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Food Safety Knowledge: The Case of Domestic Food Handlers in Accra

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Author's contribution

This work was carried out in collaboration between all authors. Authors PTA and MAA designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

The Food safety knowledge of 608 respondents in Accra was assessed under five food safety themes using a Likert-type scale questionnaire, and Mean Aggregate Score (MAS) for each theme computed. Further, the Mean of the MAS was calculated and used as an index of interpreting overall food safety knowledge of food handlers who participated in the study. The themes considered in this study were "Concern" for food Safety, "Cross-contamination", "General and personal hygiene", "Knowledge of pathogenic microbes" and "Handling left-over food". The relationship between respondents' knowledge of food safety and demographic characteristics was also explored. Some of the demographic factors that were found to influence food safety knowledge significantly were education and age but not gender. MAS ranged between 3.0 – 4.0 (Indifference – Agree) for "Cross-contamination" and "Handling-leftover", while the overall score for food safety knowledge was 3.6, interpreted largely as Good on the scale adopted for the study. Generally, however, respondents were well-informed in the areas of food safety concerns, general and personal hygiene and handling leftover food but not, as far as cross-contamination and pathogenic bacteria are concerned.

Keywords: Food safety; likert-scale; pathogens; food handlers; knowledge.

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1. INTRODUCTION

Food safety continues to be a public health problem worldwide because food borne illnesses are widespread. Consequently, consumers are increasingly concerned about food safety and quality; and demand more transparency in production and distribution.[1]reports that foodborne and waterborne diarrheal diseases together kill about 2.2 million people each year. Outbreak of foodborne illnesses have been cited as being responsible for 5000 and 500 deaths each year, respectively in the USA and England and Wales [2,3].Reports from other parts of Europe and North America also depict quite a similar trend [4]. The situation in developing countries is rather grim. One out of 40 Ghanaians are estimated to suffer, while 65,000are estimated to die annually from food borne illnesses. The total cost of the problem to the Ghanaian economy is valued as USD 69 million [5]. This makes the subject a pressing national issue and calls for an all-inclusive approach in dealing with it urgently.

The increase and associated significance of food borne illness has been attributed to dramatic changes in animal production, industrialization of animal production, mass production in food processing and distribution, emergence of new pathogenic organisms, globalization among other factors [6,7]. A great proportion of these diseases are erratic and hardly ever reported [8] because outbreaks are usually small, mostly traced to domestic kitchens and involve only a few people [9]. The causes of these illnesses have been traced to a large number of bacteria, viruses, heavy metals and toxic chemicals that have in one way or another, contaminated food or drinking water [10,11,12,13].

Although food contamination may occur at any point from production, processing, distribution and preparation [14], food handlers and other people responsible for food preparation have a critical role in the occurrence and spread of food borne illnesses as their hands and other body parts may harbour micro-organisms and their actions as well, may compromise the chain of safety from “farm-to-fork”. Indeed, previous studies have implicated food handlers and have shown improper food preparation practices in domestic kitchen, contaminated equipment and food, to be a significant origin of most of these cases [15,9,16]. Other factors that have been cited as contributing to food borne diseases include unsafe keeping of food (temperature and time), poor personal hygiene and food from unsafe sources [17].The objective of this survey was to assess food safety knowledge of domestic food handlers in Ghana under five common food safety themes since these food handlers are generally responsible for the nutrition of their families. This study would create more awareness and serves as a starting point for designing policies and food safety educational programmes [18,19] for food handlers from different segments of the Ghanaian populace.

2. MATERIALS AND METHODS

2.1 Study Area

A survey for a cross-section of domestic food handlerson food safety knowledge was conducted between the months of June and September 2012, in Accra. The study area has been described as being cosmopolitan and urbanized [20] and therefore fairly represents a modern dynamic society. It has a population of approximately 4,010,054, of which about52% is female [21]. Accra has a youthful population, with 56% of the population being under the age of 24 years [22].

