Investigation of the outbreak of typhoid in a village of Thar Desert Rajasthan, India

P.K. Anand & R. Ramakrishnan*

Desert Medicine Research Centre (ICMR), Jodhpur & *National Institute of Epidemiology (ICMR)
Chennai, India

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Background & objectives: Outbreaks of typhoid have been reported from Maharashtra, Bangalore, West Bengal and Pondicherry in India but rarely from Rajasthan. We investigated an outbreak of typhoid in a village of Thar Desert of Rajasthan.

Methods: A retrospective cohort study was carried out during May-July 2007 in Varkana village, Pali district, Rajasthan, to identify the risk factor for disease. The information on outbreak was collected and then described in time, place and person characteristics to arrive at aetiological hypotheses.

Results: There were 219 cases of typhoid in village. Attack rate was 104 cases per 1000 population. Maximum attack rate of 276 cases per 1000 population was noted in persons of 10-14 yr age group. Forty three serum samples were reported positive for Widal agglutination test out of 70 tested. Drinking of water from government overhead tanks was associated with disease significantly (RR= 11.1, 95% CI= 3.7-33). Two of the three water samples from government tanks were found positive for faecal contamination.

Interpretation & conclusion: The outbreak of typhoid in a village affected >200 persons of all age groups and both gender. Exposure to the drinking water from government tanks was found significantly associated with the disease. Preventive and control measures undertaken after analytical epidemiological study helped in terminating the outbreak.

Key words Thar Desert - typhoid outbreak - water tanks

Typhoid is under regular surveillance by integrated disease surveillance project of India1. An estimate of annual typhoid incidence rate of 493.5 cases per 100,000 person years was reported in one study2. Outbreaks of typhoid have been reported from Maharashtra3,4, Bangalore5, West Bengal6,7 and Pondicherry8 in India. Most of these outbreaks were of drug resistant strain of Salmonella Typhi5-8. Rathish et al5 reported triple drug resistance in 95.1 per cent isolates of Salmonella Typhi to chloramphenicol, ampicillin and co-trimoxazole5. Chloramphenicol resistant isolates of Salmonella Typhi have been reported from West Bengal6,7. Only limited outbreaks of typhoid were subjected to proper epidemiological investigation3,4. Kulkarni et al3 identified the role of well water in the outbreak of typhoid fever in Katkalamba village of Nanded district.
of Maharashtra. Sathe et al\textsuperscript{4} found massive central contamination of the ill maintained municipal water supply system in Maharashtra\textsuperscript{11}.

Sporadic cases of typhoid have been reported from Rajasthan\textsuperscript{9,10}. We investigated an outbreak of fever with headache and stomachache in Varkana village of district Pali, Rajasthan in 2007. This investigation was carried out as a field assignment under field epidemiology training programme, at National Institute of Epidemiology, Chennai, India.

**Material & Methods**

The study was carried out in village Varkana (with a population of 2100), district Pali (24.45 - 26.75 degree North Latitude and 72.48 - 74.20 degree East Longitude) in Rajasthan, India. It is geographically located in vegetation and water scarce agro climate of Thar Desert. Health care services to residents of village Varkana are delivered through ‘Health Ad Post’ Varkana, primary health centre (PHC) Rani, community health centre, Bali and district hospital, Pali.

Having alerted about outbreak of fever in village Varkana on June 7, 2007, we reached the place and collected surveillance data on patients’ age in completed years, gender, locality of residence, and date of examination at ‘Health Ad Post’ Varkana, primary health centre (PHC) Rani, community health centre, Bali and district hospital, Pali.

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Operational criteria used to define suspected case of typhoid included occurrence of sustained high grade fever with or without headache, stomachache, diarrhoea, and/or, constipation, vomiting, loss of appetite with negative test result for malaria in residents of Varkana village on any day since May 7, 2007.

Surveillance data of patients fulfilling this operational criterion were included in study. These cases were described in terms of time, place and person distribution through epidemic curve, spot map and frequency table respectively to formulate aetiological hypotheses.

