



of the utility of routinely available data sources in providing much-needed information on the epidemiology of injury causes and deaths.

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## AN OUTBREAK OF FOOD POISONING AMONG CHILDREN ATTENDING AN INTERNATIONAL SPORTS EVENT IN JOHANNESBURG

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**Objectives.** To describe an outbreak of food poisoning at a major international sports event in Johannesburg and to determine the likely cause and source of the outbreak.

**Design.** A descriptive, case-control study.

**Setting.** An international sports event in Johannesburg.

**Methods.** A questionnaire survey of involved children was used to conduct a case-control study. Microbiological and chemical analysis of the implicated food was undertaken. Site visits to the premises involved in food preparation were conducted.

**Results.** A total of 578 children were involved. Of the 361 children who returned questionnaires, 134 were affected by an acute-onset emetic-type illness, while 53 children developed diarrhoea. Consumption of fruit juice was associated with acute illness, while diarrhoea was associated with the consumption of maize-meal porridge (pap) and chicken stew. Microbiological analysis revealed high bacterial loads in samples of the fruit juice and the presence of *Shigella flexneri* in the maize-meal porridge. Visits to the suppliers of the implicated foods revealed several deficiencies in terms of food hygiene precautions.

**Conclusion.** The likely vehicles and causes of this outbreak are elucidated. Guidelines for monitoring the supply and distribution of food to future similar events should be established. Furthermore, hospitals should have protocols in place to deal with such outbreaks in a manner that facilitates epidemiological investigation.

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On 10 September 1999 an acute outbreak of illness occurred following a meal served to children taking part in the opening ceremony of a major international sports event held in Johannesburg. This study describes the epidemiological, microbiological and environmental investigations that followed the outbreak, in an attempt to define the causative agent and implicated food vehicle.

## METHODS

The study was performed as a joint investigation between a private sector laboratory (Karas, Isaacson and Associates), the South African Institute for Medical Research (SAIMR) and the Eastern Metropolitan Council of Greater Johannesburg's Metropolitan Council (EMLC).

### Description of the outbreak and case control study

Initial information regarding the outbreak was supplied by the EMLC and the supervisors of the involved children. Because of the overwhelming influx of affected children to hospitals, accurate information regarding the outbreak was not available from hospital records. On the night of the outbreak, staff from the private laboratory were alerted and interviewed several children to ascertain details of food consumed and predominant symptoms and to establish a case definition. On the basis of this information, a questionnaire was designed. It was distributed by the organisation that had arranged the participation of the children in the event. All questionnaires were accompanied by a letter explaining the reason for the questionnaire and asking parents to assist their children in its completion. Questionnaires were returned and analysed using EpiInfo version 6.03. Odds ratios (ORs) were calculated using 2 x 2 contingency tables with 0.05 as the cut-off for statistical significance. Multivariate analysis was performed using SPSS.

### Environmental investigation

The EMLC was notified of the outbreak three and a half hours after it became apparent. The initial focus of the EMLC staff was to obtain samples of food served to the children and to trace its origins. The secondary response focused on prevention of a second episode, and targeted all manufacturers of food and drink to be supplied over the following 9 days of the games. The premises of six suppliers were visited by environmental health officers (EHOs) on the morning following the outbreak. In addition, after the outbreak all venues at which food was being served were visited on a daily basis throughout the games and random sampling of food was undertaken.

### Microbiological and chemical analysis

Unfortunately no appropriate clinical samples were obtained, largely because the majority of children were no longer

vomiting (and had not yet developed diarrhoea) at the time of presentation to hospital. The only specimens available for microbiological analysis were samples of food taken from that served to the children. Two laboratories analysed these samples. The private laboratory received samples provided by the All Africa Games, while the EMLC provided specimens to the SAIMR. Specimens of fruit juice cocktail, beef stew and maize meal porridge (but not chicken stew) were received.

Pathnet Gauteng processed specimens using routine laboratory techniques. The SAIMR received specimens collected by the National Intelligence Service from the truck supplying food to the children. These specimens were received 11 hours after collection, having been refrigerated overnight. Specimens were processed following international standards and those of the South African Bureau of Standards for the recovery of food-borne pathogens. Enzyme-linked immunosorbent assays (ELISAs) (Oxoid) were used for detection of enterotoxins A, B, C and D of *Staphylococcus aureus* and for the detection of the diarrhoeal toxin of *Bacillus cereus*. Testing for the presence of heavy metals (copper, zinc, iron, cadmium) was conducted by the SAIMR, and organophosphate assays were performed by the State forensic laboratory. No clinical samples were available from diarrhoea cases because that illness was only discovered after the children had returned home to various parts of the country.

