



Street Food Vendor Handling Practices and Bacterial Contamination of Ready-To-Eat Foods

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Abstract

Food hygiene is a fundamental human right because it is vital for life. Food hygiene risks affect almost everyone in the world. Each year, unsafe food kills hundreds and sickens millions of people. For customers, street food provides a source of affordable, practical, and tasty food. Street food is now a major food hygiene concern because it is typically linked to a higher risk of infection, which leads to the development of food borne diseases, street foods are raising concerns about the possibility for serious food poisoning outbreaks. The hygiene of street food depends heavily on how it is handled while it is raw, cooked, and consumed. Poor food handling practices used by street food handlers are a substantial cause of food contamination. These issues include inadequate locations for the production of street food, poor quality raw materials, and portable water supplies. Inadequate garbage disposal facilities led to potential hazards. The general sources of microbiological contamination include the location of food preparation, the cooking and serving equipment used, the raw materials used, and the personal hygiene of those who handle the food. Due to the ease of contamination of microbes and the growth of foodborne diseases, street foods can be a source of these illnesses. Food hygiene and safety are all negatively impacted by street food vendors' lack of education and inadequate understanding, and may contain contaminants that provide a higher risk due to physical, chemical, and biological elements, necessitating a comprehensive examination of food safety and hygiene. The aim of this chapter is to determine the hygiene Practices by street food vendors and explain the microbial contamination related to Street Foods, know how to developed infectious diseases (COVID-19 pandemic etc.) occur and to increased awareness of food vendors about the role of food hygiene and personal hygiene through training programme.

Keywords: Street Food Vendors; RTE; Microbial Hazards; Food Poisoning; Infectious Diseases; Personal Hygiene

Abbreviations

COVID-19: Coronavirus Disease; CDI: Communicable Diseases Infection; RTE: Ready-To-Eat; FAO: Food and Agriculture Organization; WHO: World Health Organization; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; *Pseudomonas sp.*: *Pseudomonas Species*; *Proteus sp.*: *Proteus species*; *E. coli*: *Escherichia coli*; FSMS: Food Safety Management Systems; GHP: Good Hygiene Practices; HACCP: Hazard Analysis and Critical Control Point, IBM SPSS: International Business Machines Statistical Package for the Social Sciences; PPE: Personal Protective Equipment

Introduction

Street foods are an integral part of cuisine all over society. The Street food vending profession allows vital income inflow to

households involved in the selling of street foods. Even, street foods are a source of the most inexpensive, convenient, flavors, attractive, and nutritious foods, and street food vending is a major source of employment and an income-generating occupation to homes [1,2]. Street foods are defined as Ready-To-Eat (RTE) food and beverages prepared/sold through food vendors, especially in streets and similar public places for immediate consumption without further processing, FAO, 2013. It was estimated in the year 2013, that there are 2.5 billion persons who consume street foods daily [3]. Food vendors are defined as a person in the food trade who are professionally associated in direct contact with food [4]. It is important to pay attention to hygiene practices during food processing. Street foods, commonly Ready-To-Eat foods vend on stationary stalls, opened, half-closed, or closed tables or through handlers. Street foods are

commonly prepared and sold through food handlers without training and certificates [5]. The lack of basic infrastructure, lack of knowledge of hygiene, absence of potable water, improper storage facility, and improper environment in food operations [6]. WHO in the year 2019 estimated the global number of foodborne diseases is about 600 million with about 420,000 deaths annually. Unsafe food generates a vicious cycle of disease, diarrhea, and malnutrition which significantly prevent public health and socioeconomic development [4]. During the COVID-19 pandemic, the impact of COVID-19 has been on the life of millions of people who are affected by the pandemic. To an extent COVID-19 not only demonstrated just the changes to our (national and international) health systems; this illustrated the fragility of our food systems as well and was able to be disrupted [7]. Food security and food sustainability are recognized as strongly affecting dimensions of food systems during the Covid-19 pandemic [8]. SARS-CoV-2 can be transmitted through contact surfaces, due to the capability of the virus to survive on the surfaces for several days [9]. Altogether, this raises the central question of the resilience of food systems, and it links to food nutrition security (Christophe 2020). During the Covid-19 pandemic in India, the second wave of coronavirus are devastating [10]. The COVID-19 pandemic has increased the comprehensive worsening of food insecurity worldwide [11]. The COVID-19 pandemic devastated the livelihoods of street vendors, and Street vendors themselves have not been alone in the fight. Low-income households that rely on street vendors to order food supplies are now paying more for access to food which could be having widespread effects [12]. Numerous studies have found onto food vendors in India has to find contamination to be mostly the result of poor hygiene and poor water quality at the time of food preparation, dirty utensils, poor personal hygiene, cutting or peeling fruits and vegetables long before consumption, and, crowded and dirty shopping area stationed on side busy roads [13]. In almost all types of street food, panipuri or gol gappas and Papdi chaat are more famous. Which are selling foods on the roadside without any protection against smoke, and dust and using normal water without any treatment, poor handling, and also unhygienic conditions keep together, and street food is the main source of foodborne diseases. Various types of bacteria or microbes are directly connected to food contamination, illness as diarrhea such as *Escherichia coli* (e.g., *E. coli* 0157:H7), *Clostridium botulinum*, *Staphylococcus aureus*, *Salmonella typhi*, *Pseudomonas sp.* (*Pseudomonas species*), and *Proteus sp.* (*Proteus species*) [14]. Poor hygiene practices of street food vendors, defective holding, and inappropriate processing methods are as well responsive to street food contamination [15]. Microbiological contamination is present in street foods which leads to foodborne diseases [16]. It is necessary the improvement of the quantity and quality of the training of the food vendors for implementing food nutrition security and providing the human right to get sufficient and safe food [17]. There are four major challenges to street food hygiene: 1) microbiological, 2) chemical, and 3) personal hygiene. 4) Environmental hygiene, which involves keeping food clean, separating raw and

