Childhood immunization coverage in Zone 3 of Dhaka City: the challenge of reaching impoverished households in urban Bangladesh

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A household survey of 651 children aged 12–23 months in Zone 3 of Dhaka City carried out in 1995 revealed that 51% of them had fully completed the series of childhood immunizations. Immunization coverage in slum households was only half that in non-slum households.

Apart from residence in a slum household, other characteristics strongly associated with the completion of the entire series of childhood immunizations included the following: educational level of the mother, number of children in the family household, mother's employment status, distance from the nearest immunization site, and number of home visits from family-planning field workers.

The findings point to the need to improve childhood immunization promotion and service delivery among slum populations. Two promising strategies for improving coverage are to reduce the number of missed opportunities for immunization promotion during encounters between health workers and clients, and to identify through visits to households those children who need additional immunizations. In the long run, increasing the educational level of women will provide a strong stimulus for improving childhood immunization coverage in the population.

Introduction

Although Bangladesh has improved its national immunization coverage of children from 2% in 1985 to 76% in 1995 (1, 2), coverage in slum areas of Dhaka City has lagged behind that for the city as a whole. In citywide surveys in both 1990 and 1993, coverage in slum neighbourhoods was only three-quarters of that for the city as a whole (3–5).

The lower coverage in urban slums is a cause for special concern for several reasons. First, vaccine-preventable diseases account for 22% of deaths of under-5-year-olds in the slums of Dhaka City (6). Second, the Dhaka urban population is growing at a rate of 6–9% per year (7, 8); if the growth rate in the urban slums is 9% per year, their population will approximately double in 8 years. Third, because of the crowded conditions in the urban slums, communicable vaccine-preventable diseases (and measles in particular) have higher transmission rates in such areas than in non-slum urban neighbourhoods or rural communities (9).

Also, the levels of malnutrition among Bangladesh’s urban slum children are greater than those among children in rural and non-slum urban areas, where malnutrition levels are also quite high by international standards (10). The capacity of malnourished urban slum children to combat infections, including those which are vaccine-preventable, is therefore particularly compromised (11). The higher mortality among urban-slum children with measles compared with that among other children has been attributed to the combined effects of the younger age of cases (among whom the case-fatality rate is higher) and to the higher levels of malnutrition among urban-slum children (12).

To the best of our knowledge, there have been no previous analyses of the various socio-demographic influences on childhood immunization coverage in any of the major urban areas of Bangladesh, although such analyses have been carried out in one smaller municipal area of Bangladesh (13) and in rural areas of the country (14, 15).

This article reports immunization coverage of children in one major urban area of Bangladesh, compares the coverage in slum and non-slum populations, and determines the factors which influence immunization status. A companion paper

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concerning tetanus toxoid immunization among women of reproductive age in Zone 3 has also been published (16).

**Methods**

With a population of around 450000, Zone 3 is the second largest of the 10 zones within Dhaka City Corporation, which includes approximately half of the 9 million people living within the greater Dhaka metropolitan area. Zone 3 is located in the south-west of the city and borders the Buriganga river.

Approximately one-fifth of the households in Zone 3 report a monthly income of <US$ 50 and one-third of the population lives in large slum neighbourhoods. One-half of the Zone 3 population lives in substandard housing, which typically has only one room, a roof of non-permanent material, no indoor sanitation or running water, and no amenities such as a television or a refrigerator.

The data for this report have been obtained from the Urban Panel Survey (UPS) of the MCH-FP Extension Project (Urban) of the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). The UPS is a longitudinal health survey of 5940 households containing 30840 persons in 160 geographical clusters in Zone 3. The clusters were selected using a multistaged area sampling procedure. Data were collected from each household every 3 months by a field interviewer who completed a questionnaire on use of health and family planning services and occurrence of vital events.

During the third quarter of 1995, the UPS collected information about previous immunizations received by under-2-year-olds. The data for this report have been obtained from this particular round of the UPS; the survey included 651 respondents who had a child aged 12–23 months.

Childhood immunization coverages were calculated based on the WHO immunization schedule criteria and the conformity of the dates recorded on the child's immunization card (if it was available) or the dates given by the mother (if no card was available) with these criteria. The findings for overall complete coverage were confirmed using COSAS 4.3 software.