Over the 9 days of the games the SAIMR conducted microbiological testing on random food samples taken by the EMLC from all venues where food was served to identify any further contamination. These samples were stored for 4 days so that complete analysis could be conducted should a second outbreak occur.

## RESULTS

### Description of the outbreak and case control study

Participants in the opening ceremony included 578 children from various parts of South Africa. Children from surrounding areas were accommodated in a number of hotels for the night preceding the event. The only meal served to the entire group of children was eaten at the Johannesburg athletics stadium between 15h00 and 17h00. The meal comprised either chicken or beef stew together with maize-meal porridge and fruit juice. Shortly after eating the meal, an outbreak of an ill-defined emetic illness occurred among the children. A total of 513 children were taken to three hospitals in the area, with the majority seen at the Johannesburg Hospital. A total of 149 children were admitted overnight for observation.

Questionnaires were distributed to 578 children and 361 were returned completed (response rate 62.5%). The mean age of respondents was 15.7 years; 56.4% of the respondents were girls. The origin of the children is shown in Table I. The main symptoms experienced by the children are shown in Table II. A

**Table I. Origin of respondents**

Place of origin	Number	Percentage
Durban	75	20.8
East Rand	49	13.6
Johannesburg	50	13.9
Port Elizabeth	118	32.7
Cape Town	69	19.1
Total	361	100

**Table II. Symptoms affecting respondents (N = 361)**

Symptom	Number of affected children (%)
Vomiting	85 (23.5)
Nausea	73 (20.2)
Abdominal pain	207 (57.3)
Headache	164 (45.4)
Weakness	191 (52.9)
Dizziness	143 (39.6)
Diarrhoea	53 (14.7)
Total symptomatic	302 (83.7)

total of 302 children (83.7%) complained of any symptoms. The mean time from ingestion of food to onset of acute illness was 88 minutes, with 90% of affected children developing symptoms within 175 minutes. Subsequent to the distribution of the questionnaires, reports of a delayed-onset diarrhoeal illness, 2 - 3 days after consumption of the food, were received from a number of children. Unfortunately the time of onset and nature of diarrhoea could not be ascertained in all affected children, since this information was not specifically requested in the questionnaire. The development of diarrhoea was not related to the presence of vomiting or nausea. Two case definitions were therefore established. Case definition A (acute-onset illness) was defined as the onset of nausea or vomiting within 6 hours of eating. A total of 134 respondents (37.1%) met this case definition. Case definition B was defined as the development of diarrhoea at any stage. A total of 53

respondents (14.7%) met this definition. Twenty-eight respondents (7.8%) suffered from both the acute-onset illness and diarrhoea.

Details of the foods consumed are listed in Table III. The odds of developing any illness after consumption of the various foods are shown in Table IV. The consumption of fruit juice (OR = 20.0) and maize-meal porridge (OR = 5.6) was strongly associated with the development of any illness. On multivariate analysis (Table V), subjects falling into case definition A (acute-onset illness) were significantly more likely to have consumed fruit juice (OR = 11.8) or maize-meal porridge (OR = 3.0). Development of diarrhoea (case definition B) was strongly associated with the consumption of both maize-meal porridge (OR = 8.8) and chicken stew (OR = 7.3). Cross-table analysis (Table VI) failed to distinguish between porridge and chicken stew as likely vehicles. Children who ate both porridge and chicken stew were more likely to develop diarrhoea than those who ate either food alone.

**Table III. Number of respondents who consumed various foods (N = 361)**

Food	Number of children (%)
Fruit juice	328 (90.9)
Beef stew	260 (72.0)
Chicken stew	123 (34.1)
Maize-meal porridge	189 (52.4)

**Table IV. Odds ratios of foods consumed that were reported to cause illness**

Food	Odds ratio (95% CI)	P-value
Fruit juice	19.97 (6.84 - 61.05)	< 10 <sup>-6</sup>
Beef stew	2.38 (1.28 - 4.44)	0.003
Chicken stew	1.21 (0.64 - 2.33)	0.53
Maize-meal porridge	5.55 (2.70 - 11.62)	< 10 <sup>-6</sup>

CI = confidence interval.

**Table V. Multivariate analysis of association between foods consumed and case definition A (acute nausea or vomiting) and B (diarrhoea)**

Food	Case definition A		Case definition B	
	Odds ratio (95% CI)	P-value	Odds ratio (95% CI)	P-value
Fruit juice	11.8 (11.5 - 90.4)	0.0177	2.4 (0.3 - 20.9)	0.4187
Beef stew	0.7 (0.3 - 1.5)	0.3064	0.9 (0.2 - 3.2)	0.8164
Chicken stew	1.6 (0.9 - 3.0)	0.1233	7.3 (3.4 - 15.9)	0.0001
Maize-meal porridge	3.0 (1.6 - 5.5)	0.0005	8.8 (2.6 - 30.2)	0.0005

CI = confidence interval.