cooked foods, thorough cooking, maintaining temperature, and the use of safe water and food materials [15]. Nanotechnology provides comprehensive food solutions, including food manufacture, processing, and packaging, as well as the use of antimicrobial nanoparticles to protect our food products from the foodborne disease [18,19]. To reduce the incidence of foodborne illness, WHO established five key elements for food hygiene. This includes, 1) keeping food clean, 2) separating raw and cooked food, 3) cooking food thoroughly, 4) keeping food at safe temperatures, 5) using safe water and raw materials, and to established good hygiene practices (GHP), and hazard analysis and critical control point (HACCP) system, the food safety management systems (FSMS) has developed into the last two decades [8,20-23]. Codex plays a vital contribution to encouraging Food Control and Food Safety issues, and Food control systems are necessary for assuring the health and safety of domestic populations, vendor's knowledge of the principles of food hygiene requires to be refreshed, to eliminate the risk of contamination in food [24-26]. Despite the serious food poisoning outbreaks, and threats to consumers' health, that have been linked to eating street foods, there are currently very few studies about the inadequate hygiene practices of street foods vendors'. Reviews are relevant to this book chapter. Street fast foods contribute a significant role in foodborne illness to consumers. Most of the food handlers and worker are uneducated and lack of the knowledge about handling practice, sanitation and hygiene so that food can easily be contaminated. There are several reason for contamination of street fast foods includes the utensils and equipment that enhance cross contamination, vending sites that are filthy in nature, tap water used in preparation of food, waste and garbage produce in restaurants discard nearby that attract the rodents and insect which may carry foodborne pathogens, flies that land on food sporadically and finally handling of food by vendors with bare hand [27]. Street foods are defined by the FAO as ready-to-eat (RTE) food and beverages prepared and or sold by vendors and handlers especially in streets and other similar places for immediate consumption or consumption at a later stage without further processing or preparation (Food and Nutrition, 1989) [28]. According to the Food and Agriculture Organization, 2.5 million people eat street food daily. In India during recent years there is an increasing trend in the sale and consumption of foods on the road side. In many developing countries, such as India, street-food vending is a common part of urban lifestyle due to high unemployment and limited work opportunities. Vendors usually congregate in overcrowded areas where there are high numbers of potential customers. Such areas usually provide limited access to basic sanitary facilities [29]. street foods may cause foodborne diseases by microbial contamination. 1.1 A considerable proportion of street foods has shown a poor microbiological quality and a potential cause of outbreaks. 2 Poor quality of raw materials, unhygienic conditions during food preparation and awareness about food safety and sanitary practices among food vendors are possibly the main reasons for food

poisoning outbreaks.¹² As a result of unsafe food, public health and economic development will be affected greatly.¹³ However, information on the quality and safety of these street foods, especially in Can Tho city, Vietnam is very limited. Actually, food safety problems may result from poor knowledge about food safety and improper practice among vendors [30]. In many of these street food trades, conditions of production and sale are verified as having empirical handling practices, poor hygiene practice, inadequate infrastructure and lack of potable water points. This is strongly associated with the lack of hygienic and sanitary control in food production processes, such as hand hygiene and handling [31]. In India, chaat are sold at stall public places and roadside shops. However consumption, quick method of cleaning and handling, could often prove to be a public health threat. There are reports of foodborne illnesses associated with the consumption of unhygienic foods at several places in India. Hazards and critical control points (HACCP) conducted for a selected bhelpuri vendors that involved microbial analysis of 8 ingredients of bhelpuri and seven samples indicative of personal hygiene and environmental sanitation showed the presence of *E. coli* in almost all the samples and *Salmonella* and *Shigella* in knife, hand rinse, dishwater and sevpuri samples. Bacteria like *Salmonella* sp. *Shigella* sp. *Compylobacter* sp. and *E. coli* can contaminate the food through contact with sewage and contaminated water. Thus, the hazards and critical control points identified were high initial contamination of raw foods, poor personal hygiene and environmental sanitation, cross-contamination between raw and cooked foods, holding of foods at ambient temperature and poor cleaning practices for stall and utensils [32]. Most studies focusing on food in Burkina Faso showed that urban areas were already very different from rural areas in terms of food systems, food habits, culinary practices, and food supply. In the city, new easy-to-prepare and processed foods appear regularly, and street foods, which are ready-to-eat foods sold on the street by small vendors, are more and more commonly consumed. It has also been shown that the main food markets are generally well provisioned in Ouagadougou, but very few studies have looked at individual food consumption and micronutrient deficiencies among women of reproductive age. However, to design or re-orient programs to improve individual food and nutrition security, it is necessary to understand food consumption behaviors and identify nutritional problems. This is particularly relevant currently because of the effects of the food and financial crises on the diet of the urban poor [33]. Eligible vending sites were defined as the business establishments selling ready-to-eat food, including beverages and/or snacks, from any venue other than permanent storefront businesses or establishments with four permanent walls not selling directly to the street, but operating in a predefined perimeter. This includes mobile vendors as well as sellers with semi-static or stationary vending units. The exclusion criteria were the following: food establishments with four permanent walls, permanent storefront business, street vendors selling exclusively non-food products or raw food

