Original Article

Food safety profile of street food vending units in Chennai, Tamil Nadu: A cross-sectional study

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Abstract

Background: The burgeoning street food sector despite being an affordable source of fast, tasty meals, pose significant challenges to food safety. This study was conducted to assess knowledge of foodborne diseases among food handlers in street food units of Chennai, Tamil Nadu and describe their food safety profile. **Materials and methods:** A descriptive, cross-sectional study was conducted among street food units of Chennai, Tamil Nadu between August and October 2016, using multi-stage sampling method. A pretested schedule with following sections was employed in local language: sociodemographic and food business characteristics; knowledge on foodborne diseases; personal habits and hygiene of food handlers and an observational checklist for environmental and work surface hygiene. **Results**: Majority food handlers (62%) were aged 26 to 45 years; 26.5% lacked formal education. Among 200 units studied, 62% functioned part-time; 89% were unregistered. Three-fourth of food handlers had heard about foodborne diseases; 9% used hair cover while cooking; 35% wore aprons; 51% had trimmed nails; 5.5% wore gloves while serving; 34.5% washed hands with soap before cooking. Eighty percent units had own water source for cooking and 61% for washing; 23.5% had nearby restrooms; 59.5% had hand washing facility; 52% had solid-waste disposal facility; 66% units stored raw and cooked foods separately. Knowledge on foodborne diseases showed significant association with age and educational status of participants ($P<0.05$). **Conclusion:** Our study observed an unsatisfactory level of knowledge on foodborne diseases, inadequate individual hygiene, environmental safety and food handling practices, underscoring the necessity for targeted educational and regulatory measures.

Key words: Food safety; Food hygiene; Food handlers; Food handling practices; Street foods

Introduction

Unsafe food containing harmful microorganisms or detrimental chemicals contribute to about 200 diseases, ranging from diarrhoea to cancers, resulting in an estimated 2.2 million deaths per year.[1,2] Apart from resultant morbidity and mortality, foodborne diseases also impede socioeconomic development. "Food hygiene" which comprises all conditions and measures imperative to ensure food safety from production to consumption, is a basic and essential requisite.[3]

Socioeconomic changes worldwide have led to burgeoning of street food sector, which has become part of urban experience.[4] Street foods are an alternate and affordable source of fast, tasty meals for a predominant migrant population and local population.[4] They make important contribution to employment, household income and food security.[5,6] The convenience of operating in minimal spaces is a boon in crowded cities.[4]

Despite above benefits, street foods constitute a potential public health risk due to microbiological contamination and environmental pollution.[4,6] Street food vendors are often uneducated and lack appreciation for safe food handling.[4,6] The diverse and temporary, informal nature of street food sector poses challenge for identifying and enforcing regulatory measures.[6] Inculcating awareness on food safety principles among street-food vendors is one of the most

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economic options for prevention and control of foodborne diseases due to street foods.

There is significant paucity of published literature which assess knowledge and practices of food handlers or food safety profile in street food vending units in India, despite their increasing growth. Hence the present study was planned to identify the knowledge and behaviour related to food safety among food handlers and to assess the food safety profile of street-food vending units.

Materials and methods

This was a descriptive, cross-sectional study conducted between August and October 2016 among street-food vendors in selected areas of Chennai city, Tamil Nadu. Based on Manes et al study[7] among restaurant food-handlers in Chennai, where proportion of respondents with correct knowledge related to hand hygiene was 49%, the required sample size was estimated at 178, with relative precision of 15%. Assuming 15% non-response rate, sample size was finalised at 205. A multi-stage sampling method was used. Chennai city has three administrative divisions: North, Central and South Chennai which are further divided into 15 administrative zones consisting of 200 wards. In the first step, 2 zones were chosen from each of the three divisions by simple random sampling. From each of the 6 zones chosen, 5 wards were selected by simple random sampling to obtain a total of 30 wards. In each of these 30 wards, one locality was chosen and 7 street-food units selected by simple random sampling to achieve a total sample size of 210. If any of the localities was residential, another locality was selected by simple random sampling.

