THE ROLE OF STREET FOOD VENDORS IN THE TRANSMISSION OF ENTERIC PATHOGENS IN ACCRA

P. MENSAH[1], K. OWUSU-DARKO, D. YEBOAH-MANU, A. ABLORDEY, F. K. NKRUMAH, H. KAMIYA*

Noguchi Memorial Institute, PO Box 25, Legon, *Mie National Hospital, Mie, Japan.

ABSTRACT

The role of street food vendors in the transmission of diarrhoeal pathogens was evaluated by assessing their knowledge on the definition of diarrhoea and transmission of diarrhoeal pathogens. Stool and blood cultures as well as the Widal test was carried to determine their carrier status on a number of bacterial enteropathogens.

All the vendors were female which emphasises the important role women play in the provision of food through street food vending activities. They provide useful service to the community by selling food to school children, market women, traders and workers. The level of education of these females was low and this reflected in their knowledge on the definition, causes and transmission of enteric pathogens. Their personal hygiene was however good but the environment was often littered with garbage.

A number of diarrhoeal pathogens were isolated from 66(37.5%) of these individuals. *Salmonella sp* was isolated from 6(3.4%), *Shigella* from 2(1.1%), *Enteropathogenic E.coli* (EPEC) from 59 (33.5%) and *enteroaggregative E.coli* (EAEC) from 34(19.3%). Mixed enteric infection was common; seventeen had two different bacteria. Six had three and one had four different bacteria and another one had five.

A total of 176 blood samples were cultured for bacteria and out of these only 1(0.6%) tested positive for *Pasteurella gallinarium*. In the Widal test only 153 serum samples were tested for antibodies to *S typhi* and 15(9.8%) titre of 1:80 to the somatic antigen. These were positive according to the manufacturers specifications but comparison with the stool and blood culture results showed that only one subject among this group actually had confirmed *S typhi* infection.

The screening of food handlers for enteric pathogens may be difficult to monitor so food and personal hygiene education is recommended. Although the effectiveness of the Widal as a diagnostic tool for typhoid-fever was not included in the initial objectives, the study showed that the Widal test cannot be used in isolation from laboratory results. This is even more difficult in the absence of a National Cut-Off Point. A survey to provide such data is also obvious.

Key words: Food vendor, enteric pathogens, transmission

INTRODUCTION

A substantial number of diarrhoeal illness is caused by consumption of contaminated water and foods especially in areas that lack adequate sanitation and chlorinated pipeborne water. In 1983 the WHO expert committee on Food Safety[1] stated "illness due to contaminated food is perhaps the most widespread health problem in the contemporary world and an important cause of reduced economic growth".

Bacteria, parasites and viruses are the major causes of diarrhoeal illness often classified as water or food borne and these are transmitted via the faeco-oral route. The lack of adequate hygiene during food preparation could result in the transmission of enteric pathogens. Sources of contamination to food include dust, insects, raw food, fingers, dirty cooking utensils and tools. Dust gets into food as a result of handling at ground level. The contamination of the adult house fly is a risk factor in the transmission of diarrhoeal pathogens. *Salmonella typhimurium* and *Shigellae* have been shown to multiply in the gut of the house fly and this could be passed for weeks or more[2,3]. *Salmonella sp.* and *Shigella sp.* have been isolated from the gut contents of cockroaches in Ghana[4]. Poor

[1] *Author for correspondence*

handwashing practices and improper handling of raw food and utensils could facilitate transmission of enteropathogens from these sources. Storage of food increases the chances of contamination and also allows bacterial multiplication especially when food is stored at high ambient temperatures and without refrigeration.

Although most food handlers may appear to be healthy they are considered potential hazards of communicable diseases. Infected food handlers have indeed been shown to have a significant role in the contamination of street foods in a number of studies[5,6,7]. It is therefore imperative that these groups of people should be monitored regularly if tragedies, associated with outbreaks of food poisoning are to be avoided.