not ready to eat and food stalls and carts that were part of permanent stores or licensed establishments [34]. dietary behaviours related to: macronutrient profiles indicating a higher proportion of energy intake from fats and a lower proportion from carbohydrate^(1,4); a high consumption of animal-source foods, edible oils, energy-dense snack foods, sweetened beverages, processed foods and sugary snacks in the food items consumed⁽³⁾; enhanced dietary diversity⁽¹³⁾; and less structured dietary practices reflected in more food or meals eaten away from home and an increase in processed, convenience and 'fast' foods [35]. Sale of food in the streets is very controversial from a health standpoint. The main health hazard associated with street foods is microbial contamination. A number of observational studies have shown that street foods are sometimes held at improper temperatures, excessively handled by food vendors and sold at very dirty surroundings that make them prone to contamination. In addition, most of the vendors had either no formal education or few years of schooling. Therefore, they are unaware of proper food handling and their role in the transmission of pathogens. Knowing the microbiological quality of street vended foods is important factor to appreciate the safety problems related to street foods so that concerned bodies may take appropriate steps to improve safety and sanitation with respect to this economic sector [36]. The street vended foods are prepared under unhygienic conditions and displayed openly leading to a high degree of contamination. Thus, from the health point of view, the microbiological quality of street vended foods becomes important as food can act as a major source for transmission of food borne infections and intoxications. The faecal-oral route has been recognized as the most important mode of transmission for pathogenic microbes from food handlers to food.^[3] The potential for the contamination of street foods with pathogenic micro-organisms has been well-documented and several disease outbreaks have been traced to consumption of contaminated street foods. The street foods are contaminated with enteropathogens such as *Escherichia*, *Salmonella*, *Shigella* and *Enterobacter* along with toxin producing bacteria such as *Staphylococcus* and *Clostridium* species. Apart from these, food may also be contaminated with *Pseudomonas*, *Bacillus*, *Vibrio* and *Klebsiella* sp. Around 250 different foodborne diseases have been described by Centre for Disease Control in 2011. Furthermore in the recent years, a substantial increase in antibiotic resistance has been observed; mainly in developing countries^[6] because of self-medication and general public are unaware of the effects antibiotics hold. Thus it is essential to monitor the antibiotic susceptibility of foodborne pathogens [37]. In a study Rehman, *et al.* (2007) determined the effect of citrus essential oil on microbial growth using bread as a model system. They reported the delayed and inhibitory microbial growth in bread as observed with potato *masala* during our investigation [38]. The revised guidelines emphasize the pivotal role played by the mother as the primary care giver. Dangers posed by the consumption of snack foods at school highlight the need for

studies involving elementary school students [39]. The risks associated with the street foods can further be controlled and made safer if the following factors are considered. Firstly, there needs to be consumer awareness regarding the freshness, quality, and hygienic environment of the street foods. Secondly, by educating vendors about hygienic conditions, and lastly, the concerned Government authorities should periodically check and monitor the preparatory conditions of the shops/stalls in order to maintain the quality of the street foods.

Chapter
Street foods

Street food are made and sold by vendors and hawkers, often in the street and other such public spaces, as “ready-to-eat” foods and beverages [40]. For the impoverished in urban and rural areas, street food is increasingly serving as their primary source of affordable, practical, and wholesome nourishment. These foods, which include anything from conventional meals to snacks and drinks, are cooked on the street or at home and then sold by vendors and hawkers there and in other nearby, unrestricted locations for consumption right away or at a later time without any further processing or preparation. [41].

Food contamination

The safety of food products is also impacted by the physical, chemical, and microbial contamination of street foods (Figure 1). In fact, intestinal bacteria are a major cause of the widespread contamination of food goods in the streets [42]. Vendors frequently lack a formal education, are unskilled in food hygiene, workers in unsanitary circumstances with poor sanitation, and know little to nothing about the causes of food-borne illnesses. Despite the negative impacts on their health, people regularly eat street food, which is sold on the streets, in public spaces, at busy markets, near schools, at taxi stands, etc. [39]. Foodborne illnesses with symptoms of gastrointestinal distress like diarrhoea, vomiting, abdominal cramps, and nausea continue to be a major cause of mortality and morbidity despite the fact that epidemiological data on the

incidence of these illnesses are inadequate and outbreaks are frequently not investigated [41].

