduce the problem of pest entry. Animals should, wherever possible, be taking away from the grounds of factories and food processing plants. The availability of water and food encourages pest harborage and invasion (FAO/WHO, 2009).

Potential food sources should be stored in pest-proof containers, away from walls and above the ground. Areas both inside and outside food buildings should be kept clean. Waste should be stored in covered and pest-proof

containers. Establishments and surrounding areas should be orderly tested for evidence of infestation.

Finally, pest control by physical, chemical, or biological agent treatment should be done immediately and without adversely affecting the safety or suitability of food (FAO/WHO, 2009).

There are limited data available about the awareness of food handlers in food safety in Palestine and the factors that affect the awareness. Therefore, this study aims to assess the Palestinian food handler's awareness toward food safety, Food handling practices, and their relationship with some demographic characteristics.

Chapter Three

Materials and Methods

To evaluate the factors that affect awareness of food handlers in food safety in the restaurants' sector in Northern Palestine, 140 Palestinian workers in restaurants have been randomly selected from three governorates (Nablus, Qalqilia, and Tulkarem). Food handlers were different in their education level, marital status, position, age, restaurant type, and experience related to food safety. Different parameters have been employed to measure food handler's awareness about food safety including experience related to food safety, food hygiene awareness, cross-contamination prevention, food preparation practice, food handling practices, food handler's knowledge of safe food handling practices, cleanliness of the restaurant, and pest control.

These parameters were evaluated by filling specific questionnaires through face-to-face interviews with food handlers. The questionnaire was constructed based on previously published articles in peer journals relevant to the scope of the study. After drafting the questionnaire has been finished, validation was necessary, so interviews have been planned by telephone with managers for ten different normal and fast-food restaurants. Face to face, interviews with the cooker, assistance cooker, and waiters were organized; after interviews were finished, some of the adjustments on the questionnaire were needed to get access to the final copy.

After that, instructions of the survey were explained to food handlers by face-to-face interviews (duration 15-20 min) to collect all needed

information through the questionnaire. In addition to that, food handlers sometimes do not give exact information about food handling, and they have some concerns related to confidentiality. Managing the visits to the restaurant to organize a face-to-face interview with food handlers and managers of restaurants are considered the main limitations parts of the results of the questionnaire were not discussed due to low significance, but they were attached in the appendix.

3.1 Questionnaire development

Designing and developing the consumer food safety questionnaire was according to the World Health Organization, HACCP system and peer-reviewed published studies (Ghiselli, 2014; Ismail et al., 2016).

Here is the design of the questionnaire:

Type of restaurants

Normal restaurant		Fast food restaurant	
----------------------	--	-------------------------	--

1. Demographic characteristics of respondents

1.1. Gender:

Male		Female	
------	--	--------	--

1.2. Age group

19 and younger		20-39 years		40-59 years		60 or older	
----------------	--	----------------	--	----------------	--	----------------	--

1.3. Marital Status

Never married	
Married	
Separated/divorced	
Widowed	

1.4. Formal Education

Primary school	
Secondary school	
Undergraduate	
Graduate	

1.5. Gross Income (NIS)

<2000		2000-4000		4000-7000		>7000	
-------	--	-----------	--	-----------	--	-------	--

1.6. Position

Cooker		Assistance cooker		Waiter	
--------	--	-------------------	--	--------	--

2. Experience related to food safety:

2.1. Number of years in work

Less than 1		1-5		5-10		>10	
-------------	--	-----	--	------	--	-----	--

2.2. Training

	yes	No
Kitchen managers receive food safety training		
Food workers receive food safety training		
The restaurant has at least one certified kitchen manager		
Have you received courses in		

food safety?		
How many courses?		
Course titles		

3. Food hygiene awareness

3.1. Personal hygiene:

	Always	sometime	rarely	Never	I don't know
Did you wash your hand after a meal?					
Did you wash hand after holding money					
Did you wash your hand after cleaning the table?					
Did you wash your hand after handling the garbage?					
Did you wash your hand after preparing a meal?					
Did you wash your hand after smoking?					
Did you wear gloves before touching the ready-to-eat food product?					
Did you make sure nails are cut short?					
Did you wear a hairnet when working in foodservice?					
Did you wear a clean uniform during the preparation of food?					
Did you use a clean					

towel to wipe your hand?					
Did you make sure you did not cough during the preparation of food?					
Did you make sure you are not sick during food handling?					
Did you wash your hand after touching other food?					

3.2. Food hygiene practice:

	always	sometimes	rarely	never	I don't know
Cook and sell food at the same time					
Cook food 2 hours before your business activity?					
Serve food in a tray with cover					
Serve food in a clean tray					
Keep the food in the fridge for two hours before preparing and sell?					
Practices safety methods to store food before preparing and sell?					
Use a plate that is covered with plastic					

to serve the food?					
Serve food with gloves?					
Serve food with fork, spoon, and food tongs					

4. Cross-contamination prevention

	always	sometime	rarely	Never	I don't know
Clean and sanitize work surface, utensils, equipment before work And after finishing work?					
Keep raw meat, poultry separate					
Do you use disposable gloves used during the preparation of raw meat, poultry					
Do you designate a certain cutting board for raw meat only?					
Use stainless steel equipment?					
Wash hand after preparing raw meat/poultry?					

5. Food preparation practice

	Always	Sometimes	Rarely	Never	I do not know
Do you examine food packages to see if they have been opened or damaged					
When purchasing frozen foods, check to be sure they are frozen solid					
After preparing foods, clean the food preparation area with soap and water					
Leave cooked meat on the counter at room temperature for over 2- 4 h					
Use the same plate for raw and cooked meat, do not wash plate before using it for cooked meat					
Taste leftovers to check if they are still safe					
Use raw eggs in salads, desserts, and drinks					

A thermometer is used to check food temperature.					
Checking temperatures of the frozen /refrigerated foods and if having problems, rejecting them.					
Thawing foods, as much as a need					
Cooking it immediately, if not, store it in the refrigerator after thawing					
Washing and sanitizing fresh vegetables and fruits before use					
Labeling foods with use-by date in storing the RTE foods and processed foods.					

6. Food handling practices

When I need to defrost frozen foods, I take it out of the freezer and put it		In the refrigerator
		In the microwave
		On the countertop
		I put it on fire directly
		In a bag in warm water

		Never use frozen food
If luncheon meat, pasta, or sauce item is past package date, I		Do not use after the date
		Ignore date, use if smells OK
		Use if 1-2 weeks past date
		Use if 2-3 days past date
		Use if 4-7 days past date
		Do not buy this type of food Sources
What is the best way to handle leftover chili, soup, or stew?		Let cool on the countertop to room temperature
		Put in the refrigerator within 2 h of cooking it
		Put in the refrigerator within 4 h of cooking it
		I don't know
What do you believe about the danger zone is?		temperature range where the food becomes unsafe
		temperature range where the food becomes unsuitable for consumption
		temperature range where the food becomes sufficiently cooked
What do you believe that the temperature danger zone is?		0-4 C
		5-60 C
		Below -18
What do you believe that covering food will help?		protect food from spoilage
		to protect food from contamination
		keep the freshness of food
		all of the above
When the frying oil is changed		Daily
		2-4 days
		Weekly

7. Food handler's knowledge of safe food handling practices

	Strongly Agree	Agree	Disagree	Disagree Strongly	Don't know
For greater safety, ground beef patties should be cooked until they are no longer pink					

Freezing food kills all bacteria that may cause illness					
Cooked food should be cooled to room temperature before refrigeration or freezing					
Leftover foods can be safely kept at room temperature for several hours					
Irradiation of meat or poultry will destroy bacteria that cause food-borne illness					
Irradiated food is considered safe by major health and safety organizations					
If a leftover food looks and/or smells good, it is still safe to eat					

	yes	NO
Do you believe that slow cooling will expose to certain hazards		
Do you believe temperature control means maintaining food at a temperature of improving the protection from foodborne diseases?		
Did you hear about the temperature danger zone in food storage?		

Cleanliness of the restaurant

	yes	NO
All staff dressed in clean clothes, including bibs		
The floors, walls, and ceilings are clean		
Are there cracks in the ground, walls, or ceilings?		
There is no food on the floor		
Cooking surfaces (stove, grills, microwave ovens) are clean		
There is a bathroom		
Availability of drying papers or air		
Availability of soap in the bathroom		
Toxic chemicals are labeled, stored, and used correctly to prevent food contamination		

Pest Control

	yes	NO
Is there debris or garbage accumulation outside of the building?		
Are outside garbage containers clean and properly covered?		
Is there an accumulation of spilled food, liquid, or dust?		
Do all food containers have lids?		
Are all food products stored off the floor?		
Are all interior garbage is being emptied and removed from the facility daily?		
Are dirty dishes being cleaned before the facility being closed at night?		
Are all hard to reach areas of the facility (under grill lines, prep tables, and shelving units) being cleaned		
Is there any evidence of mouse droppings or mouse urine staining?		
Are chew marks visible on any boxes or materials in the facility		
Is there evidence of nesting (piles of dust, debris, insulation, etc. in quiet areas)		
External doors are equipped Self-locking device		
There is a regular pest control schedule by a licensed pest control operator		

استبيان حول التوعية بسلامة الأغذية للمتعاملين مع الأغذية

نوع المطعم

مطعم عادي		وجبات سريعة	
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1-1 الجنس

ذكر	انثى
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1-2 الفئة العمرية

19 وأصغر	39-20 سنة	59-40 سنة	60 أو أكبر	
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1-3 الحالة الاجتماعية

أعزب	
متزوج	
مطلق	
أرمل	

1-4 مستوى التعليم

ابتدائي	
ثانوي	
جامعي	

1-5 الدخل

أقل من 2000	2000--4000	4000--7000	أكثر من 7000
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1-6 موقع العمل

طباخ	مساعد طباخ	نادل
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2. الخبرة في التعامل مع الاغذية:

1-2 عدد سنوات العمل

أقل من سنة	1-5	5-10	أكثر من 10
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2-2 التدريب

لا	نعم	
		مدراء المطبخ يتلقون تدريبات على سلامة الغذاء
		عمال الغذاء يتلقون التدريب على سلامة الأغذية
		يوجد في المطعم مدير مطبخ معتمد واحد على الأقل
		هل تلقيت دوره في سلامة التغذية
		عدد الدورات
		عناوين الدورات

3. الوعي بنظافة الأغذية

3-1 النظافة الشخصية:

لا اعرف	ابدا	نادرا	احيانا	دائما	
					هل تغسل يديك بعد الوجبة؟
					هل تغسل يدك بعد حمل المال؟
					هل تغسل يديك بعد تنظيف الطاولة؟
					هل تغسل يديك بعد التعامل مع القمامة؟
					هل تغسل يديك بعد تحضير الوجبة؟
					هل تغسل يديك بعد التدخين؟
					هل ترتدي قفازات قبل لمس الطعام الجاهز للأكل؟
					هل تتأكد من تقليل اظافرك بشكل مستمر؟
					هل ترتدي غطاء للرأس عند العمل في خدمة الطعام؟
					هل ترتدي ملابس نظيفة أثناء تحضير الطعام؟
					هل تستخدم منشفة نظيفة لمسح يدك؟
					هل تتأكد أنك لا تسعل أثناء تحضير الطعام؟
					هل تتأكد أنك لست مريضاً أثناء تحضير الطعام؟
					هل تغسل يديك بعد لمس الأطعمة المختلفة؟

3-2 نظافة الاغذية والممارسات المتعلقة بذلك:

لا اعرف	ابدا	نادرا	احيانا	دائما	
					طهي الطعام وبيعه في نفس الوقت
					طهي الطعام قبل ساعتين من نشاط عملك؟
					تقديم الطعام في علبة/صينييه مع غطاء
					تقديم الطعام في علبة/صينييه نظيفة
					الحفاظ على الطعام في الثلاجة لمدة ساعتين قبل التحضير والبيع؟

				مراعاة قواعد السلامة لتخزين المواد الغذائية قبل تحضير وبيع؟
				استخدام طبق مغطى بالبلاستيك لتقديم الطعام؟
				تقديم الطعام مع قفازات؟
				تقديم الطعام بالشوكة والملقعة وملقط الطعام

4. منع تلوث الطعام

لا اعرف	ابدا	نادرا	احيانا	دائما	
					تنظيف وتعقيم سطح العمل والأواني والمعدات قبل العمل وبعد الانتهاء من العمل؟
					الحفاظ على اللحوم النيئة والدواجن منفصلة
					هل تستخدم القفازات التي تستخدم مرة واحدة أثناء تحضير اللحوم النيئة والدواجن
					هل قمت بتعيين لوح تقطيع خاص للحوم النيئة فقط؟
					استخدام معدات الفولاذ (ستانلس ستيل) المقاوم للصدأ؟
					غسل اليدين بعد تحضير الدواجن او اللحوم؟

5. الممارسات خلال تحضير الطعام

لا اعرف	ابدا	نادرا	احيانا	دائما	
					هل تفحص عبوات الطعام لمعرفة ما إذا كانت قد فتحت أم تالفة؟
					عند شراء الأطعمة المجمدة هل تتحقق من أنها مجمدة صلبة؟
					بعد إعداد الأطعمة هل تقوم بتنظيف منطقة إعداد الطعام بالصابون والماء؟
					هل تترك اللحم المطبوخ على المنضدة في درجة حرارة الغرفة لأكثر من 2-4 ساعات؟
					هل تستخدم نفس الطبق للحوم النيئة والمطبوخة ولا تغسل الوعاء قبل استخدامه للحوم المطبوخة؟
					هل تتذوق بقايا الطعام للتحقق مما إذا كانت لا تزال آمنة؟
					هل تستخدم البيض النيئ في السلطة والحلويات والمشروبات؟
					هل تستخدم ميزان الحرارة للتحقق من درجة حرارة الطعام؟
					هل تتحقق من درجة حرارة الأطعمة المجمدة / المبردة، وإذا كان هناك أي خلل يتم التخلص منها؟
					هل يتم تذويب الأطعمة بقدر الحاجة؟
					وهل يتم طبخه على الفور وإن لم يكن يتم تخزينه في الثلاجة بعد ذوبان الجليد؟

					هل تقوم بغسل وتطهير الخضروات والفواكه الطازجة قبل الاستخدام؟
					وصف الأطعمة مع تاريخ الاستخدام في تخزين الأطعمة الجاهزة والأطعمة المصنعة؟

