

## BACTERIOLOGICAL ANALYSIS OF WATER SAMPLES FROM TSUNAMI HIT COASTAL AREAS OF KANYAKUMARI DISTRICT, TAMIL NADU

\*P Rajendran, S Murugan, S Raju, T Sundararaj, BM Kanthesh, EV Reddy

### Abstract

Water borne diseases such as cholera, enteric fever and dysentery were expected after the tsunami, which hit the coastal areas of Kanyakumari district, Tamil Nadu. In the present study 151 drinking water sources were collected from the tsunami affected villages and relief shelters and tested for coliforms and pathogens. Nine well water samples were also collected for specific bacteriological analysis. Presence of coliforms was detected in 56 (37%) water samples. One isolate each of *Salmonella* Paratyphi B and NAG *Vibrio* were isolated from two well water samples. There was no report of acute diarrhoeal diseases or typhoid illness during the post tsunami period monitored by a field microbiology laboratory for a month.

**Key words:** *Tsunami, drinking water contamination, MPN, bacteriological analysis*

The tsunami that devastated Indian Ocean region on December 26, 2004, represents the greatest natural disaster of our times<sup>1</sup> which killed more than 250 000 people in 13 countries<sup>2</sup> and over five million have been left homeless in South Asia including India.<sup>3</sup>

The biggest challenge of India's health establishment after the tsunami was directed towards sustaining disease surveillance to prevent epidemics in the affected areas.<sup>4</sup> Tamilnadu was one of the worst affected states in India, which reported the highest number of deaths and displaced people. Basic services such as clean water and sanitation were severely affected in the coastal areas by tsunami. Survivors were under serious threat of disease outbreaks as a result of damaged water and sanitation systems, seawater contamination and the congested and crowded conditions of the displaced. There was an immediate increased risk of waterborne diseases like cholera, typhoid fever, shigellosis and hepatitis A and E, which are related to unsafe drinking water and inadequate sanitation.<sup>5</sup>

A tsunami creates a surge of ocean water that can sometimes engulf large geographic areas. As the ocean water comes ashore, drinking water sources can become submerged and potentially contaminated with microorganisms. If water containing disease-causing microorganisms is ingested, it may cause immediate, life threatening health problems such as acute diarrhoeal diseases, cholera and other serious infections.

In Tamilnadu, immediately after the disaster, the department of public health and preventive medicine mobilized epidemiologists, medical officers, paramedical staff and health workers from various parts of the state to the affected coastal districts to take care of health related issues of the coastal area population afflicted by the tsunami.

As an integral part of epidemic preparedness, the microbiologists deputed from the Department of Public Health and Preventive Medicine, Chennai, established a field microbiology laboratory at Kanyakumari district, Tamilnadu. In this report, various drinking water sources were analysed for bacteriological contamination due to tsunami along the coastal areas and provision of safe drinking water to large displacement centers (relief shelters) to prevent waterborne diseases.

### Materials and Methods

One hundred and fifty-one water samples from various drinking water sources from the tsunami affected villages of Kanyakumari district, Tamil Nadu, including the ones damaged due to tsunami before the implementation of clean-up and decontamination procedures by the local administration and the water supply to the 54 relief shelters, were collected in sterile plastic containers from December 28, 2004 onwards for overall analysis of coliform count and pathogens like *Salmonella* and *Vibrio* by commercial rapid water testing kits. In addition, nine well water samples from Colachel coastal area were transported in dry ice to the department of microbiology, Dr. ALM postgraduate institute of basic medical sciences, Chennai, for specific bacteriological analysis.

#### *Coliform test (presence or absence)*

The presence or absence of *Coliform* bacteria<sup>6</sup> from

\*Corresponding author (email: <rajendranparam@hotmail.com>)  
Department of Microbiology (PR, TS, BMK, EVR), Dr. ALM PGIBMS, University of Madras, Taramani, Chennai - 600 013, and Department of Public Health and Preventive Medicine (SR, SM), Anna Salai, Chennai - 600 006, Tamil Nadu, India

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drinking water sources were detected using the commercially available PA *Coliform* test kit, HiMedia laboratories, India. A positive coliform test indicates faecal contamination in the water sample.