Infectious diseases

Millions of people in both large and small cities in developing nations like India consume a variety of foods like panipuri, snacks, and drinks that are offered by street vendors. The most well-liked street cuisine is panipuri or gol gappas. Street food is one of the primary sources of foodborne infections since it is sold without any safeguards against dust, smoking, use of untreated water, improper handling, and unclean circumstances. Prior to this, there have been numerous incidents of foodborne illness brought on by eating street food both in India and overseas. The street food isn’t really protected from flies, which could potentially spread bacteria that cause food poisoning. Food contamination may also be caused by other probable physical reasons. Salmonella typhi, Escherichia coli, Proteus species, and Pseudomonas species are a few bacteria that are specifically linked to food contamination. On a broad scale, several chemical or physical techniques were applied. Although these substances are cheap and easily accessible, they are damaging to the human body. Natural biological chemicals are continually in demand since they are safer than chemical or physical preservatives, easily soluble, and environmentally beneficial [14]. Foodborne illnesses including traveler’s diarrhoea and others have frequently been linked to street cuisine. Escherichia coli, Shigella dysenteriae, Streptococcus sp., Klebsiella, and Enterobacter were detected, which indicated faecal contamination. Despite the fact that certain strains of E. coli are harmless, enterohaemorrhagic strains (EHEC) have the ability to produce one or more toxins and a specific serotype O157:H7 has been linked to thrombotic thrombocytopenic purpura, hemolytic uraemia syndrome, and hemorrhagic colitis. Also linked to traveler’s diarrhoea is Enterotoxigenic E. coli (ETEC). Similar to how Streptococcus sp. is usually linked to an acute sore throat, Shigella dysenteriae has been linked to severe bacillary dysenteriae [43]. Despite the potential advantages of foods sold on the street, questions about their quality and safety have been raised. Vendors lack awareness of fundamental issues with food safety [44].

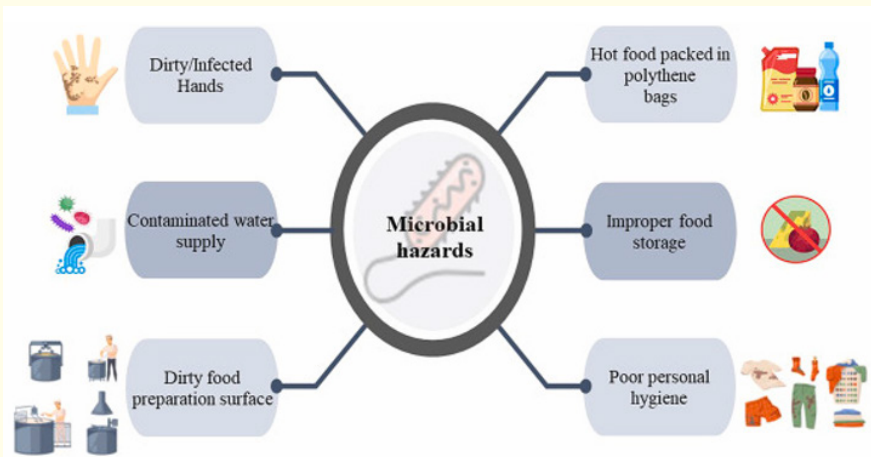


Figure 1: Causes of Food Contamination and Mcrobial Hazards [45].

Hazards

The assurance that the food won't harm the consumers is referred to as food safety (Figure 2). One's understanding of food safety is enhanced by learning the definitions of two additional terms, toxicity and hazard. The ability of a substance to hurt or injure people at all times is referred to as toxicity. Physical, chemical, and biological agents that have a reasonable chance of causing sickness or harm in the absence of this control are considered hazards. It has had a negative impact on consumers' health [23].

- **Physical hazard:** A physical hazard is any physical substance that isn't often present in food but can still make you sick or hurt you. Examples include wood, stones, insect parts, hair, and more.

- **Chemical hazard:** Chemical dangers are dangerous substances that might be intentionally or accidentally added to food. This group of risks includes pesticides, chemical residues, toxic metals, polychlorinated biphenyls, preservatives, food colours, and other additives.
- **Biological hazard:** Biological dangers are those posed by living microorganisms, such as microbiological organisms. Food-borne pathogens are bacteria that can make people ill and are connected to food. Poisoning and microbial pathogen infections (Figure 3) are two examples of food-borne illnesses [23].



Figure 2: Safety of Street Foods [46].

