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The immunization programme in Bangladesh: impressive gains in coverage, but gaps remain

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The paper reviews the achievements in tetanus immunization coverage and child immunization in Bangladesh. It uses data from the 1993–94 Bangladesh Demographic and Health Survey to identify and examine the programmatic and non-programmatic factors that influence the coverage of tetanus (TT) immunization during pregnancy, and full immunization among children 12–23 months old in rural Bangladesh. The purpose of this analysis is to identify the areas that need further programme attention.

The logistic regression results show that the coverage of TT immunization was significantly associated with proximity to outreach clinics and the presence of a health worker in the community. Home visits by health/family planning fieldworkers and the proximity to outreach clinics had larger influences on TT coverage of poorer households compared to those better-off. The effect of distance to static clinics varied by regions. Among children, full immunization coverage (coverage of all of BCG, DPT1, DPT2, DPT3, Polio1 Polio2, Polio3) was significantly associated with distance to outreach clinics, the greater the distance to the clinics, the less the likelihood of immunization.

Introduction

Tremendous progress has been made over the past 20 years toward development of effective national immunization programmes throughout the world. The major contributor to this success is the Expanded Program on Immunization (EPI) of the World Health Organization (WHO), usually implemented through UNICEF. The EPI was created in 1974 as a worldwide alliance of collaborating nations whose goal was to expand immunization services and coverage. The program consists of vaccination against six childhood diseases: polio, measles, pertussis, tetanus, diphtheria and tuberculosis. Top priority was given to developing countries because the seriousness of these diseases and the problem of immunization service delivery were more severe in these areas.

A recent estimate suggests that immunization programmes annually prevent 3.2 million child deaths, and represent one of the most cost-effective health interventions (World Bank 1993). Data indicate that more extensive delivery of EPI could further improve the survival and health status of children (Black et al. 1980; Koenig et al. 1990; Arya et al. 1994; Pan American Health Organization 1995; Ginneken et al. 1998).

Bangladesh officially initiated EPI activities in 1979, but EPI efforts were seriously considered only after 1985 when the country made its commitment at the United Nations to reach universal child immunization by 1990. The programme received strong support and assistance from multiple partners, including non-governmental organizations, donor agencies, commercial enterprises and community volunteers.

During the mid-1980s major steps were taken by the programme in many areas, with particular emphasis on establishment and improvement of the infrastructure for immunization, such as procurement of improved cold chain equipment, vaccination tools and portable vaccination kits, training of immunization teams, development of strategies for effective immunization delivery, and subsequently promotion of demand for immunization through various communication media and health education campaigns. The intensified immunization programme was expanded in phases. In 1985 the first phase of EPI commenced in 8 thana; it expanded to 190 thana in 1988, and near universal access to immunization service was achieved by end of 1989 (Talukdar et al. 1991).

EPI in Bangladesh is implemented through various clinic-based and outreach activities. Immunization motivation and education are provided during household visits by health workers, known as Health Assistants (HA), and family planning fieldworkers called Family Welfare Assistants (FWA), while vaccination services are available at outreach sites like EPI sites and satellite clinics, and in static clinics. It is primarily the health workers who are responsible for the administration of the vaccinations at health centres. The family planning fieldworkers (FWAs) also assist in the administration of vaccinations at outreach sites (EPI spots and satellite clinics), although this is not considered as their primary responsibility (Talukdar et al. 1991)

The achievement of the immunization programme in Bangladesh has been impressive. In ten years Tetanus Toxoid (TT) immunization acceptance increased more than ten-fold, from 6% in 1984 to 67% in 1993–94, and full immunization among children 12–23 months old increased from a negligible proportion to almost 60% (Huq and Cleland 1990; Mitra et

al. 1994). This increase in immunization coverage has led to a decline in child deaths and morbidity due to immunizable diseases (Ginneken et al. 1998; EPI 1998; Baqui et al. 1997; Koenig et al. 1990). According to an estimate of the Bangladesh EPI Project, during the period 1987–1997, 1.2 million child deaths have been prevented in Bangladesh by immunization.