Institutional Ethics Committee approval was obtained prior to initiation of the study. A pretested, semi-structured schedule, developed based on the Training manual for food safety regulators by Ministry of Health and Family welfare, India and World Health Organization (WHO) "Essential safety requirements for street-vended foods", was administered in local language to one employee selected by simple random sampling from each street-food unit after obtaining informed written consent.[6,8] The schedule consisted of following sections: sociodemographic characteristics, food business characteristics, knowledge on foodborne illnesses and food safety, personal habits and hygiene of food handlers, an observational checklist to assess environmental hygiene and food handling practices.[6]

Operational definitions

"Street vended foods/street foods" are defined as foods and beverages prepared and/or sold by vendors in streets and other public places for immediate consumption at a later time without further processing or preparation. It includes fresh fruits and vegetables which are sold outside authorized market areas for immediate consumption.[6]

Food handler: any person who handles food regardless of whether he actually prepares or serves it.[6]

Statistical analysis: The data was entered in Microsoft Office Excel 2007 and statistical analysis was performed using

Table 1: Baseline characteristics of respondents and food business (N= 200)

Variables	Number	Percentage (%)
Sociodemographic characteristics of respondents		
Age		
Below 25 years	35	17.5
26 to 45 years	124	62
Above 45 years	41	20.5
Sex		
Males	142	71
Females	58	29
Educational status		
No formal education	53	26.5
1-5 years of education	31	15.5
6-10 years of ducation	70	35
More than 10 years of education	46	23
Marital status		
Married	149	74.5
Unmarried	51	25.5
Employment characteristics of respondents		
Type of job		
Cook	105	52.5
Helper	39	19.5
Waiter	12	6
Seller	44	22
Duration of employment		
Less than 5 years	45	22.5
5 to 15 years	108	54
More than 15 years	47	23.5
Type of training obtained		
By observation	96	48
By trial and error	70	35
From parents or others	34	17
Food business characteristics		
Type of food served*		
Beverages	24	12
Fried foods	79	39.5
Fruits and vegetables	47	23.5
Grains and cereals	22	11
Meat and fish	42	21
Type of food preparation		
Cooked-on-site	56	28
Ready-to-eat (cooked elsewhere)	41	20.5
Both	70	35
None (no specific	33	16.5

*Multiple responses obtained

Table 2: Distribution of respondents' responses to assessment of knowledge on foodborne diseases and food safety

Variable	Frequency (N=146)	Percentage (%)
Causes of food-borne diseases		
Contamination	36	24.7
Poor personal hygiene	26	17.8
Poor cooking products and practices	25	17.1
Poor sanitation and pollution	47	32.2
Adulteration	3	2
Organism	9	6.2
Modes of transmission of food-borne diseases*		
Improper cooking practices	12	6
Poor hygiene	32	16
Food adulteration and reuse of ingredients	4	2
Food and water contamination	72	36
Environmental pollution	23	11.5
Poor waste management	4	2
No opinion	53	26.5
Symptoms of food-borne diseases*		
Abdominal pain	47	23.5
Fever	60	30
Headache	12	6
Diarrhoea	61	30.5
Vomiting	68	34
Cough	3	1.5
Constipation	1	0.5
Myalgia	6	3
Are food-borne diseases preventable?		
Yes	139	95.2
No	7	4.8
Measures to prevent food-borne diseases*		
Personal hygiene	61	30.5
Use of fresh and clean ingredients	8	4
Using clean water	20	10
Proper cooking practices	15	7.5
Proper waste management	3	1.5
By keeping environment clean	35	17.5
No opinion	58	29
Can raw and cooked food be stored together?		
Yes	22	15.1
No	124	84.9

*Multiple responses obtained

Statistical Package for Social Sciences version 23. Categorical data was expressed as frequencies and percentages. Continuous variables were summarised as mean and standard deviation (SD). Chi-square test and student t-test were used for statistical analysis of categorical and continuous variables respectively. A P-value of 0.05 was considered significant.