The term food handler also referred to as vendor in this paper applies to persons who prepare food and those who sell it, if they are different persons. Vendors of foods on streets form a common part of the life style of many countries in which there is high unemployment, low salaries, limited work opportunities, limited social programmes and urbanisation. Street food vendors benefit from a positive cash flow, are often free from taxes and can set their own working hours. They provide an essential service to factory, construction and office workers, shoppers, people in transit and those with low income by selling snacks, complete meals and refreshments at relatively low prices.

In a recent study on diarrhoeal diseases in an urban high density area in Accra about 60% of 951 mothers fed their children with purchased cooked food[8]. The study reported high levels of contamination in foods collected and further showed that feeding of purchased cooked food was a factor that predisposed a child to both acute and persistent diarrhoea. This study was therefore formulated to; i) assess personal and food hygiene practices of vendors and ii) assess the role of street food vendors in the transmission of diarrhoeal pathogens.

METHODOLOGIES

The Study Locale

The study was conducted in Nima-Kotobabi-Pig Farm-Accra New Town sub-area. Damp and insanitary conditions are found in all sectors. Drainage is very poor, surface run-off and foul water (sullage) from houses do not have properly made drains to direct them. There is no drainage system so stagnant water, muddy pools and choked gutters abound.

Despite City Regulations, most houses have no water connections. The Ghana Water and Sewerage Corporation by its policy have faced out public water stand pipes as a measure of encouraging landlords to instal water pipes on their property. There are, however, four stand-pipes from which water is purchased and stored in containers. Water mains are exposed along roads and walkways are for most parts laid through and across polluted drains and gutters. Not all houses have water closets or individual household Kumasi Ventilated Improved Pits (KVIP) Latrines. The flow of potable water in the study area is fairly regular; but not all houses have water flowing into them; even though the requirement now is for every house to have water as well as lavatory facilities. There are about five privately owned stand pipes managed by individuals who serve residents by direct payment as well as the sale of water from private houses.

There are mounting heaps of refuse which are unsightly. In the low-lying areas and especially along the banks of streams and earth drains, refuse is indiscriminately dumped and these areas could be a health menace. Household refuse is not well managed in most houses. Collection is done in open containers and are emptied each morning; however, the open container invite flies, ants and other vermin and are a risk to the health of the people. Household, industrial and all other solid waste are deposited at refuse dumps for collection leading to mounting heaps of rubbish and indiscriminate dumping between and around buildings, unkempt spaces and along the banks of streams and their tributaries.

The twelve public latrines are all KVIPs. The larger number of people who visit them, however make them inefficient and are permanent sources of pollution and nuisance to the surrounding houses and areas. The inadequacy of public latrines induce people, especially children, to openly deposit human waste on the banks of streams and in unkempt spaces.

These problems result in pollution of the air, soil and water and provides sources for the breeding of vermin, contamination of food and the spread of diseases.

Street foods abound in the study locale, but these, as well as eating places are often unprotected and often do not have water connected into the facility. Exposure of these foods to flies is common and could lead to the spread of infection, especially diarrhoeal diseases.

Data collection strategy

Prior to the start of the study a meeting was organised by the Chairman of the Council between the Principal Investigator and the representatives of the food sellers and Headteachers of schools in the study locale. The aims of the study were explained to them and they were assured of absolute confidentiality. They were requested to spread the word to the people they repre-

sented. A public broadcast was made prior to the start of the study to inform the people on the actual date.

Subjects were recruited into the study after explaining the study to the owner of the facility and seeking her approval.

Study population and sample collection

Vendors of street foods along the major streets, markets and two schools located in the study area were recruited for the study. The sample size was about 120 vending sites. The owners of the vending point were the main subjects for the study. These were interviewed by graduate staff of the Bacteriology Unit and a sociologist who acted as data manager for the study. Structured questionnaire sheets were used to obtain data on their vital statistics, socio-economic status and knowledge on diarrhoea. They were observed for personal and food hygiene practices.