#### *Test for Escherichia coli*

Rapid detection and confirmation of *Escherichia coli* based on enzyme-substrate reaction was performed using the commercially available HiSelective *E.coli* test kit, HiMedia Laboratories, India.<sup>7</sup>

#### *Test for Salmonella and Vibrio species*

Rapid detection of *Salmonella* species and *Vibrio* species were tested by commercially available Rapid HiWater Test kits, HiMedia Laboratories, India.<sup>8</sup> This test also detects *E.coli* and *Citrobacter* species.

#### *Test for culture and isolation*

All the nine samples received on dry ice were tested for MPN for coliforms and culture on nutrient agar, MacConkey's agar and blood agar for isolation and identification of specific pathogens and the bacterial isolates were confirmed by biochemical tests.

## Results

A total of 151 water samples from various sources from tsunami hit coastal areas of Kanyakumari district, Tamil Nadu, were tested for the presence of coliforms and pathogens by rapid water testing kits. The test results showed the presence of coliforms in 56 (37%) water samples but the pathogens like *Salmonella* spp. and *Vibrio* spp. were not detected by the rapid detection kits (Table 1).

The bacteriological analysis of drinking water samples

**Table 1: Water sample analysis by rapid water test kits in the coastal areas of Kanyakumari district after December 2004 tsunami**

| Type of water sample  | Total no. tested | Positive for coliforms | %            |
|-----------------------|------------------|------------------------|--------------|
| Over head tank        | 43               | 17                     | 39.5         |
| Sintex plastic tank   | 29               | 9                      | 31           |
| Packed drinking water | 25               | -                      | -            |
| Bore well             | 23               | 14                     | 60.9         |
| Public well           | 17               | 13                     | 76.5         |
| Public fountain       | 9                | 1                      | 11           |
| Sump                  | 1                | 1                      |              |
| Reservoir             | 1                | 1                      |              |
| Filter house          | 1                | -                      | -            |
| Bottle                | 1                | -                      | -            |
| Aqua guard            | 1                | -                      | -            |
| <b>Total</b>          | <b>151</b>       | <b>56</b>              | <b>37.08</b> |

revealed that 13 out of 17 (76.5%) public well water samples, 14 out of 23 (60.9%) bore well samples, 17 out of 43 (39.5%) over head tank samples and nine out of 29 (31%) plastic storage tanks were contaminated with coliforms.

Out of the nine well-water samples from Colachel coastal area tested for specific pathogens, one each of *Salmonella* Paratyphi B and NAG *Vibrio* were isolated from two different well water samples. Other bacterial species isolated from well water samples were *Aeromonas hydrophila*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Citrobacter freundii* and *Enterococci*. Interestingly a fungus *Penicillium oxalicum* was also isolated from the well water, which was also positive for *Salmonella* Paratyphi B (Table 2).

## Discussion

The tsunami that struck 13 countries in South Asia on the morning of December 26, 2004, resulted in a natural disaster of apocalyptic proportions. The sheer scope and severity of destruction prompted extraordinary international attention and support for survivors on the coastal rims and the islands in the Bay of Bengal and the Indian Ocean.

The short-term public health emergency needs of the surviving population were enormous, of which provision of safe drinking water was of paramount importance to persons who live in relief shelters. It was cautioned that the number of casualties might double with the spread of communicable diseases in tsunami hit coastal areas.<sup>9</sup>

However, the present study showed contamination in 56 (37%) drinking water sources, majority of which were public wells and bore wells. Although one each of *Salmonella* Paratyphi B and NAG *Vibrio* was isolated from well water samples subsequently there was no report of acute diarrhoeal or typhoid illness from the Colachel area of Kanyakumari district during post tsunami period, which were monitored for about a month by the public health microbiology laboratory. The public health authorities provided chlorinated drinking water to the displaced population through plastic tanks and potable water through plastic packs. In addition, the coastal area population was advised by the health authorities, not to use well water for drinking purpose which were flooded with sea water due to tsunami. These wells will remain unsafe for some more time and in future the local authorities would probably drain all the wells and allow to replenish again with natural water from ducts.

