Measles among under-9-month-olds in rural Bangladesh: its significance for age at immunization*

V. Fauveau,1 J. Chakraborty,2 A.M. Sarder,3 M.A. Khan,4 & M.A. Koenig5

Any decision to modify measles immunization strategies away from the use of the conventional vaccine given to children at 9 months of age to the adoption of recently proposed vaccine strains that can be given to 4–6-month-olds will depend on the age distribution of severe cases of measles in the community. Reported are the results of an analysis of two community-based measles surveillance systems in rural Bangladesh, which found that 17% of all measles cases reported for under-5-year-olds in a nonvaccinated population involved infants aged less than 9 months. In a vaccinated population from the same area, 31% of all measles cases reported for under-5-year-olds occurred among under-9-month-olds. Using a rather restrictive definition for measles-related deaths (those occurring within 6 weeks of the onset of the rash), the proportion of measles-related deaths that occurred before 9 months of age was 13% of all such deaths that were reported.

Although in Africa measles is recognized to be a major public health problem (1, 2), less concern has been expressed about its contribution to child mortality in parts of Asia, particularly in the Indian subcontinent. Two recent findings, however, have triggered a renewed interest in measles control. The first of these was the discovery and successful pre-testing of the new generation of measles vaccines, which permit children to be immunized at an earlier age (3–6). The second was the impressive reduction in mortality resulting from measles immunization in Bangladesh (7–9).

The decision to modify current measles immunization strategies from the use of conventional vaccine strains given to infants at 9 months of age to the recently tested strains administered at 4–6 months of age depends ultimately on the age distribution of severe cases and case fatality rates in the community (10–12). Such a decision is about to be made in many African countries because they have age-related data on measles, a situation that does not apply in Bangladesh.

In this paper, we present data on the epidemiology of measles in rural Bangladesh, based on an analysis of two community-based measles surveillance studies conducted in Matlab over the past 10 years. The Matlab study area has the advantage of a well-established demographic surveillance system, which permits a precise assessment of dates and ages.

Methods

Matlab is a rural deltaic area quite typical of southern Bangladesh, where the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B), has maintained a demographic surveillance system (DSS) since 1966. Under this system, 110 community health workers (CHWs) visit each household in their village every 15 days and note any births, deaths, migrations, or marriages that have occurred since their last visit (13). Since 1980 they have also reported all cases of measles that have occurred during or between their visits (14, 15). In one half of the DSS area (the MCH–FP or treatment area) 80 CHWs cover a population of approximately 1200 each, and provide maternal and child health—family planning (MCH–FP) services. For practical reasons, this area is divided into four operational blocks (A, B, C, and D) of 25,000 inhabitants each (16). In the other half of the DSS area (the comparison area), 30 CHWs cover a population of approximately 3200 each, and health

*From the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B).

1 Maternal and Child Health–Family Planning (MCH–FP) Project, ICDDR, B. Present address: Centre for Population Studies, London School of Hygiene and Tropical Medicine, 99 Gower Street, London WC1E 6AZ, England. Requests for reprints should be sent to Dr Fauveau at this address.

2 Manager, Health Services, Matlab MCH–FP Project, ICDDR, B.

3 Manager, Demographic Surveillance System, Matlab MCH–FP Project, ICDDR, B.

4 Data Management Supervisor, Record Keeping System, Matlab MCH–FP Extension Project, ICDDR, B.

5 Project Director, MCH–FP Extension Project, ICDDR, B; and Associate, The Population Council, New York, USA.

services are limited to those provided by the government health programme.

Measles vaccination was not provided in the study area until April 1982, when it was systematically offered at home to all children in blocks A and C in the MCH–FP area. Children in the other half of the MCH–FP area (blocks B and D) were first vaccinated against measles in November 1985 in the same way. Those in the comparison area were dealt with by the national expanded programme on immunization (EPI), which only covered about 5% of the children until its intensification in 1989 (17).

This experimental design permitted evaluation of the impact of measles vaccination on mortality (7–9) and also of the age distribution of the disease in communities with different vaccination coverage rates.

We used the following data sets for measles surveillance: the comparison area (largely unvaccinated) for 1980–81; blocks A and C of the MCH–FP area (coverage rates that ranged from 50% in May 1982 to 78% in December 1985); and blocks B and D of the MCH–FP area over the same period (coverage rates of less than 1%). Data on the age distribution of measles-related deaths from three other studies conducted in the area were also reviewed (15, 18, 19).

Results

Measles morbidity

During 1980–81 in the largely unvaccinated comparison area, 4–6-month-olds exhibited the highest reported incidence of measles (Table 1). Besides the usual definition of measles (taking into account the type of rash and accompanying symptoms), the cases reported here were restricted to children whose rash lasted 4–12 days. The age distribution of reported cases declined uniformly until the age of 10 years. Cases of measles that occurred among 3–9-month-olds represented 17% of the total number of cases among under-5-year-olds (11% of the total cases among under-10-year-olds).