6. ممارسات تداول الأغذية

عندما أحتاج إلى تذويب الأطعمة المجمدة، أخرجها من الثلاجة و	وضعها في الثلاجة
	في الميكروويف
	في كيس في الماء الدافئ
	وضعها خارج الثلاجة
	وضعه على النار مباشرة
	لا تستخدم الطعام المجمد
	لا أستخدم بعد التاريخ
إذا اللحم أو المعكرونة أو الصلصة منتهي الصلاحية؟	اتجاهل التاريخ، استخدم إذا كانت رائحة الطعام جيدة
	استخدمه إذا 1-2 أسابيع التاريخ الماضي
	استخدمه إذا 2-3 أيام الماضي التاريخ
	استخدمه إذا 4-7 أيام الماضي التاريخ
	لا تشتري هذا النوع من الطعام من هذا المصدر
ما هي أفضل طريقة للتعامل مع بقايا الطعام أو الحساء الساخن؟	تترك لتبرد على درجة حرارة الغرفة
	وضعه في الثلاجة في غضون ساعتين من طبخها
	وضعه في الثلاجة في غضون 4 ساعات من طبخها
	لا اعرف
ماذا تعتقد حول منطقة الخطر هي	نطاق درجة الحرارة حيث يصبح الطعام غير آمن
	نطاق درجة الحرارة حيث يصبح الطعام غير مناسب للاستهلاك
	نطاق درجة الحرارة حيث يصبح الطعام مطبوخًا بما فيه الكفاية
ما رأيك أن منطقة خطر درجة الحرارة هي	4-0 درجة مئوية
	5-60 درجة مئوية
	أقل -18
ماذا تعتقد أن تغطية الطعام سيساعد	حماية الطعام من التلف
	لحماية الغذاء من التلوث
	الحفاظ على نضارة الطعام
	كل ما سبق
يتم تغيير زيت القلي	يوميًا
	2-4 أيام
	اسبوعيا

7. معرفة مناوولي الأغذية بممارسات تداول المواد الغذائية الآمنة

لا اعرف	ابدا	نادرا	احيانا	دائما	
					لمزيد من الأمان، يجب طهي فطائر اللحم المفروم حتى لم تعد وردية اللون
					تجميد الطعام يقتل جميع البكتيريا التي قد تسبب المرض
					يجب تبريد الطعام المطبوخ إلى درجة حرارة الغرفة قبل التبريد أو التجميد
					يمكن أن تبقى بقايا الأطعمة بأمان في درجة حرارة الغرفة عدة ساعات
					تعريض اللحوم أو الدواجن للإشعاع يؤدي إلى تدمير البكتيريا التي تسبب الأمراض التي تنقلها الأغذية
					تعتبر الأغذية المعرضة للإشعاع آمنة من قبل كبرى منظمات الصحة والسلامة
					إذا بدا بقايا الطعام و / أو رائحته جيدة، فلا يزال من الآمن تناولها

لا	نعم	
		هل تعتقد أن التبريد البطيء سوف يعرضك لأخطار معينة
		هل تعتقد أن التحكم في درجة الحرارة يعني الحفاظ على الطعام عند درجة حرارة تحسن الحماية من الأمراض التي تنقلها الأغذية؟
		هل سمعت عن منطقة الخطر درجة الحرارة في تخزين المواد الغذائية؟
		المواد الأولية (خضار او فاكهة توضع في مكان مخصص)

8. مرفق لنظافة المكان

لا	نعم	
		جميع الموظفين يرتدون ملابس نظيفة، بما في ذلك المرايل
		الأرضيات والجدران والسقوف نظيفة
		هل يوجد شقوق في الأرض أو الجدران أو السقوف
		لا يوجد طعام على الأرض
		أسطح الطهي (الموقد، الشوايات، أفران الميكروويف) نظيفة
		يوجد حمام
		توافر اوراق التنشيف او الهواء
		توافر الصابون في الحمام
		يتم وضع العلامات على المواد الكيميائية السامة وتخزينها واستخدامها بشكل صحيح لمنع تلوث المواد الغذائية

9. مكافحة الآفات:

لا	نعم	
		هل هناك حطام أو تراكم للقمامة خارج المبنى؟
		هل حاويات القمامة الخارجية نظيفة ومغطاة بشكل صحيح؟
		هل هناك تراكم للطعام المنسكب أو السائل أو الغبار؟
		هل تحتوي جميع حاويات الطعام على أغطية؟
		هل يتم تخزين جميع المنتجات الغذائية على الأرض؟
		هل يتم إفراغ جميع النفايات الداخلية وإزالتها من المطعم يوميًا؟
		هل يتم تنظيف الأطباق المتسخة قبل إغلاق المطعم في الليل؟
		هل يصعب الوصول إلى جميع مناطق المطعم (تحت خطوط شواء، الطاولات، رفوف) لتنظيفها؟
		هل هناك أي دليل على وجود فئران (بول، براز)؟
		هل هناك علامات للقضم على صناديق أو مواد في المطعم؟
		هل هناك دليل على التعشيش (أكوام من الغبار والحطام والعزل وما إلى ذلك في المناطق الهادئة)؟
		• الأبواب الخارجية مجهزة جهاز إغلاق ذاتي.
		• هناك جدول منتظم لمكافحة الآفات من قبل مشغل مرخص لمكافحة الآفات

3.2 Statistical analysis:

Data from the questionnaire were firstly analyzed by descriptive statistics (mean, SEM, minimum and maximum values). The effect of demographic (age, sex, place of living, educational level, etc.) factors on food handlers' awareness toward food safety were evaluated by using the ANOVA option of procedure of SPSS software. The separations of means were using Turkey's honestly significant difference multiple range test with $P \leq 0.05$ considered as significant. Alpha-Cronbach equation was used to measure questionnaire stability and internal consistency paragraphs. A Kolmogorov-Smirnov Z test was performed to examine the normal distribution of the indicators used in the analysis.

Chapter Four

Results and Discussion:

The distribution of participants between three governorates is shown in Table. 4. It was found that 42.8%, 28.6%, and 28.6% of participants were from Qalqilia, Tulkarem, and Nablus governorates, respectively.

Table 4. Percentage of participants from each governorate (Nablus, Tulkarem and Qalqilya).

Governorates	Count (persons)	Percentage%
Nablus	60	42.8%
Tulkarem	40	28.6%
Qalqilia	40	28.6%
Total	140	100

The differences in personal hygiene behaviors of food handlers according to geographical places (governorates: Nablus, Tulkarem, and Qalqilia) are shown in Table 5. In general, our findings showed that there was no significant effect for living place on the personal hygiene behaviors of food handlers, except for some behaviors. The results showed that the food handlers in Nablus governorate exhibited a higher score in wearing gloves before touching the ready to eat food product (4.55 vs. 4.12, $p<0.05$), wearing hair net when working in foodservice (3.38 vs. 2.77, $p<0.05$) than Qalqilia governorate while food handlers in Tulkarem governorate showed intermediate values if compared to other groups.

However, food handlers in the Qalqilia governorate showed higher frequency in using clean towels to wipe hands (4.90 vs. 4.67, $p<0.05$) than Tulkarem while food handlers in the Nablus governorate showed

intermediate values. Moreover, checking the frequency of the health status of food handlers (not sick) during food handling in Qalqilia governorates showed higher than Nablus (4.07vs. 3.60, $p<0.05$). While food handlers in the Tulkarem governorate showed intermediate values in comparison to other groups. Overall results showed that hand washing after smoking was the least applied hygiene practice used during food preparation between food handlers in the three governorates (Table 5). The personal hygiene practices of food handlers were affected by geographical factors. In 2014, a study was carried out to investigate 91 restaurants in three European cities - Belgrade, Thessaloniki, and Porto. The obtained results indicated a greater level of personal hygiene in restaurants in Thessaloniki and Porto than in Belgrade. This may be attributed to differences in hygiene awareness in these areas (Djekic et al., 2014). In another study, almost 5% of the workers reported working while sick with vomiting or diarrhea . (George et al., 2011). Although the place of work, did not influence the responses for food handling when coughing, washing hand after touching other food and handwashing after touch money, food handlers would not handle food when coughing and Food handling and preparation for sale must not be done by persons, if they have suffered from diarrhea in the last two or three days

- N= Nablus, Q= Qalqilia, T= Tulkarem.

Table 5. The effect of geographical places (governorates: Nablus, Tulkarem, Qalqilia) on the personal hygiene behaviors of food handlers.

personal hygiene^{1*}	Nablus(Mean \pm SD²)	Tulkarem(Mean \pm SD²)	Qalqiliya(Mean \pm SD²)	P value
Hand washing after meal	4.75 \pm 0.62	4.62 \pm 0.80	4.75 \pm 0.63	0.62
Handwashing after touch money	3.70 \pm 1.319	3.20 \pm 1.36	3.45 \pm 1.35	0.18
Hand washing after the clean table	4.70 \pm 0.72	4.60 \pm 0.90	4.75 \pm 0.70	0.67
Handwashing after handling garbage	4.85 \pm 0.65	4.75 \pm 0.80	4.77 \pm 0.80	0.78
Hand washing after preparing the meal	4.46 \pm 1.04	4.55 \pm 0.95	4.42 \pm 0.93	0.84
Hand washing after smoking	2.86 \pm 1.74	2.92 \pm 1.85	2.57 \pm 1.56	0.61
wear gloves before touching the ready to eat food product	4.55 \pm 0.89 ^a	4.22 \pm 1.12 ^{ab}	4.12 \pm 1.22 ^b	< 0.05
Nails are cut short	4.93 \pm 0.31	4.82 \pm 0.67	4.95 \pm 0.22	0.35
wearing hair net when work in food service	3.38 \pm 1.39 ^a	3.20 \pm 1.26 ^{ab}	2.77 \pm 1.14 ^b	< 0.05
wearing clean uniform during preparation of food	4.83 \pm 0.49	4.80 \pm 0.68	4.97 \pm 0.15	0.23
using clean towel to wipe your hand	4.85 \pm 0.48 ^{ab}	4.67 \pm 0.47 ^b	4.90 \pm 0.30 ^a	< 0.05
Food handler not cough during the preparation of food	4.98 \pm 0.12	4.87 \pm 0.51	4.92 \pm 0.26	0.25
Food handler not sick during food handling	3.60 \pm 1.35 ^b	3.65 \pm 1.29 ^{ab}	4.07 \pm 1.14 ^a	< 0.05
Food handler Washing hand after touching other food	3.96 \pm 1.28	4.25 \pm 1.14	4.17 \pm 1.33	0.50

¹The food handlers' personal hygiene was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I do not know (1). In addition, results have been collected from section (3) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

• N= Nablus, Q= Qalqilia, T= Tulkarem.

The differences in food hygiene practices of food handlers according to geographical places (governorates: Nablus, Tulkarem, and Qalqilia) are shown in Table 6. It was found that there was a significant effect for living place on the food hygiene practice of food handlers, except in, cook and sell food at the same time, practices safety method to store food before preparing, serve food with gloves, serve food with fork, spoon and food tongs. The results showed that the food handlers in Nablus and Tulkarem governorates exhibited higher frequency score in cook food two hours before business activity (4.53 and 4.82 vs. 3.85, $p < 0.05$), Keep the food in the fridge for two hours before preparing (4.75 and 4.80 vs. 4.22, $p < 0.05$) than the food handlers in Qalqilia governorate. While the score of serve food in a tray with cover in Qalqilia and Tulkarem governorates was significantly higher (3.77 and 3.90 vs. 2.86, $p < 0.05$) than Nablus. The frequency score in serve food in a clean tray was higher in Qalqilia governorate than Nablus (4.79 vs. 4.52, $p < 0.05$) while food handlers in Tulkarem governorate showed intermediate values in comparison to other groups. However, food handlers in the Tulkarem governorate showed higher use plate which is covered with plastic (3.27 vs. 2.55, $p < 0.05$) than

Nablus while food handlers in Qalqilia governorate showed intermediate values if compared to other groups.

Table.6 The effect of geographical places (governorates: Nablus, Tulkarem, Qalqilia) on food hygiene practice of food handlers.

Hygiene practice ^{1*}	N(Mean \pm SD ²)	Q(Mean \pm SD ²)	T(Mean \pm SD ²)	P
Cook and sell food at the same time	4.25 \pm 0.81	4.17 \pm 0.90	4.32 \pm 0.61	0.69
Cook food 2 hours before your business activity)	4.53 \pm 0.96 ^a	3.85 \pm 1.29 ^b	4.82 \pm 0.54 ^a	<0.05
Serve food in a tray with cover	2.86 \pm 1.24 ^b	3.77 \pm 1.31 ^a	3.90 \pm 1.31 ^a	<0.05
Serve food in a clean tray	4.52 \pm 0.50 ^b	4.79 \pm 0.40 ^a	4.72 \pm 0.45 ^{ab}	<0.05
Keep the food in fridge for two hours before preparing	4.75 \pm 0.72 ^a	4.22 \pm 1.20 ^b	4.80 \pm 0.68 ^a	<0.05
Practices safety methods to store food before preparing	4.73 \pm 0.63	4.47 \pm 1.10	4.62 \pm 0.83	0.33
Use plate which is covered with plastic	2.55 \pm 1.09 ^b	3.12 \pm 1.41 ^{ab}	3.27 \pm 1.50 ^a	<0.05
Serve food with gloves	3.56 \pm 1.33	3.20 \pm 1.24	3.02 \pm 1.31	0.33
Serve food with fork ,spoon and food tongs	4.70 \pm 0.72	4.57 \pm 0.87	4.72 \pm 0.71	0.63

¹The food handlers' hygiene practice was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (3.2) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

• N= Nablus, Q= Qalqilia, T= Tulkarem.

The differences in cross-contamination prevention according to geographical places (governorates: Nablus, Tulkarem, and Qalqilia) are

shown in Table 7. Living place of food handlers did not affect cross-contamination prevention practices.

Table. 7 The effect of geographical places (governorates: Nablus, Tulkarem, Qalqilia) on cross-contamination prevention

Cross contamination prevention¹	N(Mean \pm SD²)	Q(Mean \pm SD²)	T(Mean \pm SD²)	P
Clean and sanitize work surface, equipment before And after work	4.63 \pm 0.66	4.60 \pm 0.63	4.37 \pm 0.74	0.15
Keep raw meat, poultry separate	4.68 \pm 0.79	4.32 \pm 1.32	4.47 \pm 1.15	0.25
Using gloves during the preparation of raw meat, poultry	4.50 \pm 0.98	4.42 \pm 1.17	4.25 \pm 1.31	0.55
designate certain cutting board for raw meat only	4.65 \pm 1.02	4.15 \pm 1.51	4.52 \pm 1.28	0.14
Use stainless steel equipment	4.65 \pm 0.65	4.82 \pm 0.38	4.55 \pm 0.81	0.16
Wash hand after preparing raw meat/poultry	4.83 \pm 0.61	4.57 \pm 1.21	4.72 \pm 0.90	0.37

¹The Cross contamination prevention was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (4) of the research questionnaire.