Results

A total of 200 street vending units participated. Responses were collected from 200 respondents from these units. Table 1 shows the distribution of sociodemographic and employment characteristics of participants and baseline characteristics of food units.

Among the 200 respondents who participated in the study, 146(73%) reported having heard about foodborne diseases. These 146 respondents were further assessed for their knowledge on foodborne diseases and food safety. Table 2 depicts the distribution of participants' responses on foodborne diseases and food safety.

Food safety profile of street-food units were assessed under following heads- environmental characteristics of street-food units, personal habits and hygiene characteristics of

Table 3: Distribution of food safety characteristics of the street food units

Food safety characteristics of the unit	Yes (N=200)	Percentage (%)
Environmental characteristics of street food units		
Clean Neighbourhood of the street vending unit	130	65
Own safe source of water for cooking purposes	161	80.5
Own safe source of water for washing purposes	122	61
Availability of restrooms (Private or Public)	47	23.5
Availability of hand washing facility	119	59.5
Availability of refrigeration facilities	42	21
Availability of exclusive solid waste disposal facility *	104	52
Availability of liquid waste disposal facility	88	44
Individual habits and personal hygiene characteristics		
Smoking	59	29.5
Alcohol intake	51	25.5
Smokeless tobacco usage	19	9.5
Wearing outer garments	70	35
Wearing hair cover	18	9
Not wearing jewellery	148	74
Nails trimmed and clean	102	51
Wearing clean gloves while serving	11	5.5
Washing hands with soap and water before working with food	69	34.5
Washing hands with soap and water after using rest rooms	139	69.5
Wearing footwear	182	91
Had atleast one medical check-up in the past six months	27	13.5
Work surface hygiene characteristics		
Clean work surfaces before and after each task	145	72.5
Using soap or detergent for washing utensils	104	52
Using hot water to wash utensils	12	6
Ready-to-eat foods kept in clean and covered container	149	74.5
Raw food items stored separate from cooked food	132	66
Cooking and storing utensils kept clean and separate	122	61

* Among the 104 units which had exclusive solid waste disposal facility, only 21 had closed lid bin, while the remaining 83 had open lid bin.

respondents and work surface hygiene. Table 3 presents the observations under food safety profile.

The personal habits and hygiene characteristics were scored (1 for healthy behaviour; 0 for unhealthy behaviour) for a maximum of 12. The mean score was 6.18 (SD 1.76). Among the 200 respondents 43% scored more than 6 and 57% scored 6 or less.

None of the respondents had undergone screening for any foodborne diseases, or any other form regular health screening.

Forty units (20%) used stainless steel plates for serving, 52 (26%) used paper plates; 111 (55.5%) used plastic plates and 4 (2%) units used plantain leaves. Few units used more than one type of serving plates.

Table 4 depicts distribution of awareness on foodborne diseases and personal habits and hygiene score of participants among sociodemographic and professional characteristics.

The mean of personal habits and hygiene score was compared among those aware about foodborne diseases (6.40 ± 1.736) and those who had not heard about foodborne diseases (5.61 ± 1.698). The difference was statistically significant ($P < 0.05$).

Discussion

Street-food sector has become an integral aspect of urban lifestyle and is increasingly gaining prominence in rural areas. The present study was conducted to assess the safety profile of street-food units in Chennai, Tamil Nadu.