Stool samples were collected from the vendor and his/her assistants and examined for bacterial enteropathogens. These were transferred on Clary-Blair transport medium and transported on ice to the laboratory. Blood samples were collected and transferred into biphasic blood culture bottles on site and sent to the laboratory for incubation and detection of bacteria.

Laboratory methods

a) Stool culture

Stool samples on Clary-Blair medium were examined for *Salmonella, Shigella, E. coli, Campylobacter jejuni/coli, Yersinia enterocolitica, Aeromonas hydrophila* and *Plesiomonas shigelloides* using standard bacteriological methods[9,10,11].

Preliminary identification of five colonies each of suspected *E coli, Shigella, Salmonella, Yersinia enterocolitica, Vibrio cholerae, Vibrio parahaemolyticus, A hydrophila* and *P. shigelloides* was carried out using triple sugar iron agar, lysine indole motility medium, urea agar and citrate agar. All bacteria identified as such were further confirmed using the API 20E identification system (BioMerieux sa 69280 Marcy-l'Etiole/France). *Campylobacter sp* was identified using API CAMPY. *E.coli, Salmonella sp.* and *Shigella sp.* were further characterised using specific antisera (Denka Seiken) antisera for *E coli* 0157 H7 (Oxoid DR 620M).

Bacteria identified as *E coli* were stored individually at -70°C in tryptic soy broth (TSB) with 40% glycerol. The *E coli* were tested for heat labile toxin (LT) and heat stable enterotoxin (ST) production using DNA-DNA hybridisation[9]. Enteroaggregative *E coli* (EAEC) were tested using HEP2 tissue culture cells provided by the Virology Unit. Cells were grown in 30-well microtitre plates with coverslips. After infecting with *E coli* and incubation in carbon dioxide the coverslips were washed, fixed in methanol and stained with Giemsa. They were mounted on clean microscope slides and examined for patterns of adherence of bacteria.

b) Blood culture and Widal test

Blood cultures and widal were performed by aseptically collecting about 10 ml blood. 5 ml of this sample was inoculated into blood tryptone soy biphasic blood culture bottles (Hemoline 52510, bioMerieux sa 69280 Marcy-lEtiole/France). The bottles were incubated at 37°C for four weeks and examined for growth regularly. All growth was identified using standard methods as described above.

The remaining 5 ml of blood was transferred into sterile 15 ml centrifuge tubes (FALCON 2095, Becton Dickinson Labware, Becton Dickinson, 2 Bridge water Lane, Lincon Park, NJ 07035) and allowed to clot at 4°C in a refrigerator. After separating out the serum, it was transferred into serum tubes and stored at -40°C. Widal was performed using Cenogenics febrile antigens kits (CENOGENICS CORPORATION, Morganville, N.J. 07751, USA. Methods were as per the manufacturer's specifications.

Data handling

All incoming data were checked by the Principal Investigator and the data manager before they were entered into the computer. Back-up files were prepared at the end of everyday to ensure the safety of the data. The data were entered twice by different data entry clerks to allow for detection of errors.

The laboratory data was also monitored carefully. Checks were made from time to time to ensure that no detail was lost.

All data were entered into EpInfo version 6 and after "cleaning" the data, analysis was conducted as follows.

Data analysis

Frequency tables of the answers as per interview sheets were prepared using EpInfo version 6. Cross tabulations were carried out to determine the association between educational level knowledge on diarrhoea. The Chi square and Student t tests were performed to determine the significance of any differences.

RESULTS

Socioeconomic description of vendors

A total of 117 street food vending points were recruited into the study. The vendors were between 10 to 50 years of age. They were all females and were mainly stationary vendors except for one who was a hawker. There were 21(17.9%) chopbar owners and 96(82.1%) open air vendors. The distribution of subjects by localities were as follows: 15(13.2%) from

Kotobaabi, 26 (22.0%) from Accra New Town, 17 (14.9%) from Nima and 33 (28.2%) from Pig Farm. Twenty vendors were located at two schools in the locality namely Kotobaabi School (13, 11.4%) and Nima School 7(6.1%).