In spite of the successes some challenges still remain for the programme. First, acceptance of TT immunization has increased but the level can be further improved.[1] The proportion of children who received at least one of the recommended vaccinations has increased to 85%, but full immunization coverage is at a less than satisfactory level. Second, there is large variation in immunization coverage among regions and socio-economic groups, where a more equitable coverage is desired.

The objectives of this paper are: first, to review the achievements of the program and identify areas where performance needs improvement; second, to identify socio-demographic, economic and health programme factors that are associated with acceptance of immunization, and to examine whether the health programme impacts on immunization were different for mothers and children of various socio-economic groups. The intent of the analysis is to identify areas where health programmes could be effective.

Methods

Data

The study used data from the Bangladesh Demographic and Health Survey (BDHS) 1993–94, which collected information throughout the nation during November 1993 through March 1994. The BDHS 1993–94 employed a two-stage probability sample design to select its respondents. At the first stage the primary sampling units were chosen from the Multi-Purpose Master Sample (IMPS) created by the Bangladesh Bureau of Statistics based on 1991 census data. A total of 304 primary sampling units were selected for BDHS with probability proportional to size. After the selection of the primary sampling units, households in each selected area were mapped and all households listed. A systematic sample of households was then selected from these lists with an average number of 25 and 37 households in the urban and rural clusters respectively. More details on sample design and field procedures can be found in the report on BDHS 1993–94 (Mitra et al. 1994).

Information on immunization was gathered from all ever-married women 10–49 years old about all births that occurred in the four years preceding the survey, and if the child born was alive at the time of the survey. Out of 9640 respondents, 4342 women reported having at least one birth in the four years preceding the survey. A total of 5171 births were reported, of which 4468 were in rural areas and the rest in urban areas.

In BDHS 1993–94 the question asked on TT immunization was: 'When you were pregnant with (name of the child), were you given an injection in the arm to prevent the baby from getting tetanus, that is convulsions after birth?' The doses of TT received were also recorded. For child immunization, if respondents were able to show the vaccination cards of the child, the information from the card was recorded. In households with no vaccination cards, the mother was asked whether the child received each of the following vaccinations: BCG, DPT (and the doses), Polio (and the doses) and Measles.

Method of analysis

The analysis consists of two parts. First, the paper reviews national trends in TT immunization during pregnancy and full immunization coverage among children 12–23 months old, using data from the Bangladesh Fertility Survey 1989 and BDHS 1993–94. Second, it examines differentials in TT immunization coverage by a variety of socio-economic characteristics and health programme inputs. Multivariate analysis, namely logistic regression, was used to identify factors that are significantly associated with differentials in TT immunization among pregnant mothers, and full immunization among children in rural Bangladesh. To examine whether programmatic factors affect immunization acceptance differentially by socio-economic groups or regions, the multivariate model included both the net and interaction effects of the independent variables. The effects of the programmatic variables were examined by adding products of programmatic variables and socio-economic and demographic variables to the model with the main effects. The predicted proportions of pregnancies/children immunized were calculated in each of the categories of programmatic and socio-economic variables with statistically significant interaction terms.

Results

To examine TT immunization coverage, the outcome variable examined in this study is the acceptance of at least one dose of TT immunization during pregnancy. In this paper, a child 12–23 months old is considered fully immunized if she/he had received all of the vaccinations BCG, DPT1, DPT2, DPT3, Polio1, Polio2, Polio3 and Measles at the time of the survey.

Trends in immunization coverage

Differentials in the trends of TT immunization and full immunization coverage among children are shown in Tables 1 and 2, respectively. The success of TT immunization and full immunization coverage among children 12–23 months old vary by region, being more prominent in Khulna[2] and Rajshahi than in Chittagong and Dhaka administrative divisions of Bangladesh. In the five years preceding the survey, the former two divisions recorded the largest increase which widened the disparity in levels of immunization among the four divisions.