Distance from the household to the nearest immunization site was obtained by direct measurement on a detailed map of Zone 3 prepared by project staff.

A household index score was derived for each household by summing the number of favourable characteristics present for each house from the following list:

- roof made of permanent material such as concrete or brick;
- walls made of permanent material such as concrete or brick;
- more than one room;
- latrine with a water seal or an indoor toilet;
- bed (i.e. a wooden structure for sleeping);
- bureau (i.e. a lockable wooden cabinet for storing valuables and clothing);
- table or chair;
- radio;
- television; and
- refrigerator.

Based on previous analyses, we considered a household index score of less than 6 out of a total possible score of 11 to indicate a slum household.

Statistical analyses of the data were carried out using Epi Info (version 6.0) and SPSS (version 6.0) software. Because of the high correlation (>0.60) between the reported monthly income and the household index score, income was not included in the multivariate model to avoid problems related to multicollinearity.

The statistical significance of the β-values in the logistic regression is based on the Wald statistic. Confidence intervals for the immunization coverage levels were calculated using Epi Info C-Sample software for multistaged area cluster sampling designs. Confidence intervals for the multiple regression odds ratios were calculated using the Computer Programs for Epidemiologic Analysis (PEPI), version 2.

**Results**

**Coverage by antigen and slum/non-slum status**

Overall, 51% of 12–23-month-olds had completed their entire series of immunizations on the day of the household survey. Of the completely immunized...
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Fig. 1. Immunization coverage among 12–23-month-olds in Zone 3, Dhaka City, 1995 (bars show 95% confidence intervals).

Fig. 2. Immunization coverage among 12–23-month-olds in Zone 3, Dhaka City, 1995, by slum status. (See text for definition of slum household; bars show 95% confidence intervals).

children, 90% had obtained all of their immunizations before their first birthday. Access to immunization services (as measured by BCG coverage among 12–23-month-olds) was 85%, and the overall drop-out rate from the first dose of diphtheria – pertussis – tetanus (DPT1) to the third dose (DPT3) among 12–23-month-olds was 14% (Fig. 1). The overall drop-out rate from BCG to measles was 33%. The 12–23-month-olds who received a BCG immunization before 3 months of age were more than twice as likely to have been completely immunized as children who had not been thus immunized (63% versus 30%, respectively).

As shown in Fig. 2, the complete series coverage of slum households was only about half that of non-slum households (38% versus 69%). However, access (as defined by BCG coverage of 12–23-month-olds) in slum households was 80% of that in non-slum households. The drop-out rate from DPT1 to DPT3 for children in slum households was 6.7 times higher than that for children in non-slum households, while the drop-out rate from BCG to measles was 1.6 times higher (data not shown). A total of 73% of the incompletely immunized children in Zone 3 aged 12–23 months lived in slum households.6

Relationship between sociodemographic, programme, and geographic characteristics and childhood immunization coverage

Table 1 shows the relationships between predictor variables and complete childhood immunization cover-

6 Families with children aged 12–23 months were much more likely to live in slum households than families that did not have children in this age group. In Zone 3, only 42% of all women of reproductive age lived in slum households, compared with 57% of those women who had a child aged 12–23 months.
### Table 1: Relationship between sociodemographic and programme characteristics and childhood immunization coverage