From January 1982 to October 1985 in the largely unvaccinated blocks B and D, children aged 5–42 months exhibited the highest incidence of reported measles cases, with peaks among 5–7-, 14–16-, and 26–29-month-olds (Table 1). Cases of measles among 3–9-month-olds represented 10% of the total among under-5-year-olds (9% of the total cases reported among under-10-year-olds).

In blocks A and C, where 50–78% of children were vaccinated between May 1982 and October 1985, the highest reported incidence of measles occurred among 5–9-month-olds (Table 1). Cases that occurred among 3–9-month-olds represented 31% of all measles cases reported for under-5-year-olds (29% of all cases reported for under-10-year-olds).

Seasonality. Analysis of the data for 1980–81 as well as from 1982–85 confirms that measles had a strong seasonality, with a consistent peak in March (Fig. 1 and 2). Annual and spatial variations occurred, with a particularly high number of cases in block A during the dry months of 1982, and in block B during the dry months of 1985 (blockwise, data not shown).

Table 1: Proportion of measles cases in infants aged 3–9 months, Matlab maternal and child health–family planning (MCH–FP) and comparison areas, 1980–85

<table>
<thead>
<tr>
<th>Area (period)</th>
<th>No. age groups (months)</th>
<th>Percentage of cases*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison area, not vaccinated (January 1980–December 1981)</td>
<td>3711</td>
<td>4–7</td>
</tr>
<tr>
<td>MCH–FP area blocks B + D, not vaccinated (January 1982–October 1985)</td>
<td>1921</td>
<td>5–7</td>
</tr>
<tr>
<td>MCH–FP area, blocks A + C, 50–78% vaccinated (May 1982–October 1985)</td>
<td>370</td>
<td>5–9</td>
</tr>
</tbody>
</table>

* Expressed as a percentage of all cases of measles among children aged under 5 years.

Table 2: Measles case fatality rates by age for two follow-up periods, Matlab comparison area (unvaccinated), 1980–81

<table>
<thead>
<tr>
<th>Age group (months)</th>
<th>No. with measles</th>
<th>No. of deaths</th>
<th>CFR</th>
<th>No. of deaths</th>
<th>CFR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6 weeks</td>
<td>12 weeks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6–12</td>
<td>425</td>
<td>11</td>
<td>2.59</td>
<td>13</td>
<td>3.06</td>
</tr>
<tr>
<td>13–24</td>
<td>564</td>
<td>13</td>
<td>2.30</td>
<td>15</td>
<td>2.66</td>
</tr>
<tr>
<td>25–36</td>
<td>526</td>
<td>9</td>
<td>1.71</td>
<td>10</td>
<td>1.90</td>
</tr>
<tr>
<td>37–48</td>
<td>529</td>
<td>7</td>
<td>1.32</td>
<td>8</td>
<td>1.51</td>
</tr>
<tr>
<td>49–60</td>
<td>386</td>
<td>1</td>
<td>0.26</td>
<td>2</td>
<td>0.52</td>
</tr>
<tr>
<td>&gt;60</td>
<td>1084</td>
<td>3</td>
<td>0.28</td>
<td>4</td>
<td>0.37</td>
</tr>
</tbody>
</table>

* CFR = case fatality rate.
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Fig. 1. Seasonality of measles among the unvaccinated population in Matlab comparison area, January 1980 to December 1981.

Measles mortality

From 1986 to 1988 in the largely unvaccinated comparison area, 98 measles-related deaths were reported among 3–60-month-olds, i.e., 11.5% of all deaths in this age range. Measles-related deaths were defined as either those that occurred during the acute phase of the disease (13/98 when the rash was present) or within 6 weeks of onset of the rash; most post-measles deaths were due to dysentery (68/98), followed by pneumonia (17/98).

The highest reported measles-related deaths occurred among 16–33-month-olds (Fig. 3). Measles-related deaths among 4–9-month-olds represented 13% (13/98) of all such deaths that were reported. The great majority of these deaths took place at home (91%). Only 12% of the children had been examined by a qualified doctor prior to death, and for most the examination was only carried out after a series of consultations with unqualified and traditional doctors had failed to produce results. In the whole of the DSS area, a significantly higher proportion of all measles-related deaths involved females rather than males (58% versus 42%, P < 0.05, Fig. 3).

Of the measles-related deaths reported during 1986–88, 47% occurred during the dry months of March–May (Fig. 4).

As shown in Table 2, the measles case fatality rates (CFRs) among those who were not vaccinated were highest for infants who had measles before reaching their first birthday, and declined regularly with increasing age. This pattern was similar for deaths observed within 6–12 weeks after onset of the disease.

Discussion

Our data indicate that among rural Bangladeshi children who were not vaccinated against measles, between 17% and 10% of all measles cases among under-5-year-olds occurred before the EPI-recommended immunization age of 9 months, and that at least 13% of all measles-related deaths occurred before this age. In the vaccinated study population, however, 30% of all measles cases occurred in infants

Fig. 2. Seasonality of measles among the unvaccinated (blocks B + D) and vaccinated (blocks A + C) populations, Matlab maternal and child health–family planning (MCH–FP) area, January 1982 to October 1985. The percentages are the measles vaccine coverage rates in blocks A + C for all children aged 9–60 months.
Fig. 3. Measles mortality (immediate and 6-weeks' delayed mortality) by age and sex, Matlab comparison area (unvaccinated), 1986–88 ($n=98$).