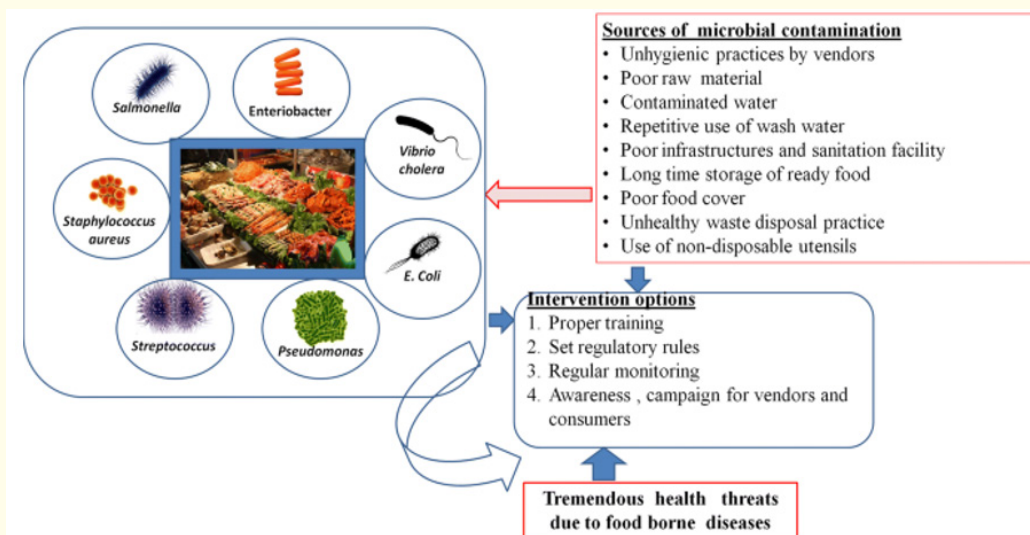


Figure 3: Biological Hazards and Prevention of Street-Vended Foods [47].

Food hygiene

In many nations when unemployment is high, wages are poor, there are few job possibilities and social services, and urbanisation is occurring, street food consumption is widespread. Street food sellers enjoy a positive revenue flow, frequently avoid paying taxes, and have control over their own working hours. To employees, shoppers, tourists, and others on modest incomes, they offer a crucial service by supplying snacks, full meals, and refreshments at comparatively low costs. People who depend on such cuisine are frequently more concerned with its convenience than its safety, quality, and hygienic standards. For food control officers, the hygienic aspects of vending operations are a key source of worry. For

instance, stands are frequently spartan constructions, and running water may not always be convenient. Additionally, there are rarely enough restrooms or washing facilities. It's common practise to wash hands, utensils, and dishes in buckets or basins. In places where there is no organised sewage disposal, disinfection is typically not done, and insects and rodents may be drawn to the area. Finally, food is typically not refrigerated and is not sufficiently protected from pests. The involvement of street food vendors in the spread of diarrheal infections, the microbiological quality of street foods, and risk variables that could make food contaminated with bacteria were all assessed in the same region [48].

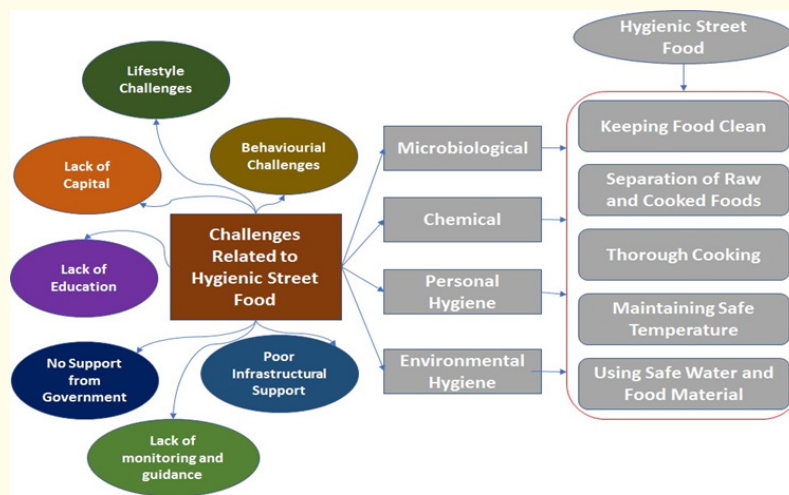


Figure 4: Conceptual diagram indicate the key challenges being faced by street vendors in India.

The four fundamental challenges with maintaining food safety are shown in figure 4. The literature discusses issues with sanitation and hygiene as they relate to street cuisine. The material also outlines the hygiene requirements that must be upheld for the safe preparation and retailing of food. However, there is no literature on the difficulties faced by Indian street food sellers as they attempt to deal with issues with sanitation and cleanliness in order to provide food that is hygienic and safe. This study will fill in this research gap in the literature [49]. A greater emphasis is now placed on managers to identify and provide food hygiene training appropriate to the work activities of the food handler and to monitor their performance in the workplace under new food hygiene regulations that have been in effect throughout the UK since January 1, 2006. We questioned food handlers on their attitudes towards food hygiene training, how relevant they thought it was to their jobs, and how much managerial support they received before and after the training. Data on organisational norms and managers' motivations to encourage the adoption of safe food handling practises by food handlers at work were acquired through interviews with people working in the food business [50,51]. Studies are pertinent to this book chapter.