Sociodemographic characteristics

Two hundred street-food units participated in the study. Sixty-two percent respondents were aged between 26 to 45 years. Similar predominance of age group 25 to 45 years (63%) was reported by Thakur et al in their study among street-food vendors in Delhi.[9] The similar age distribution among Indian studies reflect the importance of street-food sector as source of livelihood for the most productive age group. Males constituted 71% of our study population. The gender distribution varies from similar studies by Isara et al and Muyanja et al.[10,11] One-fourth of our participants (26.5%)

Table 4: Distribution of awareness on foodborne diseases and personal habits and hygiene score among sociodemographic and professional characteristics of participants

Variable	Total	Aware about foodborne diseases (n=146)	P value	Score > 6 for personal habits and hygiene(n=86)	P value
Age group					
= 25 years	35	28 (80)	**<0.001***	13 (37.1)	**0.025***
26 to 45 years	124	99 (79.8)		62 (50)	
Above 45 years	41	19 (46.3)		11 (26.8)	
Sex distribution					
Males	142	108 (76.1)	0.090	59 (41.5)	0.533
Females	58	38 (65.5)		27 (46.6)	
Educational status					
No formal education	53	24 (45.3)	**<0.001***	20 (37.7)	0.812
1-5 years of education	31	24 (77.4)		13 (41.9)	
6-10 years of education	70	56 (80)		32 (45.7)	
> 10 years of education	46	42 (91.3)		21 (45.7)	
Marital status					
Married	149	105 (70.5)	0.115	64 (43)	0.555
Unmarried	51	41 (80.4)		22 (43.1)	
Type of job of the respondent					
Cook	105	79 (75.2)	0.064	50 (47.6)	**<0.001***
Helper	39	33 (84.6)		24 (61.5)	
Waiter	12	7 (58.3)		4 (33.3)	
Seller	44	27 (61.4)		8 (18.2)	
Duration of employment					
Less than 5 years	45	37 (82.2)	0.080	17 (37.8)	**0.037***
5 to 15 years	108	80 (74.1)		55 (50.9)	
> 15 years	47	29 (61.7)		14 (29.8)	
Type of training obtained					
By observation	96	74 (77.1)	0.361	47 (49)	0.052
By trial and error	70	47 (67.1)		22 (31.4)	
From parents or others	34	25 (73.5)		17 (50)	

*p-value significant at <0.05

had never had formal education. Thakur et al and Donkor et al have reported similar trend from Delhi and Ghana respectively.[9,12] This distribution has implications on the greater need to create awareness among street-food handlers. Since these units are usually run by individuals or by families, educational status of respondents plays an important role in ensuring food safety measures.

Professional characteristics of respondents

More than half respondents of our study were employed as cooks, while rest were employed as helpers, waiters or sellers. This reflects the fact that most units are run by one or two persons who do multi-tasking. None of the participants in our study had any formal training or approved licence. Our findings contrast that reported by Okojie et al in Nigeria, where 28.7% of the respondents employed in street-food sector had undergone food safety training.[13] Thakur et al and Mudey et al have also reported that none of the food establishments in their studies had been registered or have valid licence.[9,14] Only 4.2% participants had undergone food handlers training in a similar study in Northwest Ethiopia.[15] A slightly higher proportion was reported by Zain et al in Malaysia, though more than 50% had no formal training or valid licence.[16] But Zain et al had included all types of food establishments and food stalls accounted for only 53.8%. Such comparable distribution among above studies highlights the informal nature of most food establishments in developing countries.

Food business characteristics

In our study 34.5% of food stalls sold fried food items followed by fruits and vegetables (23%) and meat and fish (21%). Thakur et al also reports that majority of establishments studied, supplied fried food items followed by meat-based snacks.[9] This differs from the distribution in Dhaka by Khairuzzaman et al, where fruits and vegetable-based food stalls were preponderant.[17] Most units supplied more than one type of foods in all the above studies.

In our study, less than 50% of street-food units had fixed stalls. Khairuzzaman et al reported a different picture from Bangladesh where majority were fixed stalls.[17] Only 11% of the establishments was registered and 8.5% of the food handlers had access to social security. The findings resemble those reported by Mudey et al in Wardha and Thakur et al in Delhi.[9,14] The comparable findings reveal gross underrepresentation of street-food units and need for regulatory measures.