This analytical retrospective cohort study was undertaken on a random cohort sample (n=108) of village residents to test the significance of aetiological hypotheses. This sample size was estimated based on village population 2100, 50 per cent assumed proportion of exposure, 95 per cent confidence coefficient, 10 per cent confidence interval including 12 more residents in anticipation of non-response during study. N= Z\textsuperscript{2}pq/d\textsuperscript{2} was used for sample size estimation.

To reach to cohort sample of 108 random village residents, 108 households were selected through draw of name slips prepared from the village census list. Then field team visited each selected household. One household member, seen first among all family members at home visit, was recruited in retrospective analytical study from each of such selected households leaving all other family members.

Socio-demographic data, presence or absence of operational criterion for suspected case of typhoid, rapid screening Widal test result and exposure to common meal, drinking water in the preceding one month was collected. This study was carried out during May-July 2007.

Data were analyzed in Epiinfo (version 3.5.1). Statistical power of the association based on normal approximation with continuity correction was estimated using OpenEpi software version 2.3.

Rapid screening slide test for typhoid was performed with ‘Typhiscreen-S’ (Monozyme India Limited, Secunderabad) at primary health centre, Rani, for those patients who could afford the price of the test to screen the presence or absence of antibodies against antigens of *Salmonella* Typhi and *Salmonella* Paratyphi A and B. Presence of agglutination was noted as positive test as per manufacturer’s instruction and indicated presence of corresponding antibodies in serum. Since this was qualitative test, antibody titre was not measured. Results of this test were used to formulate the diagnosis of outbreak.

**Results**

There was no change in surveillance system and population movement of the affected area. The usual rate of fever was 1-2 cases per month in affected village in the last three years. Most of the cases were suffering from continuous fever with stomachache, pain in abdomen, diarrhoea or constipation and vomiting. All cases were found to be negative for malaria. Till June 8, 2007, a total of 209 suspected typhoid cases fulfilling operational criteria were reported through surveillance system in Varkana village. The number rose to 219 by the time the follow up visit was made on July 4, 2007. Forty eight per cent of cases were males. Forty three out of 70 patients’ serum samples sent for rapid screening Widal test were positive.
There was no common meal, food handler/distributor in village in last one-month period. People used the open place for defecation near village. Epidemic curve began on May 18, 2007 and reached at peak on June 6, 2007 after that it declined. In four weeks duration the curve rose gradually till its peak, declined later, making a unimodel curve (Fig. 1).

Drinking water was available either through government supply or personal tube wells. Government water supply was through 2 hand pumps and 3 overhead tanks at common places. There was open well, supplying water to all the three overhead tanks in village. Spot map shows the clustering of cases in area supplied by government tanks for drinking water. The Meghwal colony, Khimawat colony, Dhani and Teachers colony had shown a few cases. Member of these colonies were using water either from government hand pump or through personal tube wells (Fig. 2).

Attack rate of disease was 104 cases per 1000 population (95.45 and 114 cases per 1000 population in male and female respectively). Attack rate was 133.33 and 276 cases per 1000 population in age groups of 5-9 and 10-14 yr respectively (Table I).

Among the 108 random villagers interviewed for retrospective analytical study, 60 were found to either have suffered from disease or suffering currently. Relative risk of disease was 11.1 with 95 per cent confidence interval of 3.7-33.0, among those exposed to water from government tanks as compared to other sources of drinking water (Table II).

**Fig. 1.** Epigraph for onset of cases of typhoid in Varkana village, district Pali, Rajasthan, India, 2007.

**Fig. 2.** Spot map for distribution of households of diseased (Orange spots) and non-diseased (Blank circles) persons in village Varkana, district Pali, Rajasthan.