Fig. 4. Seasonality of measles mortality, Matlab comparison area (unvaccinated), 1986–88 ($n=98$).
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under 9 months of age. Because the numbers involved are small, the proportion of measles-related deaths in the vaccinated population (11 deaths in the MCH–FP area in 1986–88) could not be estimated.

The validity of our data should be examined critically. Although the surveillance systems in Matlab were carefully supervised and occasionally validated in home visits by medical officers, there was a tendency to overreport as measles some rashes that occurred among under-3-month-olds. Both Koster et al. (based on serology) and Bhuiya et al. (based on home visits by a doctor) found that the rate of such overreporting was 2% (15, 18); the latter authors also reported that the rate of double reporting was 4%.

Cases of measles were reported every month throughout the study period. The marked and consistent seasonality observed is, however, in keeping with a reasonably valid reporting system, since no known childhood diseases other than measles follow such a seasonal pattern.

The assessment of measles CFRs is approximate, because all deaths following the disease over a given period have to be accounted for. The trends observed in the study were consistent, and did not change with the duration of the follow-up period. The CFRs at 12 weeks were also consistent with the findings of a national measles survey performed in 1984 in urban areas of Bangladesh, which reported lower CFRs among the younger age groups (20).

In the Matlab area, Koster et al. previously reported measles CFRs at 6 weeks that ranged from 4.4% (among children <24 months of age) to 1.6% (among children >72 months of age)(18), while Bhuiya et al. reported CFRs of 1.3% among under-12-month-olds and 1.7% among over-36-month-olds (15). Shahid et al. reported a CFR of 1.3% for children under 24 months of age, but 40% of all the measles-related deaths found by these authors were among under-6-month-olds (19). Comparison of CFRs between age groups requires large numbers of measles cases. Recent evidence from studies in Matlab suggests that the long-term effect of measles vaccination on delayed mortality might be far more important than has generally been assumed (9).

The data presented here make a case for considering the new generation of measles vaccines to be a valid alternative for the national EPI in Bangladesh. The magnitude of the additional reduction in infant mortality provided by shifting the age for measles vaccination from 9 months to between 4 and 6 months needs, however, to be further evaluated.

Acknowledgements

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Résumé

La rougeole chez les enfants de moins de 9 mois dans le Bangladesh rural: son importance pour l'âge de vaccination

Toute décision de modifier les stratégies de vaccination contre la rougeole, qui consistent à utiliser le vaccin classique chez des enfants de 9 mois, pour adopter les souches vaccinales récemment proposées pouvant être administrées aux enfants de 4–6 mois, dépendra de la distribution par âge des cas sévères de rougeole dans la communauté. Dans cet article, sont rapportés les résultats d’une analyse de deux systèmes de surveillance de la rougeole à base communautaire, dans le Bangladesh rural (Matlab), qui montrent que 17% de tous les cas de rougeole notifiés chez des enfants de moins de 5 ans dans une population non vaccinée intéressent des nouveau-nés âgés de moins de 9 mois. Dans une population vaccinée de la même région, 31% de tous les cas de rougeole notifiés chez des enfants de moins de 5 ans s’étaient produits chez ceux de moins de 9 mois. En utilisant une définition assez restrictive des décès dus à la rougeole (ayant lieu dans les 6 semaines qui suivent le début de l’éruption), la proportion des décès dus à la rougeole qui ont eu lieu avant l’âge de 9 mois était de 13% de tous les décès notifiés.

Les taux de létalité à six semaines de suivi allaient de 2,59% chez des enfants de 6–12 mois à 0,28% chez les enfants de plus de 60 mois; à 12 semaines de suivi, les taux correspondants étaient de 3,06% et 0,37%. Seuls 12% des enfants avaient été examinés par un médecin qualifié avant leur décès, et pour la plupart d’entre eux le médecin n’avait été consulté qu’après des tentatives infruc-
tueuses de traitement par des tradipraticiens et des guérisseurs non qualifiés. La comparaison des taux de mortalité dans différents groupes d’âge nécessite de grands nombres de cas de rougeole. Des données récentes provenant d’études effectuées au Matlab laissent à penser que les effets à long terme de la vaccination contre la rougeole sur la mortalité retardée peuvent être beaucoup plus importants qu’on ne le suppose en général.

Les données présentées dans cette étude incitent à penser que l’emploi de la nouvelle génération de vaccins contre la rougeole est une alternative valable pour le Programme élargi de vaccination (PEV) du Bangladesh. L’ampleur de la réduction de la mortalité infantile obtenue en abaissant l’âge de la vaccination contre la rougeole, de 9 mois à un âge situé entre 4 et 6 mois, demande cependant à être davantage évaluée.

References