Table VI. Cross-table analysis of food-specific diarrhoea attack rates (chicken stew and maize-meal porridge)

	Ate porridge (N)		Did not eat porridge (N)	
	Total	Ill (%)	Total	Ill (%)
Ate chicken stew	34	19 (55.9)	89	11 (12.4)
Did not eat chicken stew	155	21 (13.5)	83	2 (2.4)

### Environmental investigation

The suppliers of the implicated foods were visited and found to be wanting in a number of areas. The premises were not licensed or zoned for the production and sale of food, people with insufficient training were preparing food, and the origin of most of the ingredients was unclear. Water was being obtained from a borehole and no certificates of fitness could be produced. Domestic animals had access to food preparation areas. As the premises were located outside of the boundaries of the metropolitan area, law enforcement was handed over to the provincial authorities. Official notices in terms of regulation 918 of the Health Act of 1977<sup>1</sup> regarding the preparation of food were issued, stating that corrective measures had to be taken within specified time periods. The premises were re-inspected to ensure compliance.

The fruit juice, which was implicated as a potential source, was produced in a dilapidated house in the inner-city of Johannesburg in a domestic kitchen with a carpeted floor using standard domestic appliances clearly incapable of producing the quantities of juice required for the entire event. The local authority took a decision to close the business and a notice to this effect was handed to the proprietor. The planning department was requested to take action as the premises were not licensed. No further fruit juice was provided to the games from this source.

The premises of the remaining four suppliers of food revealed no major problems except that in one instance food was being prepared outside, and the disposal of waste water and garbage at the athletes' village was inadequate. Both issues were addressed relatively quickly after appropriate warnings and education were given.

### Microbiological and chemical analysis

The private laboratory received specimens of beef stew and fruit juice. The SAIMR received specimens of beef stew, maize-meal porridge and fruit juice. Food and fruit juice samples received were normal in appearance and smell. *Shigella flexneri* was isolated from a specimen of maize-meal porridge. High levels of bacterial contamination of fruit juice samples were observed, with a range of  $1.2 - 6.8 \times 10^5$  colony-forming units and a mean of  $3.8 \times 10^5$  colony-forming units per millilitre of juice. The results of other microbiological analyses were within normal limits. Neither *B. cereus* nor *S. aureus* were isolated from any source. Tests for the enterotoxins produced by *B. cereus* and

*S. aureus* were also negative. Assays for heavy metals were within normal limits and organophosphates were not detected in any of the samples. Since the short incubation period for acute illness was not compatible with a viral aetiology, and since the diarrhoeal illness was only later documented, tests for the presence of enteric viruses were not performed on the implicated foods.

Subsequent analysis of random samples of food under preparation to be served later in the games revealed several instances of high levels of bacterial contamination and a Greek salad contaminated with *B. cereus* diarrhoeal toxin.

### DISCUSSION

This outbreak is significant in having occurred at a high-profile international sports event, and in the large number of children affected. The investigation of this outbreak was hampered by a number of logistical problems, in particular the lack of reliable and complete hospital records and the absence of clinical specimens for laboratory analysis. In addition, the delay between collection of food specimens and laboratory processing was unfortunate. Furthermore, chicken stew was not received for analysis. Nevertheless, a number of tentative conclusions regarding the possible source of the outbreak can be drawn.

There appear to have been two illnesses associated with the consumption of food at this event. The first, an acute-onset emetic illness, was associated with the consumption of fruit juice contaminated with a high bacterial load (and less strongly with consumption of maize-meal porridge). The second, a delayed-onset diarrhoeal illness, was associated with the consumption of maize-meal porridge and chicken stew. The porridge was contaminated with *S. flexneri*, a known gastrointestinal pathogen.

The exact cause of the acute-onset illness remains unclear. The short incubation period would suggest the possibility of the ingestion of pre-formed toxins, such as those produced by strains of *S. aureus* and *B. cereus*. Neither of these two organisms was detected in any of the food specimens. While tests for the toxins of *S. aureus* were negative, similar tests for the emetic toxin of *B. cereus* were not available. The emetic toxin of *B. cereus* is difficult to detect, requiring a cell culture technique<sup>2</sup> or the use of a recently described boar spermatozoa motility assay.<sup>3</sup> So-called 'vomitoxins' produced by a variety of