²SD is the standard deviation.

^{A-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

• N= Nablus, Q= Qalqilia, T= Tulkarem.

The differences in food preparation practice of food handlers according to geographical places (governorates: Nablus, Tulkarem, and Qalqilia) are shown in Table 8. Our study revealed that there was a significant effect of

living place on food preparation practice and another was no significant. The results showed that the food handlers in Nablus and Tulkarm governorates exhibited higher scores in checking temperatures of the frozen (4.86 and 4.87 vs. 4.62, $p<0.05$), thawing foods as much as a need (4.03 and 4.20 vs. 3.40, $p<0.05$), labeling foods with use-by date in storing (3.11 and 3.32 vs. 2.45, $p<0.05$), then the food handlers in Qalqilia governorate. Food preparation practice of food handlers in Nablus and Qalqilia governorates exhibited higher scores in cook immediately after thawing (4.05 and 3.15 vs. 1.83, $p<0.05$), washing and sanitizing fresh vegetables (4.76 and 4.95 vs. 4.30, $p<0.05$) than the food handlers in Tulkarem governorate. While the score of serve food in use same plate for raw and cooked meat in Qalqilia governorate exhibited higher (2.20 vs. 2.01 and 2.02, $p<0.05$) than Nablus and Tulkarem.

Table. 8 The effect of geographical places (governorates: Nablus, Tulkarem, Qalqilia) on Food preparation practice

Food preparation practice¹	N (Mean \pm SD²)	Q (Mean \pm SD²)	T (Mean \pm SD²)	P
Examine food packages	4.81 \pm 0.39	4.62 \pm 0.95	4.60 \pm 0.84	0.25
Check frozen food to be sure they are solid	3.90 \pm 1.59	3.80 \pm 1.53	3.42 \pm 1.88	0.36
Clean food preparation area with soap and water	4.28 \pm 1.05	4.27 \pm 0.98	4.32 \pm 0.94	0.97
Leave cooked meat on the counter at room temperature for over 2- 4 h	2.53 \pm 1.08	2.57 \pm 1.10	2.95 \pm 1.33	0.18
Use the same plate for raw and cooked meat	2.01 \pm 0.12 ^b	2.20 \pm 0.72 ^a	2.02 \pm 0.15 ^b	<0.05
Taste leftovers to check if they are still safe	4.63 \pm 0.88	4.42 \pm 1.03	4.72 \pm 0.71	0.29

Use raw eggs in salads, desserts, and drinks	2.23±0.78	2.00±0.00	2.07±0.47	0.12
A thermometer is used to check food temperature	2.43±0.96	2.25±0.77	2.15±0.66	0.23
Checking temperatures of the frozen	4.86±0.38 ^a	4.62±0.83 ^b	4.87±0.51 ^a	<0.05
Thawing foods, as much as a need	4.03±1.66 ^a	3.40±1.82 ^b	4.20±1.52 ^a	<0.05
cook immediately after thawing	4.05±1.54 ^a	3.15±1.83 ^a	1.83±1.63 ^b	<0.05
Washing and sanitizing fresh vegetables.	4.76±0.62 ^a	4.95±0.22 ^a	4.30±0.51 ^b	<0.05
Labeling foods with use-by date in storing	3.11±1.43 ^a	2.45±1.10 ^b	3.32±1.49 ^a	<0.05

¹The Food preparation practice was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (5) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

• N= Nablus, Q= Qalqilia, T= Tulkarem.

The differences in the Food handler's knowledge of safe food handling practices of food handlers according to geographical places (governorates: Nablus, Tulkarem, and Qalqilia) are shown in Table 9. It was found that there was no significant effect for living place on the food handler's knowledge of safe food handling practices except the results showed that the food handlers in Tulkarm governorates exhibited higher score in ground beef patties should be cooked until they are no longer pink (4.75 vs. 3.90, $p < 0.05$), than the food handlers in Qalqilia governorate. While food

handlers in the Nablus governorate showed intermediate values in comparison to other groups.

Table. 9 The effect of geographical places (governorates: Nablus, Tulkarem, Qalqilia) on Food handler's knowledge of safe food handling practices

safe food handling practices ¹	N (Mean ± SD ²)	Q (Mean ± SD ²)	T (Mean ± SD ²)	P
ground beef patties should be cooked until they are no longer pink	4.21±1.26 ^{ab}	3.90±1.37 ^b	4.75±0.80 ^a	<0.05
Freezing food kills all bacteria	3.68±1.53	3.82±1.51	3.60±1.67	0.81
Cooked food should be cooled to room temperature before refrigeration	4.95±0.38	4.87±0.56	4.97±0.15	0.50
Foods can be safely at room temp. several hours	3.48±1.12	3.20±1.18	3.60±1.00	0.25
Irradiation of meat will destroy bacteria	2.15±1.11	1.85±0.80	2.20±1.38	0.31
Irradiated food is considered safe	2.40±1.18	2.10±0.81	2.47±1.19	0.26
If a leftover food looks and/or smells good, it is still safe to eat	3.66±1.08	4.05±0.87	3.92±0.99	0.15

¹The Food handler's knowledge of safe food handling practices was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (7) of the research questionnaire.

² SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

- N= Nablus, Q= Qalqilia, T= Tulkarem.

The distribution of participants according to restaurant type (fast versus standard) is shown in Table.10 According to our findings, 39.3% and 60.7% of participants were from standard and fast restaurants respectively.

Table 10. Distributing of participants according to restaurant type (fast versus standard).

Restaurant type	Count	Percentage
Standard restaurants	55	39.3%
Fast food restaurants	85	60.7%

The differences in food hygiene practices of food handlers according to restaurant type (Standard versus fast food) are shown in Table 11. In general, our findings showed that there was no significant effect of restaurant type on the food hygiene practice of food handlers. Exceptionally, the results showed that the food handlers in fast restaurants exhibited higher frequency score in serve food in a tray with cover (3.96 vs. 2.58, $p < 0.05$), serve food in a clean tray (4.67 vs. 4.43, $p < 0.05$), use plate which is covered with plastic (3.29 vs. 2.34, $p < 0.05$), than normal food restaurants.

Table.11 The effect of restaurants type (normal, fast food) on food hygiene practice of food handlers.

hygiene practice^{1*}	fast(Mean \pm SD²)	normal(Mean \pm SD²)	P
Cook and sell food at the same time	4.30 \pm 0.77	4.16 \pm 0.81	0.29
Cook food 2 hours before your	4.42 \pm 1.06	4.41 \pm 1.03	0.97

business activity			
Serve food in a tray with cover	3.96±1.27 ^a	2.58±1.03 ^b	<0.05
Serve food in a clean tray	4.67±0.56 ^a	4.43±0.71 ^b	<0.05
Keep the food in the fridge for two hours before preparing	4.60±0.92	4.63±0.89	0.81
Practices safety methods to store food before preparing	4.54±0.92	4.76±0.71	0.13
Use plate which is covered with plastic	3.29±1.46 ^a	2.34±0.88 ^b	<0.05
Serve food with gloves	3.36±1.35	3.21±1.25	0.52
Serve food with fork, spoon, and food tongs	4.57±0.87	4.81±0.51	0.06

¹The food handlers' hygiene practice was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (3.2) of the research questionnaire.

² SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in cross-contamination prevention according to restaurant type (normal, fast food) are shown in Table 12. There was no significant effect for restaurants type on cross-contamination prevention and another was significant. The results showed that the food handlers in normal restaurants exhibited higher score in keeping raw meat and poultry separate (4.74 vs. 4.37, $p < 0.05$), designate certain cutting boards for raw meat only (4.87 vs. 4.21, $p < 0.05$), wash hand after preparing raw meat/poultry (4.96 vs. 4.57, $p < 0.05$) if compared to a fast restaurant.

Table.12 The effect of restaurants type (normal and fast food) on cross contamination prevention.

Cross contamination prevention¹	Fast (Mean \pm SD²)	Normal (Mean \pm SD²)	P
Clean and sanitize work surface, equipment before And after work	4.49 \pm 0.68	4.63 \pm 0.67	0.22
Keep raw meat, poultry separate	4.37 \pm 1.20 ^b	4.74 \pm 0.79 ^a	<0.05
Using gloves during the preparation of raw meat, poultry	4.30 \pm 1.23	4.56 \pm 0.95	0.19
designate certain cutting board for raw meat only	4.21 \pm 1.47 ^b	4.87 \pm 0.66 ^a	<0.05
Use stainless steel equipment	4.64 \pm 0.66	4.70 \pm 0.62	0.58
Wash hand after preparing raw meat/poultry	4.57 \pm 1.12 ^b	4.96 \pm 0.18 ^a	<0.05

¹The Cross contamination prevention was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (4) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in food preparation practice according to restaurants type (standard versus fast food) are shown in Table 13. There were some significant differences between standard and fast-food restaurants in the practices of food preparation. The results showed that the food handlers in normal restaurants exhibited higher score in examine food packages (4.83vs. 4.61, $p < 0.05$). Check frozen food to be sure they are solid (4.27 vs. 3.38, $p < 0.05$), Thermometer is used to check food temperature (2.45 vs.

2.20, $p < 0.05$), than fast-food restaurants. There is greater danger of bacterial growth and food spoilage for food thawed at room temperature, hence the best way to safely thaw meat and poultry is in the refrigerator. The microwave can also be used to defrost meat more rapidly. Food may also be thawed in cold water in a sink or container and this must be clean (George et al., 2011).

Table. 13 The effect of restaurants type (normal and fast food) on food preparation practice.

Food preparation practice	Fast (Mean \pm SD²)	Normal (Mean \pm SD²)	P
Examine food packages	4.61 \pm 0.87 ^b	4.83 \pm 0.37 ^a	<0.05
Check frozen food to be sure they are solid	3.38 \pm 1.75 ^b	4.27 \pm 1.36 ^a	<0.05
Clean food preparation area with soap and water	4.25 \pm 1.07	4.34 \pm 0.88	0.61
Leave cooked meat on the counter at room temperature for over 2- 4 h	2.61 \pm 1.20	2.74 \pm 1.12	0.51
Use the same plate for raw and cooked meat	2.07 \pm 0.40	2.07 \pm 0.42	0.97
Taste leftovers to check if they are still safe	4.52 \pm 0.93	4.70 \pm 0.80	0.24
Use raw eggs in salads, desserts, and drinks	2.10 \pm 0.55	2.14 \pm 0.62	0.69
A thermometer is used to check food temperature	2.20 \pm 0.70 ^b	2.45 \pm 0.99 ^a	<0.05
Checking temperatures of the frozen	4.78 \pm 0.61	4.81 \pm 0.54	0.77
Thawing foods, as much as a need	3.81 \pm 1.76	4.03 \pm 1.57	0.44
Cook immediately after thawing	3.68 \pm 1.77	3.96 \pm 1.56	0.33
Washing and sanitizing fresh vegetables	4.67 \pm 0.49	4.70 \pm 0.65	0.69
Labeling foods with use-by date in storing	2.94 \pm 1.39	3.05 \pm 1.43	0.64

¹The food preparation practice was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (5) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in the food handler's knowledge of safe food handling practices according to restaurants type (normal and fast food) are shown in Table 14. In general, our findings showed that there was no significant effect for restaurants type on the food handler's knowledge of safe food handling practices. Exceptionally, the results showed that the food handlers in normal restaurants exhibited a higher score in considering irradiated food as safe (2.58 v 2.17, $p < 0.05$) than handlers in fast restaurants. In this context, the result of a study in Accra, Ghana on (33) hotels. revealed the majority of food handlers respondents agreed that, when food became mouldy or had a bad smell, then they will be certain, it contains bacteria causing foodborne disease. Foods contaminated with disease-causing organisms are considered by some microbiologists as spoilt. This type of spoilage is distinguished from organoleptic spoilage in which flavour, odour and changes in appearance are evident. In the majority of cases the food involved shows no sign of any symptoms that would enable a consumer to determine, whether the food is acceptable and would not normally be considered as spoilt (George et al., 2011).

Table. 14 The effect of restaurants type (normal, fast food) on Food handler's knowledge of safe food handling practices

safe food handling practices ¹	Fast (Mean \pm SD ²)	Normal (Mean \pm SD ²)	P
ground beef patties should be cooked until they are no longer pink	4.31 \pm 1.22	4.21 \pm 1.22	0.64
Freezing food kills all bacteria	3.84 \pm 1.53	3.47 \pm 1.58	0.16
Cooked food should be cooled to room temperature before refrigeration	4.94 \pm 0.38	4.92 \pm 0.42	0.84
Foods can be safely at room temp. several hours	3.40 \pm 1.13	3.49 \pm 1.08	0.63
Irradiation of meat will destroy bacteria	2.07 \pm 1.14	2.09 \pm 1.11	0.91
Irradiated food is considered safe	2.17 \pm 0.90 ^b	2.58 \pm 1.31 ^a	<0.05
If a leftover food looks and/or smells good, it is still safe to eat	3.88 \pm 0.98	3.80 \pm 1.06	0.63

¹The Food handler's knowledge of safe food handling practices was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (7) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in personal hygiene behaviors of food handlers according to restaurants type (standard versus fast food) are shown in Table 15. In general, our findings showed that there was no significant effect for restaurant type on personal hygiene behaviors of food handlers and others

were significant. The results showed that the food handlers working in standard restaurants exhibited higher score in hand washing after a meal (4.90 vs. 4.58, $p < 0.05$), hand washing after a clean table (4.89 vs. 4.55, $p < 0.05$), hand washing after preparing the meal (4.81 vs. 4.25, $p < 0.05$), and washing hand after touching other food (4.30 vs. 3.97, $p < 0.05$) than fast-food restaurants. In this context, a study evaluated food hygiene awareness and practices of food handlers in Kumasi Metropolis, Ghana. The result was indicated that food handlers in fast food restaurants are more committed than standard restaurants (Ababio et al., 2012). The study revealed that some of food handlers practices was not correctly like do not handwashing after touch money and smoking. That the same finding of study in Ethiopia (2015) that only 39.4% and 32.79% of the food handlers had proper practice of covering mouth with tidy cloth while coughing and cut their nail when it becomes tall respectively (Meleko et al., 2015).