In our study, 38% units operated full-time and 28% units, cooked-on-site. In Thakur et al's study in Delhi, 95% units operated full-time and almost twice the number of units, cooked-on-site revealing a well established street-food sector.[9]

Knowledge about foodborne diseases among food handlers

In our study only 73% participants had ever heard about foodborne diseases. The overall knowledge on foodborne diseases was less compared to similar studies in Malaysia and Northwest Ethiopia.[15,16] Among those who were aware about foodborne diseases, one-fourth had no idea about mode of transmission (26.5%). Though 95% respondents thought foodborne diseases are preventable, only 71% were aware about preventive measures. Fifteen percent of respondents opined that raw and cooked foods could be stored together. All respondents had adequate awareness on etiology and symptoms of foodborne diseases. The participants had limited idea on direct causes of foodborne diseases which varies greatly from the findings reported by Donkor et al where 98.4% had knowledge on pathogens and faeco-oral transmissions.[12] Tessema et al in Northwest Ethiopia, also reported that 88.9% respondents were aware about foodborne diseases, albeit only 32.4% had good knowledge.[15] In Zain et al's study knowledge regarding modes of transmission and preventive measures was higher compared to etiology and symptoms.[16] This varying pattern of responses could be due to diversity of study units in the above studies.

Awareness on foodborne diseases was significantly associated with age distribution and educational status of participants. Similar statistically significant relationship between educational status and knowledge was also reported by Zain et al.[16] Awareness about foodborne diseases had a significant influence on mean score of personal habits and hygiene. Tessema et al have also reported significant association between knowledge about foodborne diseases and food handling practices in Northwest Ethiopia.[15]

Environmental characteristics of street-food units

In our study, 65% of street-food units had clean neighbourhood and 59.5% had hand-washing facilities. This differs from findings reported by Okojie et al in Nigeria where 90.5% of street-food units had clean premises and 70% had exclusive hand-washing facilities.[13] Khairuzzaman et al in Bangladesh reported that only 22% of street-food units had hand washing facilities.[17]

In our study 80.5% and 61% of the food units had their own safe water source for cooking and washing purposes respectively. Although unsatisfactory, the figures are higher compared to that reported by Thakur et al in Delhi (7%) and Khairuzzaman et al in Bangladesh (22%).[9,17]

About half of the street-food units studied had exclusive solid waste disposal facility which is marginally higher than that reported by Okojie et al (43.2%) and Khairuzzaman et al (47%) and 44% had liquid waste disposal facility.[13,17] The proportion of study units which used closed lid bins for solid waste disposal (10.5%) was similar to that reported by Thakur et al (11%).[9] While 10% of our study units practised open waste disposal, the proportion reported by Thakur et al was much higher (17%).[9] In our study 59% units had fly and insect breeding in the premises which is much higher than that reported by Okojie et al (41.3%).[13] Our study records suboptimal environmental hygiene standards in most study units. Donkor et al study from Ghana reports satisfactory environmental hygiene in more than three-fourths of units.[12]

In our study, about one-fifth of street-food units had refrigeration facilities, whereas in the study by Khairuzzaman et al in Bangladesh, none of the units had refrigeration facilities.[17]

More than 75% of our study units did not have access to sanitary toilets. Among the rest, 20% used public facilities. This disproportionate access to sanitary toilet facilities was similar to findings by Khairuzzaman et al in Bangladesh.[17]

Personal habits and Personal hygiene of food handlers

In the present study, only 13% had undergone any routine medical examination in the past one year. In Zain et al study in Malaysia, 61.9% had undergone routine medical examinations and 59.6% were immunised with Typhoid vaccine.[16] But Zain et al had included diverse food establishments.[16] Hence the difference points to the state of disadvantage of street-food sector.