2.2 Research Design, Selection of Respondents and Data Collection

A total of 608respondents, identified as usually being responsible for preparing the food they eat or preparing food for their households were randomly selected and interviewed for their knowledge about food safety. The study area was split into 6 sections and at least 30 homes from each section randomly selected for the study. Respondents were directly contacted at their homes, where the purpose of the study was explained to them and their informed consent sought. A well-structured questionnaire was chosen as the data collection instrument because it is likely to be less expensive in time spent to collect data and the fact that they could be given to many people simultaneously, therefore covering a wider area [23]. While those who could read and write were given the questionnaire to complete on their own, questions were interpreted for respondents who could not read and write in English and their responses entered on the questionnaire. This approach was aimed at enhancing the response rate and to ensure that people with varied educational backgrounds participated in the survey. The average completion time for one questionnaire was 15 minutes.

Statements on the questionnaire were adopted from previous studies [24,25,26] and modified to suit the objective of the current study. Most of these statements generally fall under the five key behavioral constructs for food safety education [16]. These questions were selected in order to elicit responses than can form a basis for assessing the extent of awareness and understanding of food safety among domestic food handler. The questionnaire was pre-tested on 30 respondents, leading to minor modifications and rearrangement of the statements. The questionnaire had a total of 33 questions, and was divided into two main parts. The first part (4 questions) was to record some respondents' demographic data while the second part contained 29questions; 25of them with a 5-point Likert-type scale, to ascertain respondent's knowledge of food safety. Responses to positive statements were scored as follows: "Strongly agree" – 5, Agree" – 4, "Indifferent" – 3, "Disagree" – 2, "Strongly Disagree" – 1. Negatively framed statements had a reverse of this order of scoring. The remaining 2 questions, which bothered on respondents' awareness of two commonplace bacteria worthy of food safety attention, had "Agree" and "Disagree" as responses.

2.3 Data Processing and Analysis

The statements on food safety knowledge were grouped under five themes, namely; Concern for safe food, Cross-contamination, General and Personal Hygiene, Microbial contamination and Handling left-over food. Responses under the various themes were coded and entered into the Statistical Package for Social Sciences (SPSS v 17.0.1, SPSS Inc, 2008) and analysed using descriptive statistics. A Mean Aggregate Score (MAS) was calculated for each theme by summing up the scores (Microsoft Excel, 2010) given to statements under a particular theme and dividing it by the frequency of a chosen option, viz:

$$MAS = \frac{\sum(frequency\ of\ option\ x\ score\ assigned\ to\ option)}{\sum frequency\ of\ option}$$

On the 5-point Likert scale, the MAS ranged between 1 and 5, i.e., "Strongly Disagree" and "Strongly Agree". The Mean of the MAS was adopted as the index of food safety knowledge and interpreted as follows; 5 – Excellent, 4 – Good, 3 – Fair, 2 – Weak, 1 – Poor. The association between respondents' food safety knowledge and their demographic background was also assessed using ANOVA and t – test (for comparison of food safety knowledge among genders).

3. RESULTS AND DISCUSSION

3.1 Demography of Respondents

The study population of 608, made up of 67.1% female and 32.9% male, was well educated and generally youthful (Table 1). More than 80% fell within the age bracket of 20–39 years. Apart from 3.3% who had no education, respondents had either vocational education (8.6%), Secondary education (Middle/Junior/Senior secondary)(41.4%) or tertiary education (46.7%). Also, respondents from the study population were either married (38.2 %) or single (61.8%).

Table 1. Demographic characteristics of study population

Characteristic	*n*	Percentage (%)
Gender		
Male	200	32.9
Female	408	67.1
Age (years)		
Less than 20	76	12.5
20 – 29	288	47.4
30 – 39	216	35.5
40 – 49	16	2.6
50 or more	12	2.0
Educational		
No Education	20	3.3
JHS/Middle	72	11.8
SHS/Secondary	180	29.6
Vocational	52	8.6
Tertiary	284	46.7
Marital Status		
Single	376	61.8
Married	232	38.2
N= 608		

3.2 Food Safety Themes

The Mean Aggregate Scores (MAS) for each of the 5 thematic areas of food safety knowledge are presented in Table2. Generally the results reveal a good level of food safety knowledge among the largely educated and youthful domestic food handlers encountered, since high MASs were recorded for 3 out of the 5 thematic areas investigated. These scores ranged from 3.1 for “Microbe knowledge” to 4.0 for “Handling Leftover” food. Using the Likert scale interpretation (“1 – 5”,“Strongly disagree” – “Strongly agree”), respondent generally “agreed” to statement under all the themes apart from those concerning “microbial knowledge” and “cross-contamination”, to which they were “indifferent”.