Table.15 The effect of restaurants type (Standard versus fast food) on the personal hygiene behaviors of food handlers.

personal hygiene ^{1*}	Normal (Mean \pm SD ²)	Fast (Mean \pm SD ²)	P value
Hand washing after meal	4.90 \pm 0.34 ^a	4.58 \pm 0.80 ^b	< 0.05
Hand washing after touch money	3.67 \pm 1.36	3.36 \pm 1.33	0.188
Hand washing after the clean table	4.89 \pm 0.31 ^a	4.55 \pm 0.93 ^b	< 0.05
Handwashing after handling garbage	4.78 \pm 0.78	4.81 \pm 0.71	0.81
Hand washing after preparing a meal	4.81 \pm 0.61 ^a	4.25 \pm 1.11 ^b	< 0.05
Hand washing after smoking	2.94 \pm 1.79	2.70 \pm 1.67	0.42

wear gloves before touching the ready to eat food product	4.43±1.01	4.27±1.10	0.373
Nails are cut short	4.94±0.29	4.88±0.49	0.39
wearing hair net when work in food service	3.32±1.34	3.04±1.27	0.21
wearing clean uniform during preparation of food	4.92±0.26	4.82±0.60	0.23
using clean towel to wipe your hand	4.81±0.51	4.81±0.39	0.93
Food handler not cough during the preparation of food	4.96±0.18	4.91±0.38	0.41
Food handler not sick during food handling	3.92±1.27	3.63±1.29	0.19
Washing hand after touching other food	4.30±1.12 ^a	3.97±1.33 ^b	< 0.05

¹The food handlers' personal hygiene was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I do not know (1). In addition, results have been collected from section (3) of the research questionnaire.

² SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The distribution of participants according to age group (20-39 years and 40-59 years) is shown in Table.16 The major participants belonged to the 20-39 years age group. In this context, 71.8% and 28.2% of participants belonged to 20-39 years and 40-59 years age groups, respectively.

Table 16. The distribution of participants according to age group (20-39 years and 40-59 years).

Age group	Count	Percentage
20-39 years	94	71.8%
40-59 years	37	28.2%

The differences in personal hygiene behaviors of food handlers according to age groups (20-39 and 40-59 years) are shown in Table 17. In general, our findings showed that there was no significant effect for age groups on the personal hygiene behaviors of food handlers. In this context, the result of a study in Oregon on 1265 restaurants revealed that food handlers having age >40 years were more restricted to personal hygiene practices than food handlers having age 20-39 years were (71% vs. 67%, $p < 0.05$) (DeBess et al., 2009). Poor and faulty food handling practices have been identified as the leading cause of the majority of foodborne diseases. This study identified some poor hygiene practices exhibited at work. These include: Lack of provision of medication by establishment, non isolation from work environment when sick, lack of wearing hair net when work in food service, lack of hand washing after smoking, irregular food hygiene training, non use of thermometer to check food temperature. This finding of our study is a strong indication of the poor health status and poor hygiene practices of food handlers/establishments.

Table.17 The effect of age group (20-39, 40-59 years) on the personal hygiene behaviors of food handlers.

Personal hygiene1*	20-39 years (Mean \pm SD2)	40-59 years (Mean \pm SD2)	P
Hand washing after meal	4.69 \pm 0.71	4.75 \pm 0.64	0.63
Hand washing after touch money	3.46 \pm 1.33	3.43 \pm 1.38	0.89
Hand washing after clean table	4.65 \pm 0.82	4.78 \pm 0.53	0.39
Hand washing after handling garbage	4.82 \pm 0.68	4.75 \pm 0.83	0.60
Hand washing after preparing meal	4.48 \pm 0.98	4.56 \pm 0.89	0.67
Hand washing after smoking	2.92 \pm 1.73	2.40 \pm 1.65	0.12

Wear gloves before touching the ready to eat food product	4.40±0.98	4.16±1.21	0.23
Nails are cut short	4.91±0.40	4.94±0.22	0.66
wearing hair net when work in food service	3.10±1.29	3.24±1.27	0.58
wearing clean uniform during preparation of food	4.88±0.41	4.86±0.53	0.83
using clean towel to wipe your hand	4.78±0.48	4.89±0.31	0.22
Food handler not cough during the preparation of food	4.96±0.17	4.91±0.27	0.23
Food handler not sick during food handling	3.76±1.28	3.64±1.31	0.64
Food handler Washing hand after touching other food	4.03±1.28	4.24±1.21	0.39

¹The food handlers' personal hygiene was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (3) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in food hygiene practices of food handlers according to age group (20-39, 40-59 years) are shown in Table 18. There was no significant effect for age groups on the food hygiene practice of food handlers. A study revealed those food handlers who have age of 40 years or more tend to have higher application of personal hygiens compared to food handles between the age group of 20-39 years (71% vs. 67%, $p < 0.05$) (DeBess et al., 2009).

Table.18 The effect of age group (20-39 and 40-59 years) on the food hygiene practice of food handlers.

hygiene practice ^{1*}	20-39(Mean ± SD ²)	40-59(Mean ± SD ²)	P
Cook and sell food at the same time	4.21±0.85	4.32±0.52	0.46
Cook food 2 hours before your business activity	4.41±1.04	4.45±1.01	0.82
Serve food in a tray with cover	3.47±1.38	3.18±1.30	0.27
Serve food in a clean tray	4.62±0.62	4.48±0.55	0.23
Keep the food in the fridge for two hours before preparing	4.67±0.86	4.51±1.01	0.37
Practices safety methods to store food before preparing	4.70±0.73	4.54±0.90	0.28
Use plate which is covered with plastic	2.92±1.37	2.73±1.17	0.44
Serve food with gloves	3.41±1.30	3.02±1.25	0.12
Serve food with fork, spoon, and food tongs	4.64±0.75	4.81±0.56	0.24

¹The food handlers' hygiene practice was scored as follows: always (5), sometimes (4),

rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (3.2) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in cross-contamination prevention according to age group (20-39, 40-59 years) are shown in Table 19. In general, our findings showed that there was no significant effect for the age group on cross-contamination prevention. In this context. Age of the respondents was

found not to influence the knowledge and practice of food hygiene of the respondents in study in Accra, Ghana. However, the significance of age on the measures used by respondents to ensure that, knives used for raw foods are not afterward used on foods that would not be cooked was proven. Ready-to eat foods must never be prepared using a chopping board or knife, that have been used to prepare raw meat, unless they have been washed thoroughly first (George et al., 2011).

Table.19 The effect of age group (20-39 and 40-59 years) on cross contamination prevention.

Cross contamination prevention¹	20-39 (Mean ± SD²)	40-59 (Mean ± SD²)	P
Clean and sanitize work surface, equipment before and after work	4.50±0.758	4.67±0.47	0.19
Keep raw meat, poultry separate	4.47±1.16	4.56±0.95	0.68
Using gloves during the preparation of raw meat, poultry	4.40±1.15	4.41±1.11	0.99
designate certain cutting board for raw meat only	4.43±1.29	4.70±1.02	0.26
Use stainless steel equipment	4.73±0.55	4.54±0.83	0.12
Wash hand after preparing raw meat/poultry	4.63±1.07	4.94±0.22	0.08

¹The Cross contamination prevention was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (4) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in food preparation practice according to age group (20-39 and 40-59 years) are shown in Table 20. Our study showed that there were significant differences in practices of food preparation between different age groups. The results showed that the food handlers whose age 20-39 years exhibited higher scores in checking temperatures of the frozen (4.85 *vs.* 4.64, $p<0.05$), labeling foods with a use-by date (3.09 *vs.* 2.62, $p<0.05$), than food handlers whose age 40-59 years. It was highlighted in a study that the older age group had more advanced knowledge of this aspect of food preparation than their younger counterparts (Martins et al., 2012).

Table. 20 The effect of age group (20-39 and 40-59 years) on Food preparation practice

Food preparation practice	20-39 (Mean \pm SD²)	40-59 (Mean \pm SD²)	P
Examine food packages	4.64 \pm 0.75	4.78 \pm 0.71	0.35
Check frozen food to be sure they are solid	3.74 \pm 1.68	3.70 \pm 1.66	0.89
Clean food preparation area with soap and water	4.20 \pm 1.09	4.51 \pm 0.69	0.11
Leave cooked meat on the counter at room temperature for over 2- 4 h	2.56 \pm 1.14	2.81 \pm 1.19	0.27
Use the same plate for raw and cooked meat	2.09 \pm 0.48	2.00 \pm 0.00	0.23
Taste leftovers to check if they are still safe	4.65 \pm 0.81	4.62 \pm 0.86	0.81
Use raw eggs in salads, desserts, and drinks	2.18 \pm 0.70	2.00 \pm 0.00	0.12
A thermometer is used to check food temperature	2.30 \pm 0.84	2.21 \pm 0.75	0.56
Checking temperatures of the frozen	4.85 \pm 0.46 ^a	4.64 \pm 0.85 ^b	<0.05
Thawing foods, as much as a need	3.95 \pm 1.69	3.83 \pm 1.67	0.71
Cook immediately after	3.93 \pm 1.66	3.59 \pm 1.72	0.29

thawing			
Washing and sanitizing fresh vegetables	4.63±0.60	4.81±0.39	0.11
Labeling foods with use-by date in storing	3.09±1.44 ^a	2.62±1.21 ^b	<0.05

¹The food preparation practice was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (5) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in the food handler's knowledge of safe food handling practices according to age group (20-39 and 40-59 years) are shown in Table 21. In general, our findings showed that there was no significant effect for the age group on the food handler's knowledge of safe food handling practices. The result of the study revealed that age had not significant association with awareness. This indicates that, if once a person is an adult, age might not be important influencing factor on awareness. Because once a person reaches adulthood, the subsequent awareness acquiring solely depends on formal and non-formal education, experience and other personal efforts. On the contrary, in 2011, the result of a study in Malaysia showed that both food handlers' knowledge and experience increase with age (Nee et al., 2011). This result needs future research to obtain additional evidence.

Table. 21 The effect of age group (20-39, 40-59 years) on Food handler's knowledge of safe food handling practice

safe food handling practices¹	20-39 (Mean \pm SD²)	40-59 (Mean \pm SD²)	P
Ground beef patties should be cooked until they are no longer pink	4.27 \pm 1.24	4.51 \pm 0.96	0.30
Freezing food kills all bacteria	3.73 \pm 1.54	3.70 \pm 1.57	0.91
Cooked food should be cooled to room temperature before refrigeration	4.92 \pm 0.44	4.94 \pm 0.32	0.80
Foods can be safely at room temp. several hours	3.42 \pm 1.10	3.29 \pm 1.15	0.55
Irradiation of meat will destroy bacteria	2.13 \pm 1.10	1.89 \pm 1.12	0.25
Irradiated food is considered safe	2.29 \pm 1.08	2.21 \pm 0.94	0.68
If a leftover food looks and/or smells good, it is still safe to eat	3.81 \pm 0.98	4.08 \pm 0.89	0.16

¹The Food handler's knowledge of safe food handling practices was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (7) of the research questionnaire.

² SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The distribution of participants according to marital status (married and never married) is shown in Table.22 The married participants were 62.6% while never married participants were 37.4%.

Table 22. The distribution of participants according to marital status (married and never married).

marital status	Count	Percentage
Married	87	62.6%
never married	52	37.4%

The differences in personal hygiene behaviors of food handlers according to marital status (Married and never married) are shown in Table 23. In general, our findings showed that there was no significant effect for the marital status on some personal hygiene behaviors of food handlers and another were significant. The results showed that the food handlers who were never married exhibited higher scores in handwashing after handling garbage (4.82 vs.4.59, $p<0.05$), and washing after smoking (3.11 vs. 2.63, $p<0.05$) than food handlers was married. These results are not in agreement with some previous studies. In this context, a study showed that personal hygiene practices among married food handlers were 2.09 times higher if compared to single participants in Northeast Ethiopia. The possible reason could be married food handlers might have acquired experience and responsibility to have good handling practice during their marriage (Reta et al., 2019).

Table.23 The effect of marital status (Married and Never married) on the personal hygiene behaviors of food handlers.

Personal hygiene1*	Married (Mean \pm SD2)	Never married (Mean \pm SD2)	P
Hand washing after meal	4.71 \pm 0.68	4.71 \pm 0.69	0.99
Hand washing after touch money	3.40 \pm 1.36	3.61 \pm 1.33	0.37
Hand washing after the clean table	4.59 \pm 0.88 ^b	4.82 \pm 0.51 ^a	< 0.05

Hand washing after handling garbage	4.75±0.82	4.86±0.59	0.41
Hand washing after preparing the meal	4.44±1.05	4.51±0.87	0.68
Hand washing after smoking	2.63±1.66 ^b	3.11±1.78 ^a	< 0.05
wear gloves before touching the ready to eat food product	4.25±1.14	4.48±0.93	0.22
Nails are cut short	4.88±0.49	4.94±0.30	0.45
wearing hair net when work in food service	3.14±1.27	3.19±1.37	0.85
wearing clean uniform during preparation of food	4.83±0.58	4.90±0.29	0.46
using clean towel to wipe your hand	4.80±0.47	4.82±0.38	0.77
Food handler not cough during the preparation of food	4.91±0.38	4.96±0.19	0.46
Food handler not sick during food handling	3.64±1.28	3.90±1.29	0.25
Food handler washing hand after touching other food	4.11±1.26	4.07±1.28	0.86

¹The food handlers' personal hygiene was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I do not know (1). In addition, results have been collected from section (3) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in food hygiene practices of food handlers according to marital status (Married and never married) are shown in Table 24. The marital status of food handlers had no significant effect on some food hygiene practices and another was significant. The results showed that the

non-married food handlers exhibited a higher score in use plate which is covered with plastic (3.30 vs. 2.70, $p<0.05$), and serve food with gloves (3.69 vs. 3.05, $p<0.05$) than married food handlers. In addition, married food handlers exhibited a higher score in cooking food two hours before food business activity (4.60 vs. 4.11, $p<0.05$) than non-married food handlers. In contrast to our findings, it was found that non-married food handlers had 2.09 times higher score commitment to hygiene practices as compared to single participants. The possible reason could be married food handlers might have acquired experience and responsibility to have good handling practice during their marriage (Reta et al., 2019).

