

# Measles Outbreak among the Dukpa Tribe of Buxa Hills in West Bengal, India: Epidemiology and Vaccine Efficacy

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## Summary

Although measles is a vaccine preventable disease, its occurrence and outbreaks are common in India. Four remote and inaccessible hamlets, inhabited by the Dukpa tribe, at Buxa Hills under Kalchini Block of Jalpaiguri District, West Bengal experienced a measles outbreak during the months of April-June, 2011. The authors conducted an investigation to assess vaccine coverage, vaccine efficacy (VE) and to describe the patterns of measles outbreaks in this community. The over-all attack rate was 14.3%; that among males and females were 12.6% and 16.0% respectively ( $P = 0.189$ ). Attack rate was highest (40%) in 0 to <5 years followed by that in the 5 to <15 years (36.5%). VE was 66.3% (95% of the confidence interval 46.9-78.6%). There is an urgent need to increase the vaccination coverage through special tactics for reaching the unreachd.


**Keywords:** Attack rate, Measles outbreak, Measles vaccine, Vaccine efficacy

Measles is still a major cause of childhood morbidity and mortality in India in spite of Universal Immunization program being in place since 1985. A number of measles outbreaks (281) were notified during 2008-2011 under integrated disease surveillance project, Ministry of health and family welfare, Government of India.<sup>5</sup> The ongoing evaluation of vaccine programs is an important strategy to get insight into the effectiveness of the program and provide necessary feedback. Studies are revealed that measles outbreaks occurs mainly due to low vaccine coverage or low vaccine efficacy (VE) or both.<sup>1,2,4</sup>

A measles outbreak occurred at four high altitude villages of Buxa Hills in Jalpaiguri District over a 12 week period in April-June 2011. These villages had poor accessibility to modern health care system; a non-government organization alone has been providing the basic maternal and child health services with logistic support from health and family welfare Department since 2007 in that area. The four village namely viz. Lepchakha (2800 ft), Onchulom (2700 ft), Lalbanglow (2000 ft), Tashigaon (2300 ft) in Jalpaiguri District of West Bengal, India are inhabited by the Dukpa tribe. Total population of the four villages was 793 (males-52%, females-48%).

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The District Surveillance unit conducted a study in order to determine the time, place and person characteristics of the outbreak as well as the VE in the outbreak affected area with prior permission from the respective authority of the Directorate of Health Services, Government of West Bengal. Ethical clearance was also taken. Clinical measles cases which had occurred during last 3 months were found and line listed through the house to house search in the affected villages in the 1<sup>st</sup> week of July 2011 by using a semi-structured questionnaire. Measles vaccination status was determined from immunization cards. If immunization card was not available, vaccination

status was recorded as unknown. We followed World Health Organization definitions of clinical and confirmed measles. A clinical case of measles is defined as fever with maculo-papular rash and either conjunctivitis or cough or coryza. A confirmed case of measles is defined as a clinical case who is positive for anti-measles virus nucleoprotein immunoglobulin M (IgM) antibodies in serological tests but has not been vaccinated against measles during last 1 month.<sup>3</sup> Six blood samples were collected from selected cases, who were within 5<sup>th</sup>-15<sup>th</sup> day of illness from the onset of rash, for IgM enzyme-linked immunosorbent assay test.

A retrospective cohort study was conducted to estimate VE. There was no system of measles vaccination service in Buxa Hills area before 2007. Since then, vaccination program was going on having a coverage rate of 74% until June 2011. Hence, children above 5 years in this region were mostly unimmunized. Hence, we considered only the children of 9-59 months (as on 30 June 2011) as the cohort for the study. There was no reported history of measles within the cohort prior to the outbreak. The exposure variable as measles vaccination before the outbreak and the outcome variable was an attack of clinical measles. We used the formula:  $VE (\%)^9 = (1 - \text{relative risk}) \times 100$ . As we included all children in the above-mentioned age group in the study, there is no need to calculate any sample size. Data analysis was done by using a statistical test calculator and relative risk calculator.

The outbreak was confirmed as measles as five of six serum samples tested positive for measles IgM. The total number of measles cases was 113. No death was reported. The epi-curve [Figure 1] shows that the outbreak started from the 1<sup>st</sup> week of April and continued until last week of

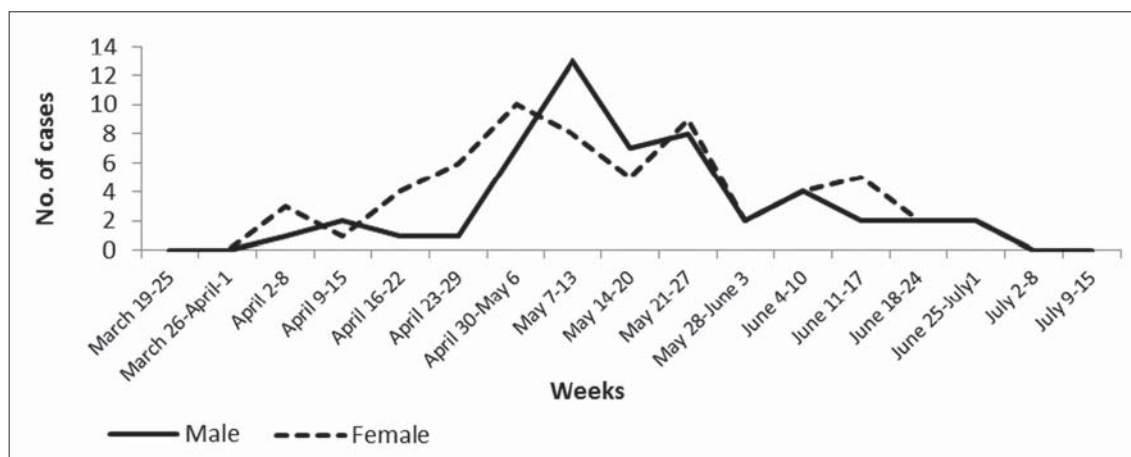
June, i.e., the early monsoon. Peak of the outbreak was in 6<sup>th</sup> week. Maximum number of cases occurred in between 4<sup>th</sup> and 8<sup>th</sup> week of the episode. No further cases were reported in the village in next 6 weeks following the last case reported in June 2011. There is not much variation in gender wise time distribution of the occurrence of measles cases.