The present study was conducted in Lucknow city, by using cluster sampling and randomly selecting 100 street food vendors in different areas of Lucknow city which were operating in busy streets (market), near schools and offices the study was conducted. Data was collected through a structured questionnaire, interviews, and observations, and data were entered and analyzed with the help of IBM SPSS Statistics 20, and analysis was done using descriptive statistics. Results were presented in terms of a chi-square (χ^2) test, percentage, and p value. A descriptive survey design was used to answer questions concerning the current status of hygiene practices by vendors of street foods. The data collection sheet (questionnaire) was used to assess the hygiene practice of street food vendors. The data collection sheet was a combination of the questionnaire used in previous studies by (Ngoc, *et al.* 2020; Sharaf 2020), and before adopting the final questionnaire, I made some significant changes. Before the survey's final version was adopted, all of the questions were standardized. The questionnaire was divided into two main sections: socio-demographic Profile, hygiene practices and knowledge. The socio-demographic Profile was assessed through the information on variables age of the respon-

dent, qualification of the respondent, gender, occupation, training and experience. The food hygiene practices and knowledge portion (13 questions) was developed to measure vendors’ awareness and the information were assessed through these variables such as Use of the apron, Availability of Water sources, Clean with soap, Washing hand, Animals and Using the mask, Using head cap, Using gloves, Eating, cleaning, infectious, Microbes and Health were studied. The present study, with the help of knowledge practices, and hygiene practices level of the respondent with knowledge, and practices scale. 13 questions were asked on a dichotomous (Yes/No) scale to assess food hygiene practices and knowledge. A Yes answer received a value of 1, while a No answer received a value of 0. The relationship of these hygiene practices variables with the Socio-demographic Profile of vendors has been assessed with a chi-square (χ^2) test. The impact of the Socio-demographic Profile on knowledge level, on practice level, was checked with the help of a chi-square (χ^2) test. The influence of hygiene practices of the vendors on their knowledge, and practices. Hygiene knowledge practice was assessed with the help of the chi-square (χ^2) test and level of significance at 5%.

Study participants’ socio-demographic profile

The vendors’ personal information included their age, qualification, gender, occupation, training, and experience. Table 1 reveals that the majority of respondents (37%) were in the age group of 20 to 30 years. Whereas 30-40 years old were 30%, 40-50 years old were 19%, and above 50 years old were 14% respectively (Figure 5). Very few respondents were females (15%) and the majority of the vendors were male (85%). Out of the total respondents, 46% of the respondents were illiterate, while 28% of the respondents have achieved a secondary level of education, in addition, 18% have achieved the primary level of education and a few vendors achieved graduate-level education respectively (Figure 6). The majority of the respondents (56%) were non-government. Whereas businesses were 35% and house-wife was 9% respectively (Figure 7). The majority of the respondents (29%) had experience of less than one year (Figure 8). Whereas 1-2 years had the experience at 15%, 3-4 years had the experience at 11%, above more than five years experience were 45% respectively.

Hygiene practices and knowledge observed in food handlers

The study revealed that most of the vendors (94%) practiced selling their food items without wearing gloves, 96% did not cover their heads and 98% did not wear an apron. Almost all vendors were not aware of the covid-19 infection, while some vendors were knowledgeable of the coronavirus infection through contact and touching the contaminated surface, and some were not.

S. No.	Characteristics	Percentage(%)
1.	Age	
	20 to 30 years	37%
	30 to 40 years	30%
	40-50 years	19%
	Above 50 years	14%
2.	Qualification	
	Primary level	18%
	Secondary level	28%
	Graduate level	8%
3.	Illiterate	46%
	Gender	
	Male	85%
	Female	15%
4.	Occupation	
	Non- government	56%
	Business	35%
	House-wife	9%
5.	Training Received	
	No	90%
	Yes	10%
6.	Experience	
	More than five years	45%
	3-4 years	11%
	1-2 years	15%
	Less than one year	29%

Table 1: Socio-demographic Profile of the Food Vendors (N = 100).

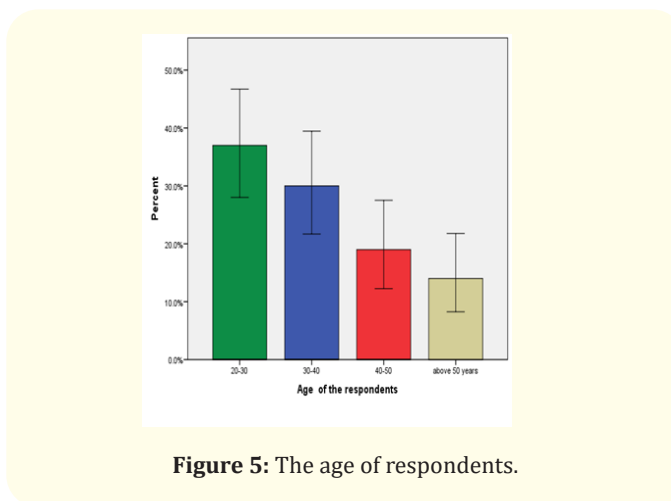


Figure 5: The age of respondents.

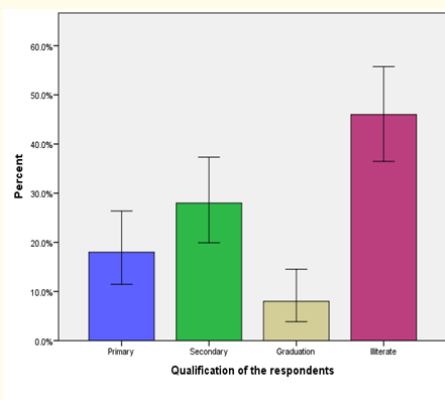


Figure 6: The qualifications of respondents.