Table. 24 The effect of marital status (Married and never married) on the food hygiene practice of food handlers.

hygiene practice ^{1*}	Married (Mean \pm SD ²)	Not married (Mean \pm SD ²)	P
cook and sell food at the same time	4.20 \pm 0.73	4.32 \pm 0.87	0.38
Cook food 2 hours before your business activity	4.60 \pm 0.88 ^a	4.11 \pm 1.23 ^b	<0.05
Serve food in a tray with cover	3.29 \pm 1.32	3.65 \pm 1.41	0.13
Serve food in a clean tray	4.51 \pm 0.64	4.69 \pm 0.61	0.11
Keep the food in the fridge for two hours before preparing	4.68 \pm 0.79	4.48 \pm 1.07	0.19
Practices safety methods to store food before preparing	4.63 \pm 0.82	4.63 \pm 0.90	0.98
Use plate which is covered with plastic	2.70 \pm 1.24 ^b	3.30 \pm 1.44 ^a	<0.05
Serve food with gloves	3.05 \pm 1.25 ^b	3.69 \pm 1.32 ^a	<0.05
Serve food with fork, spoon, and food tongs	4.75 \pm 0.62	4.53 \pm 0.93	0.10

¹The food handlers' hygiene practice was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (3.2) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in cross-contamination prevention according to marital status (Married and non-married). In this context, the marital status of food handlers did not affect the practices to prevent cross-contamination. Exceptionally, the results showed that the food handlers who married exhibited a higher score in a designated certain cutting board for raw meat only (4.66 vs. 4.15, $p < 0.05$) than food handlers who is not married. On the issue of storage position of a vegetable salad when a large piece of meat is stored on the middle rack, the findings of study in Accra, Ghana that the majority of the respondents from all the hotels knew they were to place the salad on top, to prevent contamination from the drip of the meat. This result corroborates with a study where majority (92%) of respondents reported correctly separating raw meat from other foods during storage. A total of 23.8% of the forty two respondents from this study reported that, they would place the salad next to the meat, while 4.8% were not certain where to place the salad. This represented the responses by the minority of respondents from the hotels involved in the study. Similar result, thus 10%

of their respondents did not effectively separate such food items. This according to the authors is disturbing (George et al., 2011).

Table.25 the effect of marital status (Married and Not married) on cross contamination prevention

Cross contamination prevention¹	Married (Mean \pm SD²)	Not married (Mean \pm SD²)	P
Clean and sanitize work surface, equipment before And after work	4.58 \pm 0.60	4.50 \pm 0.80	0.47
Keep raw meat, poultry separate	4.58 \pm 1.00	4.40 \pm 1.19	0.33
Using gloves during the preparation of raw meat, poultry	4.37 \pm 1.16	4.46 \pm 1.11	0.68
designate certain cutting board for raw meat only	4.66 \pm 1.06 ^a	4.15 \pm 1.50 ^b	<0.05
Use stainless steel equipment	4.61 \pm 0.73	4.78 \pm 0.45	0.11
Wash hand after preparing raw meat/poultry	4.75 \pm 0.86	4.67 \pm 0.98	0.59

¹The Cross contamination prevention was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (4) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in the food handler's knowledge of safe food handling practices according to marital status (Married and not married) are shown in Table 26. There was no significant effect of the marital status on the food handler's knowledge of safe food handling practices.

Table. 26 The effect of marital status (Married and married) on food handler's knowledge of safe food handling practices.

safe food handling practices¹	Married (Mean \pm SD²)	Not married (Mean \pm SD²)	P
Ground beef patties should be cooked until they are no longer pink	4.39 \pm 1.10	4.09 \pm 1.40	0.17
Freezing food kills all bacteria	3.85 \pm 1.52	3.42 \pm 1.61	0.11
Cooked food should be cooled to room temperature before refrigeration	4.93 \pm 0.39	4.94 \pm 0.41	0.87
Foods can be safely at room temp. several hours	3.41 \pm 1.09	3.44 \pm 1.14	0.88
Irradiation of meat will destroy bacteria	2.01 \pm 1.12	2.19 \pm 1.13	0.36
Irradiated food is considered safe	2.24 \pm 0.94	2.50 \pm 1.32	0.18
If a leftover food looks and/or smells good, it is still safe to eat	3.82 \pm 1.04	3.86 \pm 0.95	0.83

¹The Food handler's knowledge of safe food handling practices was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (7) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in food preparation practice according to marital status (Married and non-married) are shown in Table 27. In general, our findings showed that there was no significant effect on the marital status on food preparation practice. Exceptionally, the results showed that the food

handlers who are not married exhibited higher scores in use the same plate for raw and cooked meat (2.17 vs. 2.01, $p<0.05$), labeling foods with use-by date in storing, (3.26 vs. 2.82, $p<0.05$) than food handlers whose married. In our study, a low percent of food handlers correctly answered that foodborne pathogens cannot be observed by the naked eye. But, high percent of them wrongly believed that they can tell if food was contaminated with food poisoning bacteria by visual, olfactory or taste checks. Our study showed that food handlers lack the knowledge regarding temperature control as a measure to reduce the risk of food poisoning. Temperature control of ready to eat food and cooked food are crucial steps in catering industry to prevent the growth of foodborne pathogen to an infectious level. Specifically, improper holding temperature and slow cooling of hot foods, promote growth of *B.cereus* and *Cl. perfringens* to disease-causing levels (McCabe-Sellers et al., 2004). Moreover, improper storage of ready to eat food facilitates the growth of *Listeria monocytogenes* to an infectious level.

Table. 27 The effect of marital status (Married and non-married) on food preparation practice

Food preparation practice	Married (Mean \pm SD²)	Not married (Mean \pm SD²)	P
Examine food packages	4.68 \pm 0.75	4.71 \pm 0.69	0.86
Check frozen food to be sure they are solid	3.79 \pm 1.65	3.61 \pm 1.69	0.54
Clean food preparation area with soap and water	4.32 \pm 0.95	4.25 \pm 1.08	0.68
Leave cooked meat on the counter at room temperature for over 2- 4 h	2.62 \pm 1.14	2.75 \pm 1.23	0.53
Use the same plate for raw and	2.01 \pm 0.10 ^b	2.17 \pm 0.64 ^a	<0.05

cooked meat			
Taste leftovers to check if they are still safe	4.68±0.73	4.50±1.03	0.21
Use raw eggs in salads, desserts, and drinks	0.45±2.06	2.21±0.75	0.16
A thermometer is used to check food temperature	2.28±0.81	2.32±0.87	0.78
Checking temperatures of the frozen	4.79±0.66	4.82±0.43	0.74
Thawing foods, as much as a need	3.83±1.71	3.98±1.67	0.63
Cook immediately after thawing	3.75±1.71	3.84±1.69	0.77
Washing and sanitizing fresh vegetables	4.72±0.47	4.61±0.69	0.27
Labeling foods with use-by date in storing	2.82±1.33 ^b	3.26±1.49 ^a	<0.05

¹The food preparation practice was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (5) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The distribution of participants according to education level (Graduated, Primary, and Secondary) is shown in Table.28 About 50% of participants were received secondary education level. Primary educated and graduated participants were 39.3 and 10.7% respectively.

Table 28. The distribution of participants according to education level (Graduated, Primary and secondary).

Education level	Count	Percentage
Graduated	55	10.7%
Primary	15	39.3%
Secondary	70	50%

The differences in personal hygiene behaviors of food handlers according to education level (Graduate, Primary school, Secondary school) is shown in Table 29. In general, our findings showed that there was significant effect for education level on some personal hygiene behaviors of food handlers and another was no significant. The results showed that the primarily educated food handlers had significantly the lowest score in hand washing after a meal (4.53 vs. 4.87, 4.62, $p < 0.05$) while graduated educated food handlers had significantly the highest score in handwashing after touch money (3.92 vs. 2.86, 3.27, $p < 0.05$). For handwashing after handling garbage, graduated educated food handlers had a higher score significantly (4.98 vs. 4.67, $p < 0.05$) than secondary educated, while primary educated food handlers exhibited intermediate values if compared to other groups. In general, not enough study supports our findings. Isara and Isah (2009) found that the level of education of respondents did not significantly influence their practice of food hygiene and safety. Another study in India found that the out of the 42 food handlers who had an acceptable level of personal hygiene 30 (71.42%) of them had education level ranging up to 10th standard, this shows that the level of education co-relates with the level of personal hygiene. And hence, a good level of education or formal training before commencing food handling activity is a must. (Prabhu et al., 2012).

Table.29 The effect of education level (Graduate, Primary school, Secondary school) on the personal hygiene behaviors of food handlers.

personal hygiene¹*	G (Mean ± SD²)	P (Mean ± SD²)	S (Mean ± SD²)	P
Hand washing after meal	4.87±0.47 ^a	4.53±0.64 ^b	4.62±0.80 ^a	<0.05
Hand washing after touch money	3.92±1.28 ^a	1.30 ^b ±2.86	3.27±1.32 ^b	<0.05
Hand washing after the clean table	4.70±0.74	4.93±0.25	4.61±0.85	0.34
Hand washing after handling garbage	4.98±0.42 ^a	4.93±0.25 ^{ab}	4.67±0.95 ^b	<0.05
Hand washing after preparing a meal	4.51±0.96	4.40±0.91	4.45±1.03	0.90
Hand washing after smoking	2.70±1.74	2.46±1.59	2.97±1.73	0.49
wear gloves before touching the ready to eat food product	4.48±0.96	3.93±1.33	4.31±1.08	0.21
Nails are cut short	4.88±0.50	4.93±0.25	4.91±0.40	0.92
wearing hair net when work in food service	3.38±1.32	2.86±1.12	3.05±1.31	0.24
wearing clean uniform during preparation of food	4.94±0.23	4.73±0.79	4.82±0.56	0.25
using clean towel to wipe your hand	4.88±0.31	4.86±0.35	4.74±0.53	0.17
Food handler not cough during preparation of food	4.96±0.19	4.93±0.25	4.91±0.41	0.71
Food handler not sick during food handling	3.83±1.27	3.53±1.35	3.71±1.29	0.71
Food handler Washing hand after touching other food	4.20±1.23	4.00±1.36	4.04±1.27	0.74

¹The food handlers' personal hygiene was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (3) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in hygiene practices of food handlers according to education level (Graduate, Primary school, Secondary school) are shown in Table 30. In general, our findings showed that there was no significant effect on education level on hygiene practices of food handlers, except in two cases were significant. The results showed that the graduated educated food handler exhibited a higher score in serving food in a clean tray (4.67 vs. 4.20, $p < 0.05$) than primary educated, while secondary educated food handlers exhibited intermediate values if compared to other groups. Moreover, the secondary educated food handler exhibited a higher score in serving food with fork, spoon, and food tongs (4.81 vs. 4.47, $p < 0.05$) than graduated educated, while primary educated food handlers had intermediate values if compared to other groups. In this context, there was a study in Indonesia showed that the education level and working experiences had different results in safe food handling knowledge, attitude and practice. It was interesting to observe that participants who had lower education levels (primary and junior high school) performed not worse than those who graduated from senior high school, colleges, or higher education (Lestantyo et al., 2017). In this study, there was no association between educational status and food hygiene practice, and the food handlers who attended college and above education had poor food hygiene practice. This might be because these workers are not frequently engaged in food handling and preparation.

Table. 30 The effect of education level (Graduate (G), Primary school (P), and Secondary school (S)) on the food hygiene practice of food handlers.

hygiene practice ^{1*}	G (Mean \pm SD ²)	P (Mean \pm SD ²)	S (Mean \pm SD ²)	P
cook and sell food at the same time	4.23 \pm 0.83	4.00 \pm 0.92	4.31 \pm 0.71	0.37
Cook food 2 hours before your business activity	4.36 \pm 1.12	4.66 \pm 0.81	4.41 \pm 1.02	0.61
Serve food in a tray with cover	3.25 \pm 1.37	3.93 \pm 1.10	3.44 \pm 1.39	0.22
Serve food in a clean tray	4.67 \pm 0.47 ^a	4.20 \pm 0.86 ^b	4.58 \pm 0.67 ^{ab}	<0.05
Keep the food in the fridge for two hours before preparing	4.60 \pm 0.95	4.73 \pm 0.79	4.60 \pm 0.90	0.86
Practices safety methods to store food before preparing	4.74 \pm 0.55	4.26 \pm 1.38	4.61 \pm 0.88	0.15
Use plate which is covered with plastic	3.03 \pm 1.44	3.13 \pm 1.45	2.78 \pm 1.25	0.48
Serve food with gloves	3.54 \pm 1.34	2.80 \pm 1.14	3.22 \pm 1.29	0.11
Serve food with fork, spoon, and food tongs	4.47 \pm 0.97 ^b	4.73 \pm 0.45 ^{ab}	4.81 \pm 0.57 ^a	<0.05

¹The food handlers' hygiene practice was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (3.2) of the research questionnaire.

² SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in cross-contamination prevention according to education level (Graduate, Primary school, Secondary school) are shown in Table 31. In general, our findings showed that there was no significant effect for education level on some personal hygiene behaviors of food handlers and another was significant. The results showed that the graduated educated food handler had a higher frequency score significantly (4.85 vs. 4.24, $p < 0.05$) in keeping raw meat and poultry separated than secondary educated, while primary educated food handlers were intermediate values if compared to other groups. The results showed that the primarily educated food handlers had the lowest significantly in wash hands after preparing raw meat/poultry (4.06 vs. 4.83, 4.78, $p < 0.05$) in comparison to other groups.

Table. 31 The effect of education level (Graduate, Primary school, and Secondary school) on cross contamination prevention.

Cross contamination prevention¹	G (Mean \pm SD²)	P (Mean \pm SD²)	S (Mean \pm SD²)	P
Clean and sanitize work surface, equipment before and after work	4.59 \pm 0.68	4.40 \pm 0.63	4.55 \pm 0.69	0.62
Keep raw meat, poultry separate	4.85 \pm 0.59 ^a	4.60 \pm 0.82 ^{ab}	4.24 \pm 1.32 ^b	<0.05
Using gloves during the preparation of raw meat, poultry	4.25 \pm 1.21	4.53 \pm 1.06	4.50 \pm 1.10	0.46
designate certain cutting board for raw meat only	4.25 \pm 1.41	4.53 \pm 1.24	4.62 \pm 1.13	0.26
Use stainless steel equipment	4.74 \pm 0.55	4.66 \pm 0.48	4.62 \pm 0.74	0.63
Wash hand after preparing raw meat/poultry	4.83 \pm 0.63 ^a	4.06 \pm 1.62 ^b	4.78 \pm 0.83 ^a	<0.05

¹The Cross contamination prevention was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (4) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in food preparation practice according to education level (Graduate, Primary school, Secondary school) are shown in Table 32. Our study revealed that there was a significant effect on education level on some components of food preparation practices of food handlers. The results showed that the primarily educated food handlers had the highest significantly values in evaluating the leftover foods by look and smell (4.60 vs 3.71, 3.79, $p < 0.05$) than other groups. A previous study showed the higher the educational level of the respondents the higher their knowledge of foodborne infection and food safety. Established that poor knowledge of food-borne infections was due to low educational level (Adebukola et al., 2015).