Majority of the vendors had Ewe 43(36.8%) as their first language. The other language groups were Hausa 38(32.5%), Ga 11 (9.4%), Twi 11 (9.4%), Fante 7(6.0%) Losso, Sissala, Busanga, Tallasi and Frafra 7(6.0%).

Most of the subjects have been to Middle School (41, 35.0%). Twenty (17.0%) have had up to Primary School education, while 9.0 (7.7%) have been to secondary/commercial school. Seven (6.0%) of the vendors have only been to Arabic school. It is significant to note that 38(33.3%) of the vendors have had no education and there were no university graduates among the vendors.

These vendors provide useful service to the community as they sell food to school children, market women, traders and workers alike.

Knowledge on diarrhoea

The vendors have a fair knowledge on definition of diarrhoea as 110 (94.0%) defined diarrhoea as the passage of three or more liquid stools in a day. Only seven (6.0%) attributed the passage of mucoid stools to diarrhoea. None of the subjects associated diarrhoea with the passage of bloody stool. The knowledge on the definition of diarrhoea is not associated with the educational level of the vendors.

On the transmission of diarrhoeal pathogens, 34(29.1%) identified dirty food, 8(6.8%) dirty water but none of the vendors identified dirty hands as a source of pathogens. Cross tabulation of the level of education and the knowledge on mode of transmission of enteric pathogens showed significant differences between education and dirty food as well as dirty water ($p = 0.0157$ and 0.0167) respectively. Only 21(17.9%) knew that germs can cause diarrhoea.

Environmental hygiene and food handling practices

Certain foods were prepared the day before while others were prepared early in the morning and sold till exhausted. After cooking, food was popularly scooped into large polythene bags (49,41.9%) and placed in a big bowl or was kept in the container in which it was cooked (46, 39.3%) and sold. Some vendors reheated food before and during sales (22, 18.8%). Other vendors scooped the food into a bowl and kept in a sieve (32, 27.4%) while in some cases the food was kept on a fire to simmer and keep warm (5, 4.3%). Five vendors (4.3%) kept food in trays covered with lace/cloth, 7 (6.0%) sold food in sieves but 3 (2.6%) kept the food in trays without any form of protection. In some cases a combinations of the above were practised.

Drinking water for customers were stored in containers without 9 (7.7%) and with 95 (80.3%) covers but 13 (12.0%) did not provide drinking water.

The environment was poorly kept as there was litter around most vending sites. Food was exposed to flies at 41(35.0%) vending sites and there was stagnant water in 11(9.4%) cases while 20(17.1%) vendors handled food at ground level. Food was served with spoon/fork by 80(68.4) vendors but 45(35.9%) vendors used bare hands. Food was served into cup/plate/calabash by 26(22.2%) and paper/leaves by 4(3.4). These crockery were fairly well washed but 57(48.8%) of vendors used dirty water to clean their crockery and tools.

Hand-washing was common practice among the vendors but the use of soap was rare. Hands were washed at least three times by 35(30.2%) vendors and more than three times by 81(69.8%) vendors in a day. Only one vendor did not wash her hands throughout the day.

The personal care of the vendors was generally good as majority of them had clean clothes (110, 96.5%) and cut nails (103, 92.8%). Few vendors covered their hair (62, 54.4%). Only (12, 10.3%) vendors had an infant/baby at the vending site.

Prevalence of bacterial enteropathogens in street food handlers

a) Stool culture

Stool samples were collected from 176 food handlers who were all females. Sixty-six (37.5%) of these harboured at least one enteropathogen. *Salmonella sp* was isolated from 6(3.4%), *Shigella* from 2(1.1%), *Enteropathogenic E.coli* (EPEC) from 59 (33.5%) and *enteroaggregative E.coli* (EAEC) from 34(19.3%) (Table 1).