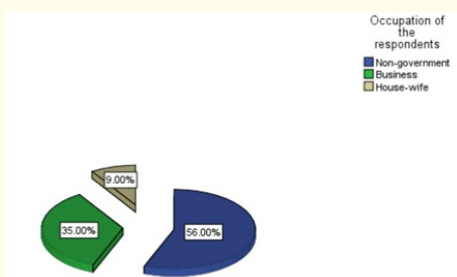


Figure 7: Occupation of the respondents.

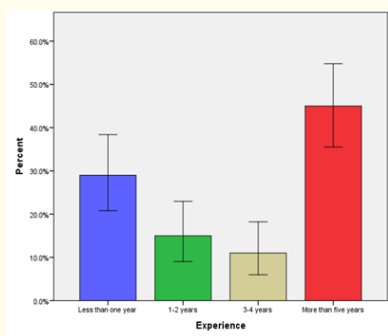


Figure 8: Vendor Experience.

As shown in table 3 there was a statistically significant difference in the hygiene practices, Training programs have a significant association with the use of aprons as the chi-square value is 18.376 ** which is highly significant, (0.009) statistically significant at 5% (0.05) level of significance. Occupations and qualifications have an association with the washing hands as the chi-square value is 11.105** and 9.309** which is highly significant, (0.004, 0.025) statistically significant at 5% (0.05) level of significance. Age, Qualifications, and Training have a significant association with Animals around shops. As shown in Table 3 there was a statistically significant difference in the hygiene practices, Experience have an association with the infectious disease of the skin as the chi-square value is 15.699** which is highly significant, (0.001) statistically significant at 5% (0.05) level of significance. Age and Qualification

have an association with the health status of workers as the chi-square value is 11.610** and 10.908* which is highly significant and significant, (0.009, 0.012) statistically significant at 5% (0.05) level of significance. The training program, qualifications, and age have an association with Using the mask as the chi-square value is 7.104**, 13.109** and 10.163 ** which is highly significant, (0.008, 0.004, and 0.017) statistically significant at 5% (0.05) level of significance. Experience has a significant association with Microbes in the skin, nose, and mouth of healthy handlers. Training programs have a significant association with using gloves. Experience and Qualifications have an association with Eating and drinking in the workplace increases the risk of food as the chi-square value is 8.073* and 9.038* which is significant, (0.045, 0.029) statistically significant at 5% (0.05) level of significance. Qualifications have a significant association with Proper cleaning and sanitization of utensils decreasing the risk of food contamination as the chi-square value is 10.986* which is significant, (0.012) statistically significant at 5% (0.05) level of significance.

S. No.	Hygiene practices	Yes	No
1.	Does a water source are available nearest to your vending area?	26%	74%
2.	Do your dirty utensils cleaned with soap and cleaned water	44%	56%
3.	Does the operator use an apron when handling, preparing and serving food	2%	98%
4.	Does the operator wash their hands in clean water each time before the handling, preparation, and serving of food	25%	75%
5.	Do animals or pests evident around the vending stall during serving food?	28%	72%
Knowledge of hygiene practices			
6.	Using a mask while handling food reduces the risk of food contamination	61%	39%
7.	Using a head cap at the time of working reduces the risk of food contamination	4%	96%
8.	Using gloves while handling food reduces the risk of food contamination.	6%	94%
9.	Eating and drinking in the workplace increase the risk of food	16%	84%
10.	Proper cleaning and sanitization of utensils decrease the risk of food contamination.	25%	75%
11.	During the infectious disease of the skin, it is necessary to take leave from work.	20%	80%
12.	Microbes are in the skin, nose, and mouth of healthy handlers.	15%	85%
13.	The health status of workers should be evaluated before employment.	20%	80%

Table 2: Hygiene Practices and Knowledge Observed in food handlers (N = 100).

Hygiene Practices								
	Use of apron		Availability of Water sources		Clean with soap	Washing hand	Animals	
Age	3.470(0.324)		0.731(0.866)		2.266(0.519)	2.41(0.491)	9.507**(0.023)	
Occupation	1.60(0.449)		4.392(0.111)		0.568(0.753)	11.105**(0.004)	4.567(0.102)	
Qualification	5.248 (0.155)		5.433(0.143)		0.446(0.931)	9.309**(0.025)	10.279**(0.016)	
Training	18.376 **(0.009)		1.132(0.287)		0.072(0.788)	1.333(0.248)	4.321**(0.038)	
Hygiene practice knowledge								
	Using mask	Using head cap	Using gloves	Eating	cleaning	infectious	Microbes	Health
Age	10.163** (0.017)	6.089 (0.170)	3.648 (0.302)	1.976 (0.577)	2.075 (0.557)	4.536 (0.209)	6.625 (0.085)	11.610** (0.009)
Qualification	13.109** (0.004)	1.818 (0.611)	5.291 (0.152)	9.038* (0.029)	10.986* (0.012)	3.990 (0.263)	18.671** (0.000)	10.908* (0.012)
Occupation	1.039 (0.595)	3.274 (0.195)	2.989 (0.224)	3.486 (0.175)	0.895 (0.639)	0.367 (0.832)	3.682 (0.304)	1.104 (0.623)
Experience	0.467 (0.926)	5.093 (0.165)	4.975 (0.174)	8.073* (0.045)	3.717 (0.294)	15.699** (0.001)	9.885* (0.020)	4.237 (0.237)
Training	7.104** (0.008)	37.500** (0.000)	3.861* (0.042)	0.132 (0.716)	3.704 (0.054)	2.778 (0.096)	0.218 (0.641)	2.778 (0.096)