<table>
<thead>
<tr>
<th>Characteristic/variable</th>
<th>Relationship with complete childhood immunization coverage</th>
<th>Odds ratio</th>
<th>Bivariate analysis</th>
<th>Logistic regression analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Family background</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Mother’s birthplace</td>
<td>Children of mothers born in urban slums or in a rural village had a lower coverage than those whose mothers were born in urban non-slum locations</td>
<td>0.35</td>
<td>(0.21–0.57)</td>
<td>NSa</td>
</tr>
<tr>
<td>Mother’s age</td>
<td>Children of mothers aged ≥30 years had a lower coverage than those whose mothers were aged &lt;30 years</td>
<td>0.43</td>
<td>(0.29–0.63)</td>
<td>NS</td>
</tr>
<tr>
<td>No. of children living in the family</td>
<td>Children in families with ≥3 children had a lower coverage than those whose mothers did not work for money</td>
<td>0.39</td>
<td>(0.27–0.56)</td>
<td>0.38</td>
</tr>
<tr>
<td>Mother’s education</td>
<td>Children of mothers with &lt;6 years’ education had a lower coverage than those whose mothers had ≥6 years’ education</td>
<td>0.25</td>
<td>(0.17–0.38)</td>
<td>0.47</td>
</tr>
<tr>
<td>Length of time mother has been living in Dhaka</td>
<td>NAc</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Mother’s marital status</td>
<td>Children of mothers who were divorced, separated, or widowed had a lower coverage than those whose mothers were married</td>
<td>0.32</td>
<td>(0.11–0.88)</td>
<td>NS</td>
</tr>
<tr>
<td>Mother’s employment status</td>
<td>Children of mothers who worked for money either in the home or elsewhere had a lower coverage than those whose mothers did not work for money</td>
<td>0.35</td>
<td>(0.21–0.57)</td>
<td>0.42</td>
</tr>
<tr>
<td>Father’s occupation</td>
<td>Children whose fathers were unemployed or who had unskilled manual jobs had a lower coverage than those whose fathers had manual skilled or non-manual jobs</td>
<td>0.42</td>
<td>(0.29–0.64)</td>
<td>NS</td>
</tr>
<tr>
<td>Sex of the index child</td>
<td>Female children had a lower coverage than male children</td>
<td>0.68</td>
<td>(0.49–0.94)</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Household</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Average reported monthly income</td>
<td>Children in households with a monthly income of &lt; Tk 2500 (ca. US$ 60) had a lower coverage than those living in households with higher incomes</td>
<td>0.29</td>
<td>(0.20–0.43)</td>
<td>Not included in regression model</td>
</tr>
<tr>
<td>Slum household status</td>
<td>Children in slum households (household index score &lt;6) had a lower coverage than those living in households with higher housing index scores</td>
<td>0.28</td>
<td>(0.20–0.39)</td>
<td>0.42</td>
</tr>
<tr>
<td><strong>Programme</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Distance to nearest EPI centre</td>
<td>Children living in households &gt;0.4 km from the nearest EPI centre had a lower coverage than those living &gt;0.4 km away</td>
<td>0.59</td>
<td>(0.39–0.90)</td>
<td>0.53</td>
</tr>
<tr>
<td>Home visit by field workers</td>
<td>Children whose mothers reported 0–2 field-worker visits over the previous year had a lower coverage than those whose mothers reported ≥3 visits</td>
<td>0.71</td>
<td>(0.51–0.98)</td>
<td>NS</td>
</tr>
</tbody>
</table>

a Figures in parentheses are 90% confidence intervals.
b NS = not significant.
c NA = no association.

Mother’s birthplace, mother’s age, length of time living in Dhaka, mother’s marital status, father’s occupation, sex of the index child, and frequency of home visits by field workers had no independent effect after controlling for the effects of the other predictor variables. The strong effects observed in the bivariate analysis for the effect of number of children living in the household, mother’s employment status, and distance to the nearest immunization centre remained in the multivariate analysis. The effects of a mother having a limited education and of living in a slum household were attenuated in
the multivariate model compared with the bivariate analysis, but in the multivariate model both of these variables were still associated with a reduction by more than half in the probability of complete immunization coverage. There were no significant interaction effects identified in the logistic regression model.

We analysed why there were differences between the bivariate and multivariate analyses with respect to the effect of specific predictor variables on coverage. The effect of mother's birthplace was mediated by the number of children, slum/non-slum household status, and maternal employment status: mothers born in urban slums or in rural villages had more children, were more likely to live in slum households, and were more likely to work for money. The effect of maternal age was mediated by the number of children: older mothers were more likely to have more children. The effect of marital status on coverage was mediated by mother's employment status: mothers who were divorced widowed or separated were more likely to work for money. The effect of father's occupational status was mediated by slum/non-slum household status and maternal employment status: fathers with lower occupational status were more likely to live in slum households and be married to women who worked for money.

The effect of the child's sex on coverage was mediated by the number of children living in the family; in families with only one or two such children, immunization coverage of 12–23-month-olds did not differ significantly by sex, but for families with three or more children, the coverage among female 12–23-month-olds was far less than that of their male counterparts (Fig. 3).