**Table I.** Age- and gender-wise attack rates of typhoid in village Varkana, district Pali, Rajasthan

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total cases</th>
<th>Population</th>
<th>Attack rate (cases per 1000 population)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>105</td>
<td>1100</td>
<td>95.45</td>
</tr>
<tr>
<td>Female</td>
<td>114</td>
<td>1000</td>
<td>114</td>
</tr>
<tr>
<td><strong>Age group (yr):</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-4</td>
<td>15</td>
<td>270</td>
<td>55.55</td>
</tr>
<tr>
<td>5-9</td>
<td>34</td>
<td>255</td>
<td>133.33</td>
</tr>
<tr>
<td>10-14</td>
<td>69</td>
<td>250</td>
<td>276</td>
</tr>
<tr>
<td>&gt;15</td>
<td>101</td>
<td>1325</td>
<td>76.22</td>
</tr>
<tr>
<td>Total</td>
<td>219</td>
<td>2100</td>
<td>104.28</td>
</tr>
</tbody>
</table>

**Table II.** Relative risks of typhoid amongst persons exposed to different sources of drinking water in village Varkana, district Pali, Rajasthan

<table>
<thead>
<tr>
<th>Source of drinking water</th>
<th>Disease present</th>
<th>Disease absent</th>
<th>Incidence rate (%)</th>
<th>Relative risk</th>
<th>95% CI</th>
<th>Statistical power with continuity correction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Govt. tank</td>
<td>52</td>
<td>4</td>
<td>92.8</td>
<td>11.1</td>
<td>3.7-33</td>
<td>100</td>
</tr>
<tr>
<td>Govt. tank &amp; hand pump &amp; personal well</td>
<td>5</td>
<td>11</td>
<td>31.2</td>
<td>3.75</td>
<td>1.02-13.8</td>
<td>36.49</td>
</tr>
<tr>
<td>Hand pump &amp; personal well</td>
<td>3</td>
<td>33</td>
<td>8.3</td>
<td>Reference</td>
<td>Reference</td>
<td>Reference</td>
</tr>
</tbody>
</table>
to those exposed to hand pumps and personal wells for drinking. This association was found significant ($P<0.05$; Table II).

Persons exposed to government tanks and hand pumps and personal wells were at 3.75 times higher risk of developing disease than the reference group with 95 per cent CI limits of 1.02-13.8. 1-tailed probability value for Fisher Exact test found was 0.048, which was significant.

Of the three water samples from each of three government tanks sent to laboratory, Public Health Engineering Department, Jodhpur for faecal contamination test, two were positive for presumptive coliform test. Two water samples from different hand pump sent for test reported negative.

**Discussion**

The findings of the study, verified the existence of an outbreak in village Varkana, district Pali, Rajasthan. Clinical presentation of cases was in accordance to the WHO criterion. Epidemic curve with single peak and moderate duration of about one month is suggestive of the common source outbreak of disease with incubation period of approximately 15 days to one month, which is a similar requisite for typhoid.

In high and medium incidence areas for typhoid, maximum proportion of cases occurs in 0-4 yr age group, however in low incidence rate areas maximum proportion of cases belong to 20-24 yr age group. During this outbreak, the maximum attack rate was noted in 10-14 yr age group suggesting low incidence of typhoid in desert of India.

Exposure to the drinking water from government water supply was found significantly associated with the disease. Dose response effects observed with the exposure of tank water add evidence for its causality. This finding is in consistency with other investigated outbreaks of typhoid in India where contaminated drinking water was found as risk factors. Environmental condition around open well supported the possibilities of its contamination. Faecal contamination seen in water samples provided additional evidence for the source of infection.

There were a few limitations in this study. Drinking water was tested for faecal contamination, which is indirect evidence for probable presence of *Salmonella* Typhi in water. Microbiological testing of water for causative bacteria was not done. Probable case definition for typhoid was used in this outbreak. Because of cross reactivity of antigens of *Salmonella Typhi* with non-typhoidal salmonella, malaria and dengue, false positive cases would have been included in our study. Malaria was excluded based on negative blood smear examination. Though nobody presented with retro-orbital pain, which can occur in dengue, we could not exclude it based on clinical ground. Probability of dengue may be minimal in hot weather of desert village, because it is mostly considered a problem, associated with urbanization. Non-typhoidal salmonella could not be excluded.

**Acknowledgment**

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**References**


*Reprint requests:* Dr P.K. Anand, Scientist C, Desert Medicine Research Centre (ICMR), New Pali Road Jodhpur 342 005, Rajasthan, India  
e-mail: pkanand@dmrcjodhpur.org, ananddmrc@yahoo.co.in