Table 1: Prevalence of enteric bacteria among street food vendors

Bacteria Isolated	No (%) Positive
Salmonella	6(3.4)
Shigella	2 (1.1)
Enteroaggregative *E.coli* (EAEC)	34 (19.3)
Enteropathogenic *E.coli* (EPEC)	59 (33.5)
No pathogen	72(42.6)
Total	176

None of the stool samples were positive for *enterotoxigenic E.coli, Campylobacter sp, Yersinia enterocolitica, Vibrio cholerae, Vibrio parahaemolyticus* and *Aeromonas hydrophila*. The types of *Salmonella, EPEC, EAEC* isolated are shown in Tables 2. There were two strains of *Shigella; sonnei* and *flexneri*.

Eighteen (18) of the food handlers had two enteric bacteria, six had three and one had four different bacteria and another one had five.

b) Blood culture and Widal test

A total of 176 blood samples were cultured for bacteria and out of these only 1(0.6%) tested positive for *Pasteurella gallinarium* and was sensitive to Nalidixic Acid, Monocycline, Tetracycline, Chloramphenicol and Norflouxacillin. It was however resistant to Penicillin G, Ampicillin, Cefalacin, Septrin and Cefuroxime.

Table 2: Subtypes of Salmonella, Enteropathogenic E coli and Enteroaggregative E coli isolated from street food vendors

Serovar	Frequency (%)
Salmonella type	
0,13	1 (0.6)
0,18	1 (0.6)
0,3,10 (S typhi)	1 (0.6)
0,4	1 (0.6)
0,9	2 (1.1)
Total	6 (3.4)
Enteropathogenic E coli	
Poly 8 029	*7 (4.0)*
Poly 5 0153	5 (2.8)
Poly 1 0128	2 (1.1)
Poly 4 0148	2 (1.1)
Poly 4 027	3 (1.7)
Poly 5 0167	3 (1.7)
Poly 5 020	2 (1.1)
Poly 7 012	8 (4.6)
Poly 7 0144	2 (1.1)
Poly 4 0168	1 (0.6)
Poly 4 06	1 (0.6)
Poly 6 0169	6 (3.4)
Poly 8 016	6 (3.4)
Poly 8 0152	1 (0.6)
Poly 2 0124	2 (1.1)
Poly 4 0159	6 (3.4)
Poly 7 0136	1 (0.6)
Poly 6 015	1 (0.6)
Poly 6 08	1 (0.6)
Total	59(33.5)
Enteroaggregative E coli	
Diffuse	22 (12.5)
Aggregative	6 (3.4)
Localised	6 (3.4)
Total	34 (19.3)

In the Widal test only 153 serum samples were tested for antibodies to *S typhi* and 15(9.8%) had 1:80 as titre for somatic antigen. These were positive according to the manufacturer's specifications. Table 3 shows a comparison of data of subjects who tested positive in the widal test with their stool and blood culture. Only one of the subjects who was a carrier for *S typhi* had a titre of 1:80 while the other had a titre of 1:20. In the group with a titre of 1:80, three other subjects had mixed infection of EAEC and EPEC.

Table 3: "Positive" widal results by stool and blood culture results of vendors

Subject No.	Widal "O" titre	Stool culture	Blood Culture
009	1:80	EAEC, EPEC	-
012	1:80	No pathogen	-
060A	1:80	No pathogen	-
064A	1:80	No pathogen	-
065A	1:80	No pathogen	-
072	1:80	No pathogen	-
074A	1:80	EAEC, EPEC	-
075A	1:80	No pathogen	-
080	1:80	No pathogen	-
088A	1:80	EAEC, EPEC	-
094B	1:80	No pathogen	-
038A	1:80	No pathogen	-
043A	1:80	*S typhi*	-
047B	1:80	No pathogen	-
105	1:80	No pathogen	-