Table. 32 The effect of education level (Graduate, Primary school, Secondary school) on food handler's knowledge of safe food handling practices.

safe food handling practices¹	G (Mean \pm SD²)	P (Mean \pm SD²)	S (Mean \pm SD²)	P
Ground beef patties should be cooked until they are no longer pink	4.48 \pm 1.02	4.00 \pm 1.60	4.18 \pm 1.27	0.26
Freezing food kills all bacteria	3.50 \pm 1.55	3.93 \pm 1.71	3.78 \pm 1.55	0.49
Cooked food	4.92 \pm 0.42	5.00 \pm 0.00	4.92 \pm 0.42	0.80

should be cooled to room temperature before refrigeration				
Foods can be safely at room temp. several hours	3.55±1.05	3.40±1.12	3.32±1.15	0.53
Irradiation of meat will destroy bacteria	2.07±0.92	1.80±1.37	2.14±1.21	0.56
Irradiated food is considered safe	2.33±1.16	2.46±1.24	2.31±1.02	0.88
If a leftover food looks and/or smells good, it is still safe to eat	3.79±0.93 ^b	4.60±0.50 ^a	3.71±1.07 ^b	<0.05

¹The Food handler's knowledge of safe food handling practices was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (7) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in food preparation practice according to education level (Graduate, Primary school, Secondary school) are shown in Table 33. There was no significant effect on the education level on the food preparation practice of food handlers, except for cook immediately after thawing and thawing food as much as needed. On the contrary, the results of the study have been carried in Oman showed that the postsecondary education level for food handlers had a significantly higher level of knowledge on food preparation and handling as compared to other groups

had lower education level (Al-Ghazali et al., 2020). And Meleko et al., in 2015 finding that Food handlers who had a better level of formal education had a good food handling and preparation practice than those who had lower level of formal education.

Table. 33 The effect of education level (Graduate, Primary school, Secondary school) on food preparation practice.

Food preparation practice	G (Mean \pm SD²)	P (Mean \pm SD²)	S (Mean \pm SD²)	P
Examine food packages	4.83 \pm 0.42	4.73 \pm 0.45	4.58 \pm 0.92	0.16
Check frozen food to be sure they are solid	3.72 \pm 1.70	3.13 \pm 1.84	3.85 \pm 1.59	0.31
Clean food preparation area with soap and water	4.24 \pm 1.11	4.40 \pm 0.50	4.31 \pm 1.00	0.84
Leave cooked meat on the counter at room temperature for over 2- 4 h	2.63 \pm 1.06	2.93 \pm 1.38	2.64 \pm 1.21	0.65
Use the same plate for raw and cooked meat	2.03 \pm 0.27	0.27 \pm 0.00	2.11 \pm 0.52	0.45
Taste leftovers to check if they are still safe	4.64 \pm 0.87	4.60 \pm 0.82	4.60 \pm 0.87	0.95
Use raw eggs in salads, desserts, and drinks	2.16 \pm 0.69	2.00 \pm 0.00	2.11 \pm 0.55	0.61
A thermometer is used to check food temperature	2.48 \pm 1.04	2.00 \pm 0.00	2.22 \pm 0.72	0.08
Checking temperatures of the frozen	4.88 \pm 0.31	4.93 \pm 0.25	4.71 \pm 0.76	0.17
Thawing foods, as much as a need	4.24 \pm 1.52	3.13 \pm 1.95	3.78 \pm 1.71	<0.05
Cook immediately after thawing	4.22 \pm 1.48	3.33 \pm 1.87	3.55 \pm 1.76	<0.05
Washing and sanitizing fresh vegetables	4.74 \pm 0.55	4.80 \pm 0.41	4.61 \pm 0.59	0.32
Labeling foods with use-by date in storing	2.92 \pm 1.43	3.00 \pm 1.30	3.04 \pm 1.41	0.90

¹The food preparation practice was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (5) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$)

The participants were classified according to income level (<2000, 2000-4000, 4000-7000, and >7000 NIS) is shown in Table. 34. The participants were distributed as 7.1%, 56.4%, 28.6%, and 7.9% based on income levels (<2000, 2000-4000, 4000-7000, and >7000 NIS) respectively.

Table 34. The participants were classified according to income level (<2000, 2000-4000, 4000-7000, and >7000 NIS).

Income (NIS*)	Count	Percentage
<2000	10	7.1%
2000-4000	79	56.4%
4000-7000	40	28.6%
>7000	11	7.9%

*New Israeli Shekel

The differences in personal hygiene behaviors of food handlers according to income (<2000, 2000-4000, 4000-7000, >7000) are shown in Table 35. In general, our findings showed that there was no significant effect for income on the personal hygiene behaviors of food handlers. In 2019, a study evaluated 956-food handlers were working in that public food and drink service establishments in Woldia town, Northeast Ethiopia. The obtained results indicated having good food handling practices was higher

among food handlers whose monthly income was greater than 500 birr as compared to their counterparts (Reta et al., 2019).

Table 35. The effect of income (<2000, 2000-4000, 4000-7000, >7000) on the personal hygiene behaviors of food handlers.

personal hygiene1*	<2000(Mean ± SD2)	>7000(Mean ± SD2)	2000-4000 (Mean ± SD2)	4000-7000 (Mean ± SD2)	P
Hand washing after a meal	5.00±0.00	4.72±0.64	4.63±0.81	4.79±0.41	0.33
Hand washing after touch money	3.50±1.35	3.81±1.47	3.35±1.35	3.64±3.64	0.59
Hand washing after the clean table	4.30±1.25	4.91±0.30	4.64±0.84	4.79±0.46	0.22
Hand washing after handling garbage	4.60±0.96	4.63±1.20	4.77±0.79	4.94±0.22	0.40
Hand washing after preparing the meal	4.80±0.42	4.27±1.19	4.36±1.06	4.66±0.83	0.26
Hand washing after smoking	1.90±1.44	3.09±1.86	2.87± 1.70	2.84±1.77	0.36
Wear gloves before touching the ready to eat food product	3.80±1.31	4.36±1.20	4.26±1.14	4.61±0.74	0.14
Nails are cut short	5.00±0.00	4.72±0.64	4.87±0.51	5.00±0.00	0.20
Wearing hair net when working in foodservice	2.90±1.44	3.00±1.18	3.15±1.32	3.30±1.30	0.79
Wearing a clean uniform during the preparation of food	4.90±0.31	4.91±0.30	4.81±0.62	4.94±0.22	0.54
Using a clean towel to wipe your hand	4.90±0.31	5.00±0.00	4.77±0.42	4.82±0.55	0.39
Food handler not cough during the preparation of food	5.00±0.00	5.00±0.00	4.93±0.37	4.89±0.30	0.71
Food handler not sick during food handling	3.00±1.41	4.00±1.34	3.75±1.24	3.82±1.31	0.27
Food handler washing hand after touching other food	4.20±1.13	4.45±1.21	3.94±1.37	4.28±1.05	0.42

¹The food handlers' personal hygiene was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (3) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in hygiene practices of food handlers according to income (<2000, 2000-4000, 4000-7000, >7000) are shown in Table 36. The study showed that there was no significant effect for income on cross-contamination prevention except the results showed that the food handlers whose monthly income was lower than 2000 exhibited the lowest score in clean and sanitize work surface, equipment before and after work (3.90 vs. 4.81, 4.67 and 4.53, $P < 0.05$) if compared to other groups.

Table. 36 The effect of income (<2000, 2000-4000, 4000-7000, >7000) on Cross contamination prevention.

Cross contamination prevention¹	<2000 (Mean \pm SD²)	>7000 (Mean \pm SD²)	2000-4000 (Mean \pm SD²)	4000-7000 (Mean \pm SD²)	P
Clean and sanitize work surface, equipment before and after work	3.90 \pm 1.10 ^b	4.81 \pm 0.40 ^a	4.53 \pm 0.65 ^a	4.67 \pm 0.57 ^a	<0.05
Keep raw meat, poultry separate	4.30 \pm 1.25	4.63 \pm 0.92	4.36 \pm 1.24	4.85 \pm 0.53	0.11
Using gloves during the preparation of raw meat, poultry	3.90 \pm 1.37	4.72 \pm 0.90	4.34 \pm 1.24	4.57 \pm 0.84	0.26
designate certain	3.90 \pm 1.37	4.72 \pm 0.90	4.34 \pm 1.24	4.57 \pm 0.84	0.26

cutting board for raw meat only					
Use stainless steel equipment	4.50±0.85	4.72±0.46	4.64±0.66	4.75±0.63	0.69
Wash hand after preparing raw meat/poultry	4.80±0.42	4.90±0.30	4.58±1.16	4.95±0.22	0.17

¹The Cross contamination prevention was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (4) of the research questionnaire.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in the food handler's knowledge of safe food handling practices according to income (<2000, 2000-4000, 4000-7000, >7000) are shown in Table 37. It was found that there was no significant effect for income on the food handler's knowledge of safe food handling practices. On contrary, the finding of a study in Ethiopia showed that the income level had significantly associated with food handler's knowledge of food handling practices (Neme et al., 2017). Tessema et al., found that the food handlers whose monthly income <379.00 ETB were 60.5% less likely to have good food handling practices compared to those whose monthly income ≥ 379.00 ETB. The possible reason for this might be those who had monthly income ≥ 379.00 ETB might have good educational status, experience and knowledge towards food handling practices (Tessema et al., 2014).

Table.37 The effect of income (<2000, 2000-4000, 4000-7000, >7000) on food handler's knowledge of safe food handling practices.

safe food handling practices¹	<2000 (Mean ± SD²)	>7000 (Mean ± SD²)	2000-4000 (Mean ± SD²)	4000-7000 (Mean ± SD²)	P
Ground beef patties should be cooked until they are no longer pink	3.80±1.31	4.45±0.93	4.25±1.28	4.41±1.16	0.53
Freezing food kills all bacteria	2.90±1.66	3.81±1.66	3.86±1.52	3.51±1.57	0.25
Cooked food should be cooled to room temperature before refrigeration	5.00±0.00	5.00±0.00	4.96±0.33	4.84±0.58	0.42
Foods can be safely at room temp. several hours	3.30±1.16	3.27±1.27	3.49±1.13	3.35±1.03	0.85
Irradiation of meat will destroy bacteria	2.10±0.73	2.27±1.42	2.19±1.25	1.79±0.80	0.31
Irradiated food is considered safe	1.80±0.42	2.81±1.40	2.35±1.07	2.30±1.15	0.21
If a leftover food looks and/or smells good, it is still safe to eat	3.50±1.17	4.09±0.83	3.89±0.99	3.74±1.04	0.49

¹The Food handler's knowledge of safe food handling practices was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (7) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in food preparation practice according to income (<2000, 2000-4000, 4000-7000, >7000) are shown in Table 38. The level of income of food handlers exhibited an effect on some practices of food preparation. The results showed that the food handlers whose monthly income was (4000-7000) exhibited the higher score in checking the solidity of frozen food (4.41 vs. 3.54, and 2.50, $p < 0.05$) than food handlers whose monthly income was (2000-4000) and lower than 2000 while food handlers whose monthly income more than 7000 were intermediate values if compared to other groups.

Table. 38 The effect of income (<2000, 2000-4000, 4000-7000, >7000) on food preparation practice

Food preparation practice	<2000 (Mean \pm SD ²)	>7000 (Mean \pm SD ²)	2000-4000 (Mean \pm SD ²)	4000-7000 (Mean \pm SD ²)	p
Examine food packages	4.70 \pm 0.94	4.81 \pm 0.40	4.64 \pm 0.83	4.76 \pm 0.48	0.78
Check frozen food to be sure they are solid	2.50 \pm 1.78 ^b	3.72 \pm 1.61 ^{ab}	3.54 \pm 1.69 ^b	4.41 \pm 1.35 ^a	<0.05
Clean food preparation area with soap and water	4.00 \pm 1.15	4.72 \pm 0.46	4.27 \pm 1.03	4.28 \pm 0.99	0.40
Leave cooked meat on the counter at room temperature for over 2- 4 h	2.80 \pm 1.31	2.63 \pm 1.12	2.63 \pm 1.09	2.97 \pm 1.28	0.23
Use the same plate for raw and cooked meat	2.00 \pm 0.00	2.00 \pm 0.00	2.11 \pm 0.53	2.02 \pm 0.16	0.58
Taste leftovers to check if they are still safe	4.10 \pm 1.19	4.63 \pm 0.92	4.62 \pm 0.86	4.74 \pm 0.71	0.21
Use raw eggs in salads, desserts, and drinks	2.30 \pm 0.94	2.00 \pm 0.00	2.10 \pm 0.52	2.15 \pm 0.67	0.65
A thermometer is used to check food temperature	2.30 \pm 0.94	2.00 \pm 0.00	2.25 \pm 0.74	2.48 \pm 1.07	0.31

Checking temperatures of the frozen	5.00±0.00	4.63±0.92	4.81±0.62	4.79±0.46	0.57
Thawing foods, as much as a need	3.70±1.88	4.54±1.21	3.74±1.75	4.05±1.65	0.44
Cook immediately after thawing	3.40±1.89	3.90±1.70	3.67±1.73	4.10±1.58	0.52
Washing and sanitizing fresh vegetables	4.80±0.42	4.90±0.30	4.58±0.65	4.79±0.40	0.10
Labeling foods with use-by date in storing	2.30±0.94	3.27±1.34	3.08±1.45	2.89±1.41	0.33

¹The food preparation practice was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (5) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in hygiene practices of food handlers according to income (<2000, 2000-4000, 4000-7000, >7000) are shown in Table 39. The results showed that there was no significant effect for income on some hygiene practices of food handlers of and another was significant. It was found that the food handlers whose monthly income (< 2000 NIS) exhibited higher scores in serving food in a tray with cover (3.50 vs. 3.78 and 2.97, $P < 0.05$) than food handlers whose monthly income have (2000-4000) and (4000-7000). While food handlers whose monthly income was greater than 7000- exhibited intermediate values if compared to other groups.