Table 1 shows that among the cases, 52 (46%) were male and 61 (54%) were female. The youngest case was aged only 3 months. The mother of that the child was also affected. The upper limit of the age range was 31 years, the median being 10 years. The over-all attack rate was 14.3% (113/793; 95% of the confidence interval [CI] 11.8-6.7%). Attack rates among males and females were not significantly different (52/412 [12.6%] vs. 61/381 [16.0%];  $P = 0.189$ ). Of the 113 clinical cases, 89 (78.8%) were children (0 to <15 years). The attack rate among children was significantly higher than that in adults ( $\geq 15$  years) (89/236 [37.7%] vs. 24/557 [4.3%]; Chi-square = 151.36,  $P < 0.001$ ). Attack rate was highest in the under 5 years age group.

Among 113 clinical cases, only 18 (15.9%) were vaccinated before the outbreak. Vaccination status of

**Table 1: Attack rate of measles by age and sex**

| Age group (years) | No. of the population by sex |        |       | No. of persons developed measles |        |       | Attack rate (%) |
|-------------------|------------------------------|--------|-------|----------------------------------|--------|-------|-----------------|
|                   | Male                         | Female | Total | Male                             | Female | Total |                 |
| 0 to <5           | 47                           | 33     | 80    | 19                               | 13     | 32    | 40.0            |
| 5 to <15          | 81                           | 75     | 156   | 21                               | 36     | 57    | 36.5            |
| 15 to <25         | 116                          | 106    | 222   | 9                                | 10     | 19    | 8.6             |
| 25 and above      | 168                          | 167    | 335   | 3                                | 2      | 5     | 1.5             |
| Total             | 412                          | 381    | 793   | 52                               | 61     | 113   | 14.3            |
| Attack rate (%)   |                              |        |       | 12.6                             | 16.0   | 14.3  |                 |



**Figure 1:** Epi-curve showing gender-wise time distribution of measles cases ( $n = 113$ )

42 (37.2%) was unknown. Remaining 53 (46.9%) cases were unvaccinated.

The cohort size of children of 9-59 months for calculation of VE was 68. Among them 50 were vaccinated and the rest were unvaccinated on retrospective observation. Attack rates among the vaccinated and the unvaccinated were 30.0% and 88.9% respectively. Our study estimated the VE to be 66.3% (95% CI: 46.9-78.6%). VE by age at vaccination within 9-59 months children shows a marginal difference between the two groups viz.: Vaccinated between 9 and 12 months (VE = 66.59%) versus vaccinated after 12 months of age (VE = 65.38%).

We suspect that measles was transmitted from outsider tourists at Buxa Fort to the local Dukpa children, because no measles case was reported in Buxa Hills in last 1 year before the outbreak. Most of the earlier studies revealed that the respective measles outbreaks were attributable either to low measles vaccine coverage or low VE or both.<sup>1,2,4,6,7,8</sup> Our study among Drukpa tribe of Buxa Hills determined the both to be the cause(s). Mostly the children below 15 years were affected during the outbreak. There were several reasons for the predominance of measles in that age group in the community. Children over 5 years of age were not protected by measles vaccine earlier. Being in an isolated community, the herd immunity of the 5 to <15 year age group owing to exposure to natural measles was likely to be low too. A good proportion of children of 1-5 years were also unvaccinated. Moreover, VE was far below (66.3%) the expected standard (85%). Almost similar low VE was also found in a study at Nutandih village of Purulia District of West Bengal.<sup>8</sup> In our case, the unvaccinated children below 5 years were given a dose of measles immunization during the outbreak. We have considered those children to be unvaccinated ones so far VE estimation was concerned, although the said dose of vaccine might have developed some immunity in the vaccines within the time period of the outbreak. This could have resulted in an underestimation of the VE. However, out of these children only two remained to be affected with measles. Considering the much larger cohort size with respect to this, we can say that the underestimation would be only a little. Unlike some earlier measles outbreaks in other areas, there was no death in the present outbreak and the attack rate in females was not significantly higher than that in the males.<sup>2,3,6,7,8</sup> It is recommended that measles immunization program in

the Buxa Hills area be reviewed to find out the reason of low VE. The vaccination point on the hills is 23 km away from the vaccine store and it requires an uphill walk of about 8 km to reach there. Hence, vaccine cold chain is potentially vulnerable and needs to be specially monitored. However, over-all vaccine coverage among the under-five population was below the expected level of achievement, which needs to be addressed. Furthermore, the second opportunity vaccination should be arranged as per the revised guideline<sup>10</sup> (2010) of the Ministry of health and family welfare, Government of India.

This study has its own limitations; i.e., (a) the VE estimation had to be done with only a small population thereby reducing the precision of the estimate and (b) the results might not be externally valid as the study subjects belonged to a special isolated community.

Inadequate vaccine coverage, low VE and possibly low herd immunity due to geographical separation from measles endemic areas contributed to causation of the outbreak. Emphasis needs to be given to attain the program goal of primary measles vaccine coverage within the stipulated age as well as the second dose vaccination as per the current national guideline.

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