The MAS for “Concern” ($p = 0.466$) and “General and Personal Hygiene” ($p = 0.150$) were not significantly different ($p > 0.05$) among the different educational classes from which the respondents came (Table 2). However, MAS for “Cross-contamination” ($p = 0.026$), “Microbe knowledge” ($p = 0.001$) and “Handling leftover” ($p = 0.040$), were significantly different among the various educational backgrounds, especially among those belonging to “No Schooling” and the two other educational levels. These three

latter themes are somewhat technical and may therefore require some form of formal education or training to fully understand. Indeed, a correlation has been established between some form of education and knowledge about food borne pathogens [27]. Respondents who have not had any formal education are likely to find it difficult to understand explanations during mass public food safety education campaigns and probably underrate their importance [28]. This may account for the fact that respondents who have not had any schooling had quite a low level of food safety knowledge. The dearth of knowledge and awareness in the area of microbes and cross-contamination, emphasizes the need to design special awareness programmes along these themes, for this category of food handlers, aside of the general food safety awareness activities. “Concern” and “Microbial knowledge” were not significantly different among the age groups ($p = 0.103$ and $p = 0.239$ respectively), an observation conciliatory with parts of an earlier report by [19].

Respondents between 20 – 49 years seemed to have a superior knowledge of food safety under “cross-contamination”($p = 0.001$), “General and Personal Hygiene” ($p = 0.008$)compared to those less than 20 years and 50 years or more (Table 3). Knowledge of “Leftover handling” is however akin for ‘20 – 49 years’ and ‘less than 20 years’; and ‘20 – 40 years’ and ‘50 years or more’ but not for ‘less than 20 years’ and 50 years or more. The findings are rather comparable to but not exhaustively consistent with earlier studies [29] since a clearly defined trend of influence of age on food safety knowledge was not realized. Very young and old consumers as well as those of low educational backgrounds have been cited in other studies as being more vulnerable and exposed to a higher risk of contracting foodborne ailments [30,31] as has been shown under “cross-contamination” and “general and personal hygiene”. This occurrence demonstrates an urgent need for food safety awareness creation among this segment of food handlers.

Women in many societies, are more informed than men about food handling and storage [26]. In line with Ghanaian socio-cultural norms as well, females are associated with cooking. This makes them the target of most food preparation and handling programs and therefore, were expected to be more conversant with food safety compared to males [26]. However, this was not the case in this study. Generally both male and female respondents were equally knowledgeable on the food safety themes examined ($p > 0.05$). This may be due to literacy among males being higher [22], as this has been established to influence food safety knowledge positively [32,19].This out come agrees with reports by [33,34,35] but proves inconsistent with findings by other authors [36,37,19].

Respondents are likely to act in a manner that may compromise the safety of the food they prepare for their households, especially with issues regarding microbial risks and cross-contamination since their attitude to these themes was that of indifference (on the Likert scale).

Table 2. Mean Aggregate Score (MAS) of 5 Thematic areas

Themes	Strongly agree (5)	Agree (4)	Indifferent (3)	Disagree (2)	Strongly disagree (1)	Total	Mean Score
Concern	1796 (8980)	1188 (4752)	604 (1812)	396 (792)	272 (272)	4256 (16608)	**3.9±0.4**
Cross-contamination	576 (2880)	464 (1856)	352 (1056)	476 (952)	564 (564)	2432 (7308)	**3.0±0.6**
Gen. and Pers. Hygiene	1740 (8700)	1148 (4592)	476 (1428)	476 (952)	416 (416)	4256 (16088)	**3.8±0.8**
Microbe knowledge	384 (1920)	416 (1664)	304 (912)	448 (896)	272 (272)	1824 (5664)	**3.1±0.8**
Handling Leftover	1274 (6370)	1112 (4448)	196 (588)	222 (444)	236 (236)	3040 (12086)	**4.0±0.8**
Mean							**3.6±0.4**