However, food handlers whose monthly income was lower than 2000 and greater than 7000 exhibited a higher score in keeping the food in the fridge for two hours before preparing (3.80 and 5.00 vs. 4.67, $p < 0.05$) than food

handlers whose monthly income was (4000-7000). While food handlers whose monthly income was (2000-4000) exhibited intermediate values if compared to other groups. Food handlers whose monthly income was (4000-7000) exhibited a higher score in practicing safe methods to store food before preparing (4.80vs. 4.00, $p < 0.05$) than food handlers whose monthly income was lower than 2000. While food handlers whose monthly income was (2000-4000) and greater than 7000 exhibited intermediate values if compared to other groups. Food handlers whose monthly income was (2000-4000) exhibited a higher score in use plate, which is covered with plastic (3.19 vs. 2.00, $p < 0.05$) than food handlers whose monthly income was greater than 7000. While food handlers whose monthly income was (2000-4000) and lower than 2000 exhibited intermediate values if compared to other groups.

Monthly income was another factor associated with the food hygiene practice of food handlers. It was found that participants with a better income had better food hygiene practices. The obtained results indicated the odds of having good food handling practices were higher among food handlers whose monthly income was greater than 500 birr as compared to their counterparts (Reta et al., 2019). In another study in North West Ethiopia, income was not significantly associated (Tessema et al., 2014).

Table. 39 The effect of income (<2000, 2000-4000, 4000-7000, >7000) on the food hygiene practice of food handlers.

hygiene practice ^{1*}	<2000 (Mean \pm SD ²)	>7000 (Mean \pm SD ²)	2000-4000 (Mean \pm SD ²)	4000-7000 (Mean \pm SD ²)	P
cook and sell food at the same time	4.10 \pm 0.87	4.18 \pm 0.87	4.32 \pm 0.76	4.15 \pm 0.80	0.60
Cook food 2 hours before your business activity	4.10 \pm 1.44	4.36 \pm 1.20	4.38 \pm 1.07	4.60 \pm 0.81	0.52
Serve food in a tray with cover	3.50 \pm 1.17 ^a	2.36 \pm 0.80 ^{ab}	3.78 \pm 1.34 ^b	2.97 \pm 1.31 ^b	<0.05
Serve food in a clean tray	4.50 \pm 0.52	4.36 \pm 0.50	4.68 \pm 0.65	4.45 \pm 0.63	0.15
Keep the food in the fridge for two hours before preparing	3.80 \pm 1.39 ^a	5.00 \pm 0.00 ^a	4.63 \pm 0.86 ^{ab}	4.67 \pm 0.88 ^b	<0.05
Practices safety methods to store food before preparing	4.00 \pm 1.41 ^b	4.72 \pm 0.64 ^{ab}	4.60 \pm 0.88 ^{ab}	4.80 \pm 0.56 ^a	<0.05
Use plate which is covered with plastic	3.30 \pm 1.41 ^{ab}	2.00 \pm 0.00 ^b	3.19 \pm 1.43 ^a	2.55 \pm 1.15 ^{ab}	<0.05
Serve food with gloves	2.90 \pm 1.44	3.36 \pm 1.43	3.44 \pm 1.33	3.12 \pm 1.20	0.46
Serve food with fork, spoon, and food tongs	4.80 \pm 0.42	4.90 \pm 0.30	4.64 \pm 0.78	4.62 \pm 0.86	0.66

¹The food handlers' hygiene practice was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (3.2) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly (P < 0.05).

The participants were grouped into three categories according to experience level (1-5, 5-10, >10 years) in Table.40. The major part of participants (44.1%) that were involved in the study had a long period of experience

(>10 years). The remaining part of participants who had an experience of 1-5 and 5-10 years represented about 22.1 and 33.8% respectively

Table 40. The participants were grouped into three categories according to experience level (1-5, 5-10, >10 years).

experience years	Count	Percentage
1-5	30	22.1%
5-10	46	33.8%
>10	60	44.1%

The differences in personal hygiene behaviors of food handlers according to the number of experience years (>10, 1-5, 5-10 years) are shown in Table 41. In general, the results showed that there was no significant effect for a number of experience years on the personal hygiene behaviors of food handlers. This indicates that commitment to food hygiene practices in Palestine is not a very important privilege to food handler employers. On other hand, a study was conducted on 956 food handlers who were working in that public food and drink service establishments in Woldia town, Northeast Ethiopia. The obtained results indicated there was a significant association between service years of participants and a good food handling practice. Thus, the odds of having good food handling practices were higher among participants with longer service year experience (Reta et al., 2019).

Table.41 The effect of a number of experience years (>10, 1-5, 5-10 years) on the personal hygiene behaviors of food handlers.

Personal hygiene ^{1*}	>10 (Mean \pm SD ²)	1-5 (Mean \pm SD ²)	5-10 (Mean \pm SD ²)	P
Hand washing after meal	4.60 \pm 0.78	4.73 \pm 0.78	4.84 \pm 0.42	0.19
Hand washing after touch money	3.26 \pm 1.40	3.70 \pm 1.29	3.68 \pm 1.29	0.18
Hand washing after the clean table	4.68 \pm 0.77	4.83 \pm 0.37	4.57 \pm 0.96	0.38

Hand washing after handling garbage	4.73±0.84	4.90±0.84	4.80±0.75	0.61
Hand washing after preparing a meal	4.48±1.03	4.46±0.90	4.46±1.03	0.99
Hand washing after smoking	2.58±1.60	2.73±1.76	3.17±1.81	0.20
wear gloves before touching the ready to eat food product	4.16±1.13	4.56±0.93	4.42±1.03	0.20
Nails are cut short	4.88±0.45	5.00±0.00	4.86±0.54	0.39
wearing hair net when work in food service	2.88±1.18	3.46±1.38	3.31±1.34	0.08
wearing clean uniform during preparation of food	4.81±0.59	4.93±0.25	4.86±0.50	0.58
using clean towel to wipe your hand	4.85±0.48	4.83±0.37	4.73±0.44	0.39
Food handler not cough during the preparation of food	4.86±0.46	5.00±0.00	4.97±0.15	0.10
Food handler not sick during food handling	3.45±1.32	3.83±1.20	3.95±1.26	0.11
Washing hand after touching other food	4.18±1.17	3.66±1.49	4.22±1.22	0.13

¹The food handlers' personal hygiene was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (3) of the research questionnaire.

² SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$)

The differences in hygiene practice of food handlers according to a number of experience years (>10, 1-5, 5-10 years) are shown in Table 42. In general, our findings showed that there was no significant effect for a number of experience years on the hygiene practice of food handlers, except for some of the practices. The results showed that the food handlers

whose number of experience years (1-5) exhibited higher score in serving food in a clean tray (4.73 vs. 4.40, $P < 0.05$), use plate which is covered with plastic (3.46 vs. 2.75, $P < 0.05$), serve food with gloves (3.70 vs. 2.95, $P < 0.05$), than food handlers whose number of experience years was greater than 10 years. While food handlers whose number of experience years was (5-10) exhibited intermediate values if compared to other groups. Work experience was associated with the food hygiene practice of respondents. Experienced food handlers had reported better food hygiene practices. This association is consistent with earlier studies conducted regarding food hygiene practice and determinant factors. Legesse et al (2017) found that food handlers who had long service years develop or acquire better experience in food handling practice due to repeated exposure of the work as compared to those who work for a short duration in a food establishment. However, other studies reported that work experience has no association with the level of food safety practice. Work experience is important to develop better food hygiene practices as it enables workers better opportunities to undergo food hygiene training and orientation (Baluka et al., 2015).

Table. 42 The effect of a number of experience years (>10, 1-5, 5-10 years) on the food hygiene practice of food handlers.

hygiene practice ^{1*}	>10 (Mean \pm SD ²)	1_5 (Mean \pm SD ²)	5_10 (Mean \pm SD ²)	P
cook and sell food at the same time	4.21 \pm 0.73	4.40 \pm 0.85	4.17 \pm 0.82	0.45
Cook food 2 hours before your business activity	4.45 \pm 1.03	4.13 \pm 1.25	4.58 \pm 0.85	0.17

Serve food in a tray with cover	3.28±1.30	3.70±1.44	3.45±1.41	0.39
Serve food in a clean tray	4.40±0.76 ^b	4.73±0.52 ^a	4.67±0.47 ^{ab}	<0.05
Keep the food in the fridge for two hours before preparing	4.70±0.80	4.26±1.23	4.71±0.77	0.06
Practices safety methods to store food before preparing	4.55±0.98	4.73±0.64	4.71±0.62	0.45
Use plate which is covered with plastic	2.75±1.24 ^b	3.46±1.50 ^a	2.76±1.30 ^{ab}	<0.05
Serve food with gloves	2.95±1.17 ^b	3.70±1.36 ^a	3.43±1.34 ^{ab}	<0.05
Serve food with fork, spoon, and food tongs	4.70±0.74	4.50±1.04	4.71±0.58	0.43

¹The food handlers' hygiene practice was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (3.2) of the research questionnaire.

² SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$)

The differences in Cross-contamination prevention according to age number of experience years (>10, 1-5, 5-10 years) are shown in Table 43. The long experience of handlers did not show any effect on the practices to prevent cross contamination.

In general, it was observed that there was no significant association between the average of hygienic-sanitary conditions and cross-contamination of restaurants and socio-demographic characteristics variables "age", "geographical places", "education level", "work experience" and "training".

Tan et al. (2013) indicated there was no significant association between the average of “self-reported practices” about hygienic-sanitary conditions and cross-contamination of restaurants and variables such as “age”, “gender”, “education level”, “work experience” and “training” (Tan et al., 2013). The finding of overall average of 68.08% (± 13.63), which classifies them as regular (Saccol et al., 2013). Although the results of this study presented no association of socio-demographic variables both with the hygienic-sanitary condition and cross-contamination of restaurants, the relevance of these socio-demographic characteristics is acknowledged as an influence in this process, especially in regards to the education level of individuals. It was also observed that the increase in food safety knowledge leads to an increase in self-reported food safety practices.

Table. 43 The effect of a number of experience years (>10, 1-5, 5-10 years) on cross contamination prevention.

Cross contamination prevention¹	>10 (Mean \pm SD²)	1_5 (Mean \pm SD²)	5_10 (Mean \pm SD²)	P
Clean and sanitize work surface, equipment before And after work	4.65 \pm 0.54	4.53 \pm 0.81	4.43 \pm 0.75	0.27
Keep raw meat, poultry separate	4.66 \pm 0.91	4.23 \pm 1.27	4.47 \pm 1.15	0.20
Using gloves during the preparation of raw meat, poultry	4.43 \pm 1.07	4.33 \pm 1.24	4.37 \pm 1.19	0.91
designate certain cutting board for raw meat only	4.61 \pm 1.07	4.43 \pm 1.30	4.41 \pm 1.35	0.65
Use stainless steel equipment	4.66 \pm 0.70	4.73 \pm 0.44	4.60 \pm 0.71	0.72
Wash hand after preparing raw meat/poultry	4.66 \pm 1.02	4.66 \pm 0.84	4.82 \pm 0.82	0.63

¹The Cross contamination prevention was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (4) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$).

The differences in food preparation practice of food handlers according to a number of experience years (>10, 1-5, 5-10 years) are shown in Table 44. Our results showed that there was no significant effect for a number of experience years on the food preparation practice of food handlers, except for two practices. The results showed that the food handlers whose number of experience years (1-5) and (5-10) exhibited higher scores in thermometer are used to check food temperature (2.56 and 2.33 vs. 2.13, $P < 0.05$), thawing foods as much as a need (4.33 and 4.22 vs. 3.41, $p < 0.05$), than food handlers whose number of experience years was greater than 10 years. On other hand, a study was conducted on 200 food handlers who were working in Jordanian military hospitals in Amman, Jordan. The obtained results indicated there was in the full questionnaire scores, no statistically significant difference was found between participants of different experience levels. Despite the average score differences between the categories (the most experienced participants with the higher score and the less experienced with the lower score). But, in the group of questions in which less than 50% of correspondents responded correctly, there is a

statistically significant difference ($P < 0.05$) between results obtained by participants with different professional experience. Participants with more than five years of experience have higher scores than those with work experience of between one and three years ($P < 0.05$) (Sharif et al., 2013).

Table. 44 The effect of a number of experience years (>10, 1-5, 5-10 years) on food preparation practice.

Food preparation practice	>10 (Mean \pm SD ²)	1_5 (Mean \pm SD ²)	5_10 (Mean \pm SD ²)	p
Examine food packages	4.65 \pm 0.79	4.80 \pm 0.48	4.75 \pm 0.57	0.54
Check frozen food to be sure they are solid	3.83 \pm 1.62	3.83 \pm 1.64	3.53 \pm 1.76	0.62
Clean food preparation area with soap and water	4.38 \pm 0.94	4.03 \pm 1.06	4.40 \pm 0.98	0.21
Leave cooked meat on the counter at room temperature for over 2- 4 h	2.70 \pm 1.22	2.66 \pm 1.18	2.57 \pm 1.09	0.86
Use the same plate for raw and cooked meat	2.06 \pm 0.40	2.00 \pm 0.00	2.13 \pm 0.54	0.39
Taste leftovers to check if they are still safe	4.61 \pm 0.82	4.43 \pm 1.07	4.77 \pm 0.67	0.22
Use raw eggs in salads, desserts, and drinks	2.18 \pm 0.70	2.20 \pm 0.76	2.00 \pm 0.00	0.21
Thermometer is used to check food temperature	2.13 \pm 0.59 ^b	1.10 ^a 2.56 \pm	0.87 ^a 2.33 \pm	<0.05
Checking temperatures of the frozen	2.18 \pm 0.70	2.20 \pm 0.76	2.00 \pm 0.00	0.21
Thawing foods, as much as a need	3.41 \pm 1.85 ^b	4.33 \pm 1.44 ^a	4.22 \pm 1.49 ^a	<0.05
Cook immediately after thawing	3.50 \pm 1.79	3.96 \pm 1.56	4.04 \pm 1.62	0.21
Washing and sanitizing fresh vegetables	4.80 \pm 0.44	4.66 \pm 0.66	4.60 \pm 0.49	0.13
Labeling foods with use-by date in storing	2.86 \pm 1.38	3.30 \pm 1.39	2.97 \pm 1.45	0.38

¹The food preparation practice was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I do not know (1). In addition, results have been collected from section (5) of the research questionnaire.

²SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly ($P < 0.05$)

The differences in the Food handler's knowledge of safe food handling practices of food handlers according to the number of experience years (>10, 1-5, 5-10 years) are shown in Table 45. In general, our findings showed that there was no significant effect for the number of experience years on the food handler's knowledge of safe food handling practices of food handlers. In 2017, the results of a study in Malaysia that food handlers who had more working experience in the foodservice industry had a better overall food safety knowledge than food handlers with lesser experience. From the questionnaire, in the Malaysian study even though the safe food handling course did not significantly improve the food safety knowledge, those who had attended the course performed slightly better than those who had not attended the course (Lee H. K. et al., 2017). In general the experience of the individual though quite good would not be useful unless they had good knowledge of food handling. The negligent practices of the food handlers would continue unless they are given some form of training in food handling. Similarly, old habits die hard. So if one wants to change the situation, hands on training for new recruits regarding food safety would prove to be useful.

Table.45 The effect of a number of experience years (>10, 1-5, 5-10 years) on food handler's knowledge of safe food handling practices.

safe food handling practices ¹	>10 (Mean \pm SD ²)	1_5 (Mean \pm SD ²)	5_10 (Mean \pm SD ²)	P
Ground beef patties should be cooked until they are no longer pink	4.23 \pm 1.22	4.20 \pm 1.34	4.46 \pm 1.10	0.54
Freezing food kills all bacteria	3.76 \pm 1.54	3.70 \pm 1.53	3.68 \pm 1.60	0.96
Cooked food should be cooled to room temperature before refrigeration	4.95 \pm 0.28	5.00 \pm 0.00	4.93 \pm 0.44	0.66
Foods can be safely at room temp. several hours	3.46 \pm 1.06	3.33 \pm 1.21	3.44 \pm 1.09	0.86
Irradiation of meat will destroy bacteria	1.95 \pm 1.12	2.23 \pm 1.10	2.15 \pm 1.20	0.47
Irradiated food is considered safe	2.25 \pm 1.01	2.66 \pm 1.32	2.20 \pm 0.99	0.14
If a leftover food looks and/or smells good, it is still safe to eat	3.91 \pm 1.07	3.76 \pm 0.97	3.82 \pm 0.96	0.78

¹The Food handler's knowledge of safe food handling practices was scored as follows: always (5), sometimes (4), rarely (3), never (2) and I don't know (1). In addition, results have been collected from section (7) of the research questionnaire.

² SD is the standard deviation.

^{a-b} Means within a row followed by different superscript letters differ significantly.

4.1 Food safety training:

The study showed that the percentage of kitchen managers who receive food safety training just was 7.9% and 92.1% of kitchen managers do not any receive food safety training (Figure 8). This is considered very low which is attributed to regulation issues. In Palestine, it is not obligatory for

food handlers to pass a training course in food safety or to have an official certificate.

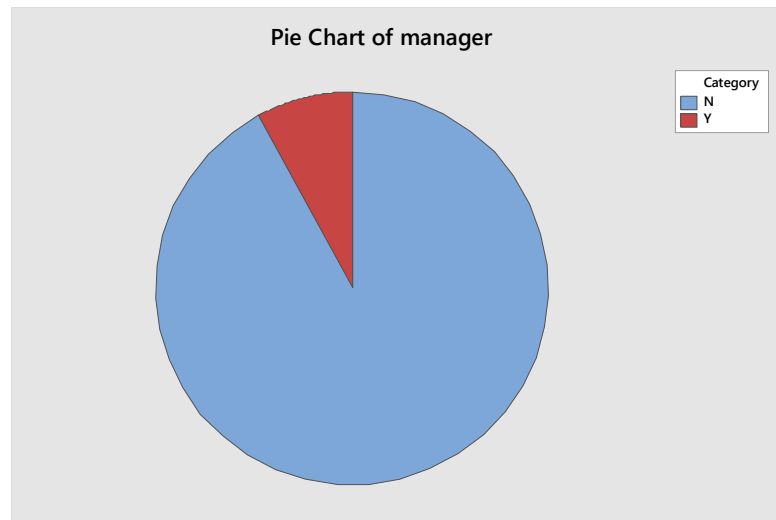


Figure 8. The percentage of kitchen managers who received training in food safety.

The percentage of food workers received training in food safety was 8.6%, and 91.4% of Food workers did not receive any training in food safety training (Figure 9).

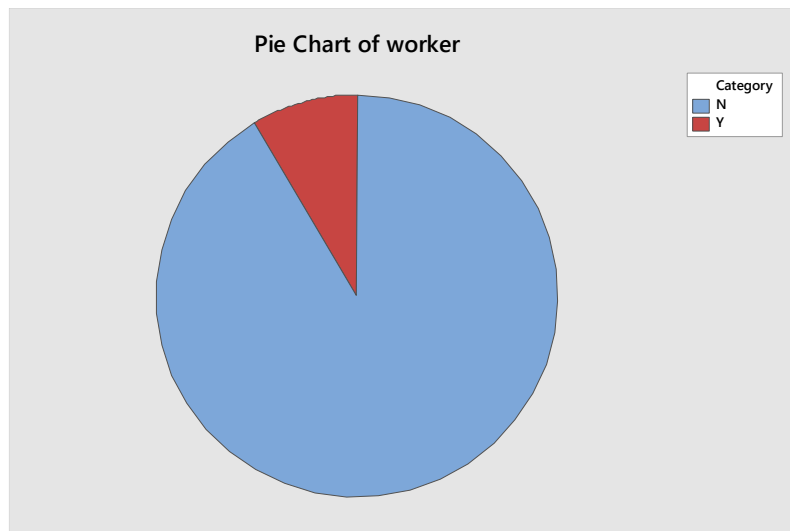


Figure 9. The percentage of food workers received training in food safety

Our finding revealed that the percentage of restaurant had at least one certified kitchen manager 30.7%, and 69.3% of the restaurant did not have any certified kitchen manager (Figure 10)

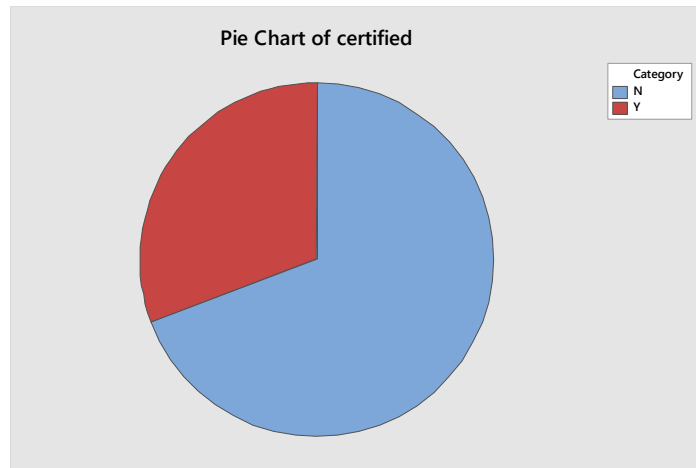


Figure 10. The percentage of restaurant has at least one certified kitchen manager

The percentage of food handlers who receive courses in food safety is 18.6%, and 81.4 % of food handlers do not receive any courses in food safety (Figure 11)

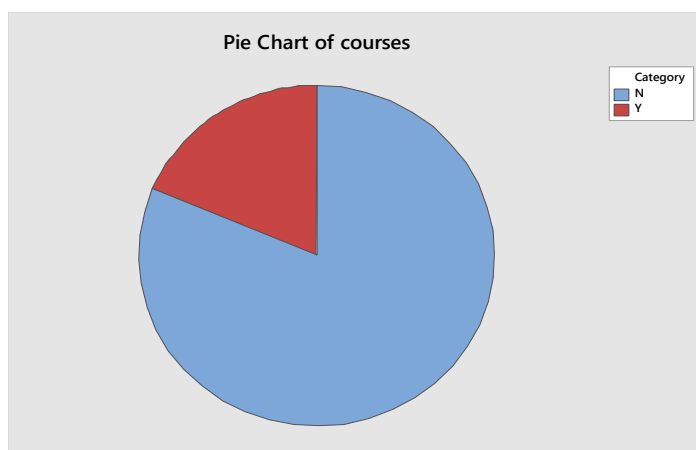


Figure 11. The percentage of food handlers receive courses in food safety

The percentage of food handlers who did not receive any training courses in food safety was 82.9 %, Food handlers received one course was 10.7%, Food handlers received two courses was 3.6%, Food handlers receive three courses were 2.1% and 0.7 % of food handlers receive five courses in food safety (Figure 12).

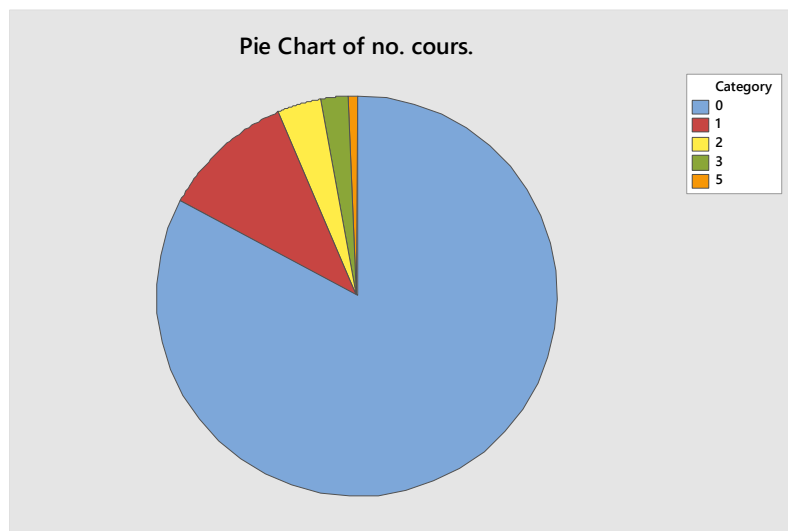


Figure 12. The percentage of food handlers who different levels of training courses.

Several factors have a positive impact on food safety in the restaurant's environment. If we compared our results or context with USA regulations and codes. In USA, inspections on food safety should be carried out by inspectors who know the FDA Food Code and have adequate training of managers and food workers. The FDA Food Code does not mandate food safety certification but does recognize certification by an accredited program as one means by which a person in responsibility can show how to apply hazard analysis and critical control point principles and knowledge of foodborne illness prevention methods. Specific requirements differ among countries, but in general, to become certified must take a training class.

Research conducted by the FDA also revealed that the presence of certified kitchen managers (CKMs) has a positive effect on the control of certain food-borne illness risk factors. For full-service restaurants, compliance with recommended practices for protecting food, utensils, and surfaces from contamination and for personal hygiene was significantly higher among restaurants with a CKM than among restaurants without a CKM. For fast-food restaurants, compliance with recommended practices for temperature and the proper holding time was significantly higher among restaurants with a CKM than among restaurants without a CKM (Cates, et al., 2009).

Chapter Five

Conclusions and Recommendations

Conclusions:

Our study showed that the food handlers' awareness towards food safety in Palestinian restaurants was affected by several factors (age, geographical places, educational level, Gross Income (NIS), number of experience years, restaurants type, and marital status). In general, our study showed that age, income, number of experience years did not affect the personal hygiene behaviors of food handlers. Age, geographical places, and a number of experience years did not affect cross-contamination prevention. In addition, age, marital status, income, and a number of experience years did not affect food handler's knowledge of safe food handling practices. Differences in food handlers' awareness of food safety were not similar in the three studied governorates. On other hand, the percentage of kitchen managers receiving food safety training, food workers receiving food safety training and food handlers receiving courses in food safety was very low.

Recommendations:

In view of the findings of this study, the following recommendations can be made:

1. The public health authorities in north Palestinian cities and Municipalities should implement the food safety program in all

restaurants to protect public health and to improve food safety management.

2. The Ministry of Health or municipalities must take food handlers courses in food safety. That is one of the most important ways to preserve the health of the citizen and decreasing food-borne illnesses.
3. Microbial analysis of equipment surfaces and screening food handlers for hand contamination should be carried out.
4. The inspection and enforcement mechanisms on food premises should be strengthened.

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كلية الدراسات العليا

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2021

ب

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الملخص

الامراض المنقولة عن طريق الغذاء في ازدياد في جميع انحاء العالم. حيث تزداد حالات الوفاة الناتجة بسببها لتصل الى 420000 حالة في العام حسب تقارير منظمة الصحة العالمية. ومع ازدياد اعتماد الناس على الاطعمة الجاهزة بسبب طبيعة الحياة فإن تطبيق الممارسات الصحية الغذائية في أماكن خدمات الطعام كالمطاعم أصبح ضروريا. أشارت العديد من الدراسات الى الحاجة لتدريب وتعليم العاملين في مجال الغذاء حيث تبين مدى افتقارهم لمعايير السلامة والنظافة والمعرفة بشأن الاخطار الغذائية الميكروبيولوجية كأهمية النظافة الشخصية ونظافة اماكن اعداد وتخزين الاغذية ومكافحة الآفات وإدارة النفايات. تبعا لذلك كان الهدف من هذه الدراسة هو تقييم مدى الوعي وتطبيق ممارسات الصحة الغذائية من قبل متداولي الاغذية في مطاعم محافظات نابلس وقلقيلية وطولكرم. تم أخذ البيانات عن طريق استبيانات ومقابلات مع عينة عشوائية شملت 140 مطعما في المحافظات الثلاث. أوضحت النتائج أن نسبة كبيرة من متداولي الاغذية ليس لديهم وعي كامل بالسلوك الغذائي الصحي أو معرفة بنظام تحليل مخاطر أو تحديد نقاط التحكم الحرجة حيث أن نسبة الذين لم يحصلوا على تدريبات في سلامة الاغذية تجاوزوا 92% ونسبة المطاعم التي لديها مدير مطبخ معتمد لا يتجاوز 30%. كما أوضحت النتائج مدى الاختلاف في نسبة الوعي لسلامة الأغذية تبعا للمنطقة والعمر والمستوى التعليمي والدخل وسنوات الخبرة ونوع المطعم ايضا سواء كان تقليديا أو شعبيا. أوصت الدراسة أنه يجب على القطاع الصحي والمسؤولين إنشاء برامج تدريبية لمتداولي الطعام كما يجب القيام بالتفتيش الدوري ووضع آليات خاصة لتحقيق هذا الهدف وحماية صحة المواطن.