Table 3: Association of Hygiene Practices with Demographic profile and Hygiene practice knowledge with demography (chi-square and p values).

Note: Figures of outside are the value of chi-square (χ^2) statistics, and figures in brackets are the significance value or p value. *5% level of significance.

In addition, study shows that it is necessary to maintain good hygiene practices around open street food displays such as street food products, salad bars, and fresh produce displays. Street food vendors should always be advised to wash their hands with soap and clean water before the preparation of food and after handling money. Both street food handlers and consumers should strictly observe good personal hygiene practices at all times around open food areas. The study concluded that vendors are not selling safe food to consumers. During the COVID-19 pandemic, street food is not allowed, yet it is being sold everywhere, and the street is not deserted either. Swiggy and Zomato, a food service where people order their food and eat their food, also serve the night. Swiggy and Zomato solders became very cautious about hygiene practices and personal hygiene during COVID- 19 Pandemic. But he was not always able to be aware of hygiene practices and personal hygiene. Swiggy and Zomato solders sold food on time and a sales prize was also decided for them. Their main objective is money-making without considering the health of the community.

The positive aspect of the study was that vendors were willing to have food security hygiene practices training. The sanitary status of street food production should be checked, and street food shops should be registered. Few of the vendors possessed less knowledge of health and personal hygiene. They still need to put their

knowledge into practice and increased it. To ensure this, authority-supported awareness-raising training programs and regular monitoring should be implemented in Lucknow Street food vending. Personal protective equipment (PPE), such as masks, gloves, aprons, and head caps can be effective in reducing the spread of viruses and disease within the street food sectors, but only if used properly. For this, during the study, street food vendors in Lucknow City were given awareness training programmes and personal protective equipment (such as head caps, masks, and gloves). Furthermore, street food vendors should be firmly advised to implement physical distance as well as strict hygiene and sanitation measures.

Following the awareness training programme, I did a study on the effectiveness of a food security awareness training programme for street food vendors in Lucknow city. The vendors’ knowledge and practice scores were compared before and after the food security awareness training intervention in this study. After the intervention, there was a greater improvement in knowledge scores; however, there was little improvement in practice when examining the personal hygiene practices of food vendors. Few vendors were wearing personal protective equipment (such as head caps, masks, and gloves). According to the findings of this study, the food security awareness training programme increasing the higher knowledge only and few practices increases.

Touching on Solutions, and Some conclusions

The result shown in table 2 concludes that the low quality of street foods can be a threat to consumers' health, due to lack of adequate hygiene practices. This is a serious issue that receives little attention, as most vendors did not know about using gloves while handling food, in addition, some food operators wash their hands in clean water each time before handling, preparing, and serving food, and mostly did not cover their heads and wear an apron, etc. Street food vendors must be trained on food security and Standard Operating Procedures for ensuring the hygiene of the cooked food and consumption. To maintain the food quality of street food and protect against microbes, further vendors may be introduced to the benefits of the application of nanotechnology or nanoparticles through training. The health hazards associated with street foods may well be controlled by maintaining food security quality of food, clean water, maintaining proper hygienic conditions, and personal hygiene of food handlers during pandemics or any other communicable disease. Future research should concentrate on identifying the microorganisms from food handlers and utensils in addition, to laboratory analysis of water used for washing utensils and preparing street food, and determining the nutrient content of the street food. In addition to awareness training programme, supportive measures such as financial aid and constant monitoring are required to improve food safety practices and vendor personal hygiene.

Recommendations

- Personal protective equipment (PPE) used and body temperature of all street food vendors should be regular checked during COVID-19 pandemic and awareness should be given through training program to follow the rules of health protocol developed by World Health Organization.
- Personal hygiene of street food vendors should be monitored strictly in order to protect community from COVID-19 pandemic.
- All street food vendors must be mandated to wear proper uniforms while cooking and handling food.
- All street food vendors must have a health certificate and be immune to food-borne diseases such as typhoid and hepatitis.
- Food hygiene health education should be provided to community awareness training programmes.
- Street food vendors must maintain their utensils and surroundings clean and hygienic.
- Hand washing with soap and sufficient water should be done before eating, while cooking, handling food, and after using the toilet.

Disclaimer

This paper is an extended version of a preprint document of the same author. The preprint document is available in this link: <https://assets.researchsquare.com/files/rs-1773368/v1/fd2ae5d9-1339-47f4-8d65-ca3aa1636999.pdf?c=1657097956>.

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