Table 3. MAS according to respondents' demography

Demography	Concern	Cross-contamination	Gen. & Pers. Hygiene	Microbe Knowledge	Handling left-over
Level of Education					
No Education	3.8[a]	2.4[a]	3.7[a]	2.8[a]	3.6[a]
Below Tertiary Level	3.8[a]	3.2[b]	3.8[a]	3.4[b]	4.0[b]
Tertiary Level	4.0[a]	3.5[b]	3.8[a]	3.0[c]	4.4[b]
Age (years)					
Less than 20	3.7[a]	3.0[a]	3.8[a]	3.0[a]	4.2[a]
20 – 49	3.8[a]	4.1[b]	4.1[b]	3.2[a]	4.0[ab]
50 or more	4.1[a]	2.0[c]	3.4[c]	3.1[a]	3.8[b]
Gender					
Male	4.0	2.9	3.9	3.0	3.9
Female	3.9	3.1	3.7	3.1	4.1

**Means along the same column with different superscripts are significantly different (p=0.05)*

Their responses reveal the lack of in-depth knowledge of the area under consideration. Most of the respondents were familiar with *Salmonella* (69.7%) but not *E. coli* (36.2%) (Fig. 1), even though these two have been classified as familiar bacteria in previous studies [26]. These pathogens have been associated with inadequate cooking and fecal contamination and have been known to cause ailments whose severity are rated as mild to severe and moderate to severe respectively [38].The lack of adequate knowledge about microbes reflects the potential practice of trusting the source of food just because the food may appear warm, presentable or might not have a foul smell. Sensory assessment of food is insufficient to identify food contamination by pathogens.

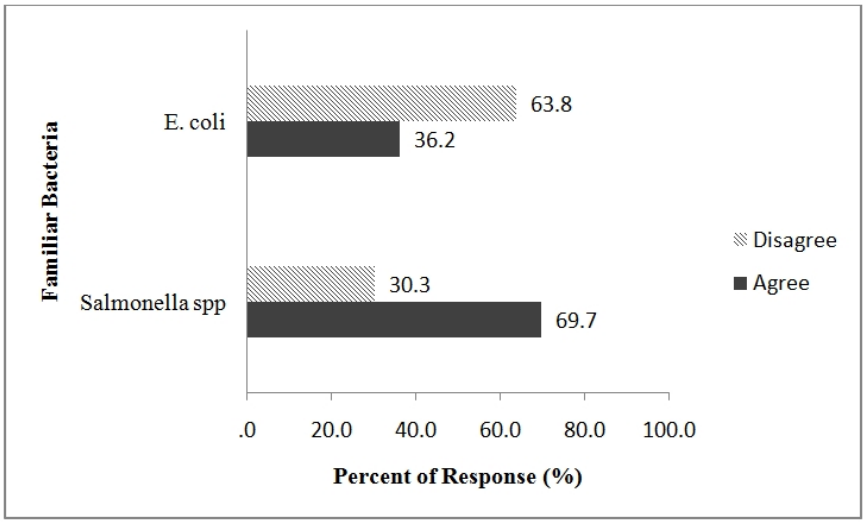

Fig. 1. Food handler awareness of familiar pathogens of food safety concern

Cross-contamination occurs when pathogens from one food get onto another. The general attitude of unconcern(MAS of 3.0) to cross-contaminationis indicative of the likelihood of keeping raw food and cooked food together or using the same chopping board for cutting animal and plant ingredients without washing. [39] states that one of the major ways bacteria spreads in kitchens is through cross-contamination and further suggests that besides hand-washing, produce that come into contact with one another or contact surfaces should be washed under running water and cutting knives and boards thoroughly cleaned before reuse.Ill food handlers may also contaminate contact surfaces, equipment or utensils which will intend contaminate food in the course of processing. Cross-contamination has been mentioned as a primary control factor for contamination due to pathogens such as Campylobacter, Toxoplasma, Salmonella and *E. coli* [38].