The proportion of participants who adopted personal protective measures in our study was lower compared to that reported by Okojie et al.[13] Only 35% of the participants wore aprons; 9% wore head cover, 74% wore jewellery while serving, 51% had clean, trimmed nails and 5.5% wore clean gloves while serving. Okojie et al in their study conducted among street-food vendors in Nigeria, reveal improved personal hygiene practices, where 84.6% wore apron; 98.6% wore hair cover and more than 90% had trimmed nails and did not wear jewellery.[13] In Thakur et al study from Delhi, a significant proportion had neat, trimmed nails.[9] But other personal hygiene measures such as wearing apron, head cover and gloves, washing hands were practised by less than 5% of participants.[9] These comparable trends related to inadequate personal hygiene practices among street-food sector employees in India is an issue of great public health concern and point to a pressing need for regulatory measures. While more than 50% participants reported washing their hands before cooking, only 34.5% participants reported washing their hands with soap and water before cooking. An

approximate 30% of study population accepted not washing their hands with soap and water after using rest rooms which is much higher than that reported by Donkor et al among vendors in Ghana (86.6%).[12]

The present study reveals significant association between age distribution and duration of employment with personal habits and hygiene score. Udgiri et al and Mudey et al has reported a statistically significant association between educational status and hygiene score.[14,18] Participants with 5 to 15 years of experience had better personal hygiene scores and this relationship was statistically significant.

Work surface characteristics

In the present study, about three-fourths of food units stored ready-to-eat food in clean and covered containers. Only 66% units stored raw and cooked foods separately despite 84.9% respondents being aware of the need to store raw and cooked foods separately. This indicates that the existing knowledge had not transformed into right behaviour. Okojie et al reported that 94.4% of study units stored their foods in covered container.[13] Donkor et al in their study reported that only 27% of the food stalls stored raw and cooked food separately at all times.[12] An approximate 25% units in our study did not store their cooking and storing utensils clean and separate. More than 50% of the units used plastic containers and plates, the quality and disposal of which is an issue of great concern. Twenty percent units used metal containers which require thorough washing, an activity which is questionable under circumstances observed. Eco-friendly materials like paper plates and plantain leaves were used by 28% units, which was encouraging.

Our study was conducted among street-food units spread over 3 divisions and 15 zones of Chennai Corporation and hence could be representative of street-food sector in most urban areas of India. This is one of the few studies which explore safety profile of street-food sector in India and the first in Tamil Nadu. We have attempted a comprehensive appraisal of food safety with assessment of knowledge on foodborne diseases; individual hygiene practices and environmental safety characteristics. There are pronounced similarities with other Indian studies on street-food sector, with regard to underrepresentation in aspects of registration and access to social security, inadequate knowledge on foodborne diseases, poor individual hygiene and environmental safety practices. The findings are comparable with those reported in Bangladesh and North West Ethiopia, emphasising the need for active and sustained measures to upgrade street-food sector in developing world.[15,17] However Okojie et al report better food handling practices and environmental sanitation in Benin City, Nigeria.[13] Donkor et al reports significant improvement in food handling practices, personal and environmental hygiene following a training programme on WHO keys for Safer food.[12]

The study has few limitations. Physical examination and laboratory investigations to rule out infections and other diseases among participants and microbiological sampling of work surface would have added value to the study, but were not carried out due to logistic and financial constraints.

Considering the increasing contribution of street-food sector to accessible and affordable food, there is a necessity for coordinated efforts from all stakeholders including the Government, local administrative authorities, food unit owners, food handlers and general public. Organised training sessions for all categories of food handlers is the need of the hour. Training and educational sessions should be followed by mandatory refresher courses and regulatory measures.

Conclusion

Our study assumes importance in the fact there are very few studies examining street-food sector in India and none in Chennai, major proportion of which is functioning under unhealthy and unregulated circumstances. This study observed suboptimal level of awareness on foodborne diseases, inadequate individual hygiene, environmental safety and food handling practices, underscoring the necessity for targeted health education programmes and regulatory activities. Regulation of street-food sector with mandatory registration could be placed under responsibility of local health and administrative authorities. Fresher training and health examination for all employees need to be provided and documented under organised database. Periodic awareness programmes could serve to inculcate food safety practices among food handlers and general public. Dedicated food streets in potential areas will help reduce environmental pollution and improve hygiene. There is a need for future surveys among street-food units to identify their unmet needs and plan appropriate measures.

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