The effect of number of field-worker contacts on childhood immunization coverage appeared to be mediated primarily by maternal employment status, mother's education, and slum/non-slum household status. Mothers who worked for money had fewer field-worker contacts than those who did not work for money. Also, mothers with less education and those living in slum households had fewer field-worker contacts. The effect of field-worker contacts was apparent for both working and nonworking mothers, however, and the effect was even stronger among working mothers. For mothers who did not work for money, the coverage increased from 52% to 65% as the number of field-worker contacts increased from 0–2 to 3–4, while among working mothers a similar increase in field-worker contact was associated with an increase in coverage from 26% to 60%.

**Discussion**

The dominant influences on immunization coverage were slum versus non-slum household location, educational level of the mother, the number of children in the family, mother's employment status, proximity to immunization sites, and number of home visits from family-planning field workers. Half of the 12–23-month-olds in Zone 3 still needed additional immunizations. The slum/non-slum differences in childhood coverage found in previous surveys of Dhaka still persist.

**Effect on coverage of number of children in the family and sex of the index child**

In families with three or more children, immunization levels were lower for the most recently born child than for such a child in families with only one or two children. This finding has also been reported previously in Bangladesh (13) and in other countries (18–20). In addition, the coverage of female children was about 10% lower than that of male children. Similar findings for Bangladesh have also been reported previously (14, 21). The striking effect of the number of previously born siblings and the sex of the index child on immunization coverage identified in our study has not previously been reported to the best of our knowledge. For index children aged 12–23 months who had at least two living siblings, the coverage for male children was almost twice that of similar female children.

Mothers with three or more children may not be as highly motivated to obtain immunizations for the most recently born child, especially if this child is female; those mothers may also be busier and have less time for such activities. Parental preference for male children and the lower mortality of such chil-
dren after the first year of life have been reported previously in Bangladesh (22–24).

**Immunization centre location and contact with family-planning field workers**

Distance of the household from the nearest immunization centre and the frequency of contact with field workers were both important predictors of immunization status. Slum households were further away, on average, than non-slum households from the nearest immunization centre. Persons living in slum households already face barriers to obtaining immunization services because of their lower educational and socioeconomic status, and the increased distance to the nearest immunization centre constitutes a further hurdle for these persons. Although all households in Zone 3 lie within 1 km of the nearest immunization centre, the “social” distance may be particularly important for the most socioeconomically disadvantaged women. In rural Bangladesh, the mother’s ability to visit a health centre without another adult accompanying her is a strong predictor of utilization of immunization services (14), and women living in slum households may not feel comfortable about travelling very far from their homes.

Number of client contacts with field workers was a significant predictor of childhood immunization coverage in the bivariate analysis, but the effect was insignificant in the multivariate model. Field-worker contact rates were also lower for mothers whose characteristics were associated with low immunization coverage rates, particularly those with low educational levels, low household index scores, and those who were working for money. A demarcation was observed for those mothers who had had three or more visits during the previous year compared with those with two or fewer visits. More frequent field-worker visits to persons living further away from an immunization centre reduced by half the adverse effect of distance on childhood immunization coverage (data not shown). Other studies in Bangladesh (14) as well as in Thailand (27, 28) and in Ghana (29) have documented the favourable effect on immunization coverage of personal contact with community outreach workers at home visits.

In the urban areas of developing countries, client knowledge and client motivation appear to be key factors that influence utilization of immunization services, and the critical role played by personal contact (particularly from health workers during home visits) in providing information and motivating clients has been reported for the urban slums in Dhaka (30) as well as in other urban settings (9, 29). If the contact rates between family-planning field workers and severely impoverished households were higher, and if greater attention were given to promoting immunizations among those needing them, coverage rates could be improved. Direct observation of field-worker–client interactions suggests there is still considerable room for improving promotion of immunizations at home visits (31, 32).

**Strategies for improving coverage in urban Bangladesh**

Despite the marked progress over the past decade, there is still an urgent need to improve immunization coverage levels among slum children in Bangladesh. Even in cities with high overall coverage levels, outbreaks of measles are not uncommon because of the presence of pockets of unimmunized children, high population mobility, and high transmission rates caused by high population density and crowded living conditions (33, 34). Previously it has been argued that reducing the number of missed opportunities for promoting immunization and conducting home visits to identify those in need of immunization are promising strategies for improving coverage (28, 35, 36).