It is interesting to note that, the literature on disasters also indicates that epidemics of communicable diseases do not always occur after large-scale floods. In the past three decades, epidemics of water borne illness such as cholera and shigellosis have been uncommon after floods and natural disasters but they are quite common in large displacement centers and refugee camps.<sup>10</sup>

**Table 2: Bacterial isolates from well water samples at Colachel area after December 2004 tsunami**

| Location                                     | Organisms   | MPN result |      |        |
|--|---|------------|------|--------|
|  |   | 10 ml      | 1 ml | 0.1 ml |
| Mallukka well, Asad nagar, Pandakasalaipuram | <i>Aeromonas hydrophila</i>   | 0          | 0    | 0      |
| Municipal well, Kottilpadu Road              | <i>Pseudomonas putrefaciens</i> , <i>Aeromonas hydrophila</i> , <i>Salmonella paratyphi B</i> , <i>Penicillium oxalicum</i> | 5          | 5    | 5      |
| Well, Akkarai Pallivasal                     | <i>Aeromonas hydrophila</i> , <i>Pseudomonas aeruginosa</i> , <i>Pseudomonas putrefaciens</i> , <i>Citrobacter freundii</i> | 5          | 5    | 5      |
| Well, Akkarai Pallivasal                     | <i>Pseudomonas putrefaciens</i>   | 1          | 0    | 0      |
| Colachel Beach                               | <i>Pseudomonas putrefaciens</i>   | 0          | 0    | 0      |
| Colachel Beach                               | <i>Aeromonas hydrophila</i>   |            |      |        |
| TWAD Board well I, Kottilpadu                | <i>E.coli</i> , <i>Vibrio Group (NAG)</i>   | 0          | 0    | 0      |
| TWAD Board Well II, Kottilpadu               | <i>Enterococci (Streptococcus faecalis)</i>   | 0          | 0    | 0      |
| TWAD Board Well III, Kottilpadu              | <i>Pseudomonas aeruginosa</i>   | 0          | 0    | 0      |
|  | <i>Pseudomonas aeruginosa</i>   | 0          | 0    | 0      |

## References

- Silove D, Zwi AB. Translating compassion into psychosocial aid after the Tsunami. *The Lancet* 2005;**365**:269-71.
- McCurry J. Cleaning up after the tsunamis. *The Lancet* 2005;**365**:835-6.
- Frist WH. Recovering from the Tsunami. *N Engl J Med* 2005;**352**:438.
- Chatterjee P. India's health workers rise to the occasion. *The Lancet* 2005;**365**:283.
- Moszynski P. Disease threatens millions in the wake of Tsunami. *BMJ* 2005;**330**:59.
- Greenberg AE, Trussel RR, Clesceri LS (Eds). *Standard methods for the examination of water and waste water*, 16<sup>th</sup> ed. APHA: Washington, DC; 1965.
- Hansen W, Yoorassawsky E. Detection of beta-glucuronidase in lactose-fermenting members of the family Enterobacteriaceae and its presence in bacterial urine cultures. *J Clin Microbiol* 1984;**20**:1177-9.
- Manja KS, Maurya MS, Rao KM. *Bull World Health Organ* 1982;**60**:797-801.
- Rooyen MV, Leaning J. After the Tsunami - Facing the public health challenges. *N Engl J Med* 2005;**352**:435-8.
- World Health Organization. Flooding and communicable disease fact sheet: Risk assessment and preventive measures. [http://www.who.int/hac/techguidance/ems/floods\\_cds/en/2005](http://www.who.int/hac/techguidance/ems/floods_cds/en/2005).