The “General and Personal hygiene” section returned a MAS of 3.8, indicating a general agreement with the questions that composed this theme which further underscores the importance of hygiene in food safety practice [40,41,42]. Majority of respondents agreed (“strongly agree” and “agree”)with statements such as “washing hands before cooking or handling food”. Other statements under the general and personal hygiene theme, such as “washing fruits and vegetables before use” and “cleaning food contact surfaces”, went down well with most of the respondents since they agreed to them. Food handlers can transmit pathogens from body parts that contaminate food and make it unwholesome for consumption. Food borne illness may occur if food handler is a carrier of *Staphylococcus*

aureus or *Staphylococcus epidermis*, two predominant pathogenic bacteria normally present on the skin [43].

Respondents' attitude towards diarrhea and food handling is shown in Fig. 2. Majority (48.7 %) rightly said it is wrong for a person with diarrhea to handle or prepare food for others while 15.1 % of respondents had no idea about the answer and so was indifferent. On the other hand, 36.2 % gave a wrong response ("Agree" and "Strongly agree") to the question. Diarrhea is associated with consuming food contaminated with *Norovirus, Bacillus cereaus, Vibrio spp* among other pathogens and can spread directly from one person to another or can contaminate food they prepare for other people [44].In order to prevent its occurrence, methods put in place to ensure good general and personal hygiene as well as prevention of cross-contamination must be stepped-up and ensured that they work. [45] have even suggested the exclusion of food handlers with diarrhea from work until they no longer have symptoms of the disease.

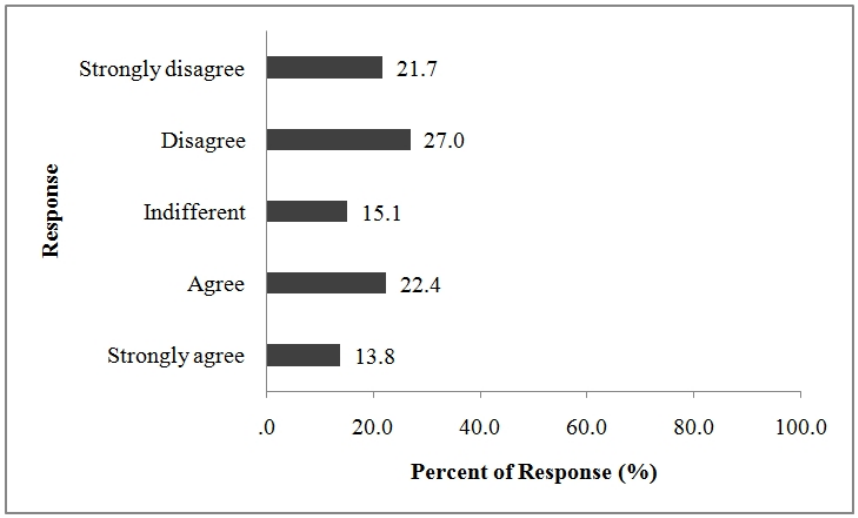

Fig. 2. Food handler response to whether it is OK to prepare food when you have diarrhea

Respondents obtained a Mean Score of 3.9 for "Concern", signifying that they generally agreed with the statements such as "I am concerned about where I eat" and disagreed with "once I am hungry I do not care about what I eat". The household food handlers encountered, were generally enlightened and are inclined to be circumspect about what they eat and the conditions under which they eat. This is because consumers with higher level education are more likely to know about food safety risks. Indeed, [46] reported an inverse relationship between education and some types of public health risks.

"Handling left-over food" had an MAS of 4.0, suggesting an overall agreement to the statements under the theme. For example, a majority of respondents (81.6%)had a general disagreement with the statement that leftover food is best eaten "as is", more than (80%) agreed ("agree" and "strongly agree") to keep leftover refrigerated, and 74.2%disagree to storing leftover fish in its can, etc. Respondents' general "disagree" to statements such as "leftover food is best eaten as is", "I leave unfinished milk, tin fish etc in can" and agreeing to "I keep leftover food in fridge" (see appendix) seem to suggest that they are aware of the

consequences of temperature abuse and food poisoning resulting from leftover food kept in their packaging material (especially cans). Over time, tin and iron from cans may dissolve into the food and cause tin poisoning. In order to slow down the proliferation of pathogens cooked and other leftover foods must be promptly refrigerated at temperature below 5 °C and not at room temperature. Findings under this theme is comparable to results obtained in [47], in which people who stored left-over food at room temperature were in the minority.