DISCUSSION

This study was conducted to evaluate the role of street food vendors in the transmission of enteric pathogens. The vendors were all females and this emphasises the important role women play in the provision of food to this community. Similar findings were reported in Nigeria[12] and Senegal[13]. In Africa women are not only involved in providing food through street food vending activities but they have a sole responsibility in preparing all the family's food. It is what women place on the table that gets eaten. The choices they make are dictated by the way she has been brought up, her cultural environment and her own eating habits. This makes her the guardian of tradition and also points to the fact that she may commit errors in working out a balanced diet for the family if not adequately informed.

The findings that only 9(7.7%) have had secondary education is a matter of great concern. This implies that these women will not be adequately informed as is indicated by their knowledge on the definition and transmission of enteric pathogens. It is therefore imperative that education of women on how to provide safe food is important. Their role is unique, because they will put whatever comes from high-level actions into practice. These women can be reached at the grass-root level through functional literacy programmes, women's groups and through school children.

The study also showed that 37.5% of the vendors harboured at least one enteric bacteria. Concurrent infections were high with 2 subjects having as many as four and five enteric bacteria respectively. The pathogens were mainly *E.coli* but one subject had *Salmonella* and 4 different types of *E.coli*. Concurrent infections with bacteria and parasites have been reported in Ghana[14] and Kenya[15]. This is a reflection of the environment

in which street food vendors abide and underscores the risk associated with such food handlers in the transmission of diarrhoeal pathogens. Infected food handlers have been shown to be significant factors in the contamination of street foods in a number of studies[6,7]. The screening of street food handlers from areas with poor sanitation was recommended by the study from Kenya[15] but this may be difficult to monitor.

WHO considers this practice cost inefficient and of limited value due to the short duration for which such examinations are relevant[16]. Most public health laboratories in developed countries discontinued routine examination of faeces of food handlers, because the number of isolates was too low[17]. The abolition of such tests was recommended by Bader[18] because the examination did not reduce the number of food-borne salmonellosis in the ten years that the law was applied.

The screening of food vendors may not be feasible, especially in a community where individuals have no fixed addresses. Education in good personal and food hygiene practices are therefore indicated. There is also the need for thorough appraisal of the sanitary conditions at the vending points. Provision of potable water and sewage-disposal facilities are also important.

The recovery of *Pasteurella gallinarum* from the blood of one subject is suggestive of zoonotic infection. This bacteria is usually recovered from fowls[19]. This is not surprising as from our previous study the people are in close contact with fowls and other domestic animals. It is noteworthy that the index food handler was asymptomatic.

According to the manufacturer's specifications, 15(9.8%) vendors were positive in the Widal assay. A comparison with data from stool and blood cultures indicated that only one subject with *S typhi* was among this group while three with EPEC and EAEC also had titres of 1:80. It is also noteworthy that one of the excreters of *S typhi* had a titre of 1:20, a clear case of non-convertor. These findings emphasise the problem associated with the interpretation of the Widal test since antibodies to the typhoid bacilli exists in the general population in an endemic area. The baseline data for Nigeria, Ethiopia and Malaysia are $\geq$1:160, $\geq$1:160 and $\geq$1:320 respectively. There is no such baseline data in Ghana, thus making interpretation of the Widal difficult especially in the healthy carrier. Studies by Somerville *et al*[20] also showed that about 95.4% of healthy carriers could have H or O titres below 1:200. Similarly 24.8% of bacteriologically proven typhoid could have titres below 1:200. A study from Nigeria[21] concluded that diagnosis of typhoid fever using the Widal test alone is prone to error. In the present study 15 individual could have been diagnosed as having typhoid fever based on the manufacturer's specifications and using the type of interpretation methods used in Nigeria and by some individuals in Ghana. There is an urgent need for a National Survey on the Widal test for the determination of a National cut-off point.

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