Greater promotion of immunization services is needed. The immunization status of women of reproductive age and of children should be checked at all interactions with MCH–FP health workers, and those who need immunization should be referred. Missed opportunity rates for immunization promotion in Zone 3 range from 43% to 97%, depending on the site of the encounter and the type of immunization (childhood versus maternal) being promoted (35, 36). Improving the understanding of each mother about the additional doses her child needs has been identified as a key strategy for improving coverage, particularly among the socioeconomically disadvantaged (37–39).

Regular home visits by paid or volunteer health workers to all women of reproductive age, promotion of immunization of those children who need them, and targeted follow-up of children in need of additional immunizations (or who are at increased risk of not obtaining the complete series, such as those who did not receive a BCG immunization before 3 months of age) are further ways to improve coverage.

Establishment of user-friendly immunization outreach sites near or adjacent to slum neighbourhoods will be important in narrowing the slum/non-slum gap in immunization coverage. Although Zone 3 clients report that providers at immunization sites are generally friendly, it is not uncommon for clients to have to pay for immunizations even though government policy prohibits this; also, the hours of op-
eration of immunization centres are quite restricted (35). Other promising approaches to improving coverage include strengthening knowledge about the immunization schedule among MCH-FP providers and other health practitioners who themselves do not give immunizations, improving the understanding of mothers about the purpose of immunizations, and increasing the prevalence of client-retained immunization cards (35).

Finally, for the small proportion of the population that does not respond to the above-mentioned efforts, vaccination from temporary sites or even in the home itself can serve as a stopgap measure until coverage levels can be improved through more sustainable approaches. Vaccination from temporary sites or in the home itself can be particularly effective in geographical areas where surveillance has detected clusters of measles or of neonatal tetanus cases.

**Need for a strategy directed specifically to slum households**

According to the results of a recent government analysis (40), 55% of the population in Dhaka City live below the poverty line, and 32% fall below the hard-core poverty line. Of Dhaka City’s population, 30% live in slum households (41). The findings of our study support the current efforts of the Expanded Programme on Immunization (EPI) in Bangladesh to develop and implement a special strategy for slum neighbourhoods (41). As in-migrants continue to set up new households in the urban slums of Bangladesh, it will be important for EPI to promote immunization in such areas. Both increased frequency of person-to-person contact for promotion of immunization services and increased proximity to immunization sites would help to improve the coverage of slum households.

Innovative approaches will be needed to improve access to immunization services and to motivate mothers to seek such services. The number of immunization sites will need to expand as the number and size of slum neighbourhoods increase, and the location of sites will need to be periodically reviewed. Enhancing local coordination with government officials, local leaders, and health staff would strengthen partnerships with the community and thereby promote local ownership of immunization activities. Such coordination would also enhance the optimal use of existing resources for immunizations. Finally, slum-specific immunization strategies will need to recognize that face-to-face promotion by field workers, volunteers, and neighbours will be more effective than mass-media communications (41).

**Importance of increasing the educational level of mothers**

A final implication of the findings of this study is that raising the general level of education among mothers and mothers-to-be is perhaps one of the most important long-term contributions to improving childhood immunization coverage. In Zone 3, 39% of women of reproductive age had no formal education at all, and only 37% had received more than a primary level of education. Other studies carried out in Bangladesh (13, 14, 21) and elsewhere (18–20) have documented, as we have, a strong association between maternal education and childhood immunization coverage.

**Conclusions**

Enormous challenges remain to improve the current levels of childhood immunization coverage in rapidly growing impoverished urban areas of Bangladesh. Socioeconomically disadvantaged parents in these areas may not understand the importance of childhood immunization or that of completing the entire series of doses. Also, they may place their short-term needs for income and food over the long-term interests of their children, they may be unable to afford or be unwilling to pay for the transport and clinic fees or may not have the time or be willing to risk the discourteous treatment associated with completing the entire series of immunizations.

Whatever the reasons, stronger efforts are needed to reduce the immunization drop-out rate of children from impoverished households in Zone 3 of Dhaka City and in other urban areas of developing countries. Stronger community promotion and improved availability of immunization services among the poorest segments of the urban populations will be needed if overall coverage levels are to improve further. The findings of this study and their associated programmatic implications are relevant for urban areas in other developing countries with moderately high levels of overall immunization coverage and where much of the challenge of creating a reasonably functioning “infrastructure” for providing immunizations has been met.

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