Domestic food handlers need to be educated to know how to handle food effectively to minimize pathogen contamination and be motivated so that their actions will be based on this acquired knowledge, because food handling in domestic setting is not guided by enforceable regulations [9]. In addition, Observing the five keys to safer food (keep clean, separate raw and cooked food, cook thoroughly, keep food at safe temperatures, use safe water and materials) can prevent the transmission of pathogens responsible for many food borne diseases [48].

4. CONCLUSION

Respondents were more knowledgeable in the areas of food safety concerns, general and personal hygiene and handling leftover food, than they were in cross-contamination and the dynamics of pathogens in causing food borne diseases. Although the general impression of food safety knowledge was good, there is still more room for improvement. Food safety education for food handlers and consumers of various demographic backgrounds with special attention paid to those on the lower rungs of education and the younger section of the youth would complement other interventions that pursue the enhancement of food safety systems.

COMPETING INTEREST

Authors have declared that no competing interest exist.

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APPENDIX

Questions under the various themes		Response (%)				
		SA	A	I	D	SD
H	I wash my hands with soap before cooking	52.6	23.0	15.1	5.9	3.3
C	Once I am hungry I do not care much about what I eat	7.9	17.8	3.9	37.5	32.9
C	I am concerned about where I eat	53.9	31.6	7.2	0.0	7.2
L	I keep leftover food refrigerated	57.9	24.3	9.2	4.6	3.9
L	Leftover food is best eaten as it is	7.2	5.3	5.9	42.1	39.5
H	I wash fruits before I serve them	36.2	26.3	13.8	13.8	9.9
Cc	It is OK to keep raw ingredients and cooked food together in the same compartment in a fridge	13.2	37.5	21.7	6.6	21.1
C	I consume the content of canned food even if the can is bloated	15.8	7.9	7.2	19.7	49.3
L	When I am unable to finish the content of canned tomato puree I leave the rest in the can	11.8	8.2	2.6	35.5	41.8
C	I do not read the label of products I consume	48.7	27.0	14.5	5.3	4.6
Cc	Raw food must be isolated from cooked food	32.2	28.3	15.1	9.2	15.1
H	I wash my hands with soap before handling food	7.9	15.1	6.6	23.7	46.7
M	Food contaminated with micro-organisms always smells bad	17.7	20.4	13.2	23.0	25.7
H	I wash raw eggs before cooking	32.2	28.3	16.4	13.2	9.9
C	I am cautious about food products containing preservatives	19.7	38.8	34.2	7.2	0.0
Cc	I use the same knife and cutting board for vegetable and meat without washing	48.0	20.4	13.2	15.8	2.6
H	I cook raw meat without washing	34.9	39.5	9.9	7.9	7.9
L	When I am unable to finish the content of canned milk I leave the rest in the can	5.9	9.7	7.2	46.1	31.1
Cc	Hand-washing after handling money enhances food safety	38.8	25.7	7.9	11.2	16.4
H	I wash vegetables in salt water before I use them	39.5	30.3	14.5	8.6	7.2
C	I should not be allowed to eat any food I prefer, whether it is safe or not	34.9	18.4	21.7	18.4	6.6
C	I only eat food from trusted sources	55.9	22.4	10.5	8.6	2.6
M	Warm food does not contain any micro-organisms	9.9	25.0	15.8	30.9	18.4

M	Raw eggs are safer than hard-boiled eggs	27.0	17.1	21.1	25.7	9.2
H	Washing utensils and food contact surfaces soon after cooking does not enhance food safety	22.4	13.8	2.0	17.8	44.1
L	I leave fish in can when I am unable to finish canned-fish	9.9	8.7	7.2	34.9	39.3

***Responses**: SA – Strongly Agree, A – Agree, I – Indifferent, D – Disagree, SD – Strongly Disagree*
***Themes:** C – Concern, Cc – Cross-contamination, H – Gen and Personal hygiene, M – Microbial knowledge, L – Handling left-over*

Peer-review history:
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