In 1988–89, the percentage of pregnancies receiving TT immunization was twice as high in the urban areas (53%) than in the rural areas (24%) of Bangladesh. In rural areas TT immunization acceptance increased 2.7 times in the next five years, compared to 1.5 times in the urban areas, thus narrowing the gap between the urban and rural areas. Yet in 1993–94, four out of five pregnancies received TT shots in the urban areas compared to only two in three pregnancies being vaccinated in the rural areas. In 1988–89, children aged 12–23 months in urban

Table 1. Differentials and trends in TT immunization in Bangladesh 1984–1994: percentage of births receiving TT immunization during pregnancy

Characteristics	Year of birth		
	1984[1]	1988/89[1]	1993/94[2]
NATIONAL	6	26	67
Region			
Khulna[3]	4	25	72
Chittagong	5	23	60
Dhaka	8	26	66
Rajshahi	5	25	71
Place of residence			
Rural	5	24	65
Urban	21	53	81
Mother's education			
None	3	19	59
Primary incomplete	8	25	67
Primary complete	16	42	83
Economic status[4]			
Owns 0–1 articles	3	18	57
Owns 2–3 articles	6	22	68
Owns 4–6 articles	15	47	83

[1] Source: Bangladesh Fertility Survey 1989
[2] Source: Bangladesh Demographic Survey 1993–94
[3] Khulna represents Barisal and Khulna Divisions
[4] The definition is not stricty comparable for the BFS 1989 and BDHS 1993–94, since information collected on ownership of household articles was not the same in both the surveys

Bangladesh were 2.4 times more likely to have received full immunization compared to those living in the rural areas. In the next five years, full immunization coverage among children in the rural areas increased much faster than those in the urban areas. As a result, in 1993–94 children in urban areas were only 1.2 times more likely to be fully immunized compared to children in rural areas.

Table 1 also shows that the largest increase in TT vaccination has occurred among the relatively disadvantaged groups, for example among mothers with no education and among the relatively poorer economic groups.[3] Although the percentage receiving TT vaccination is still considerably higher among the more educated and the economically better off, it is encouraging to see that the gaps in TT vaccination have narrowed over the years among women of different education and economic groups. Similar differentials and trends were observed in full immunization coverage among children (Table 2).

Table 2. Differentials and trends in full immunization coverage 1988–1994: percentage of children aged 12–23 months who had received full immunization by the time of the survey

Characteristics	Year of survey	
	1988/89[1]	1993/94[2]
NATIONAL	14	59
Region		
Khulna[3]	18	77
Chittagong	13	54
Dhaka	12	50
Rajshahi	16	65
Place of residence		
Rural	13	58
Urban	32	70
Mother's education		
None	10	52
Primary incomplete	18	59
Primary complete	32	75
Economic status[4]		
Owns 0–1 articles	9	52
Owns 2–3 articles	17	64
Owns 4–6 articles	28	68
Sex of the child		
Male	16	62
Female	12	56

[1] Source: Bangladesh Fertility Survey 1989
[2] Source: Bangladesh Demographic Survey 1993–94
[3] Khulna represents Barisal and Khulna Divisions
[4] The definition is not strictly comparable for the BFS 1989 and BDHS 1993–94, since information collected on ownership of household articles was not the same in both the surveys

Immunization differentials in rural Bangladesh

Since levels of TT immunization and full immunization of children were considerably lower in the rural areas of the country compared to the urban areas, this study undertook a more detailed investigation of the differentials for the rural areas only. The purpose was to examine the relative influence of various socio-demographic, economic factors, and programme inputs on the probability of immunization. The study

Table 3. Logistic regression analysis of TT immunization during pregnancy and full immunization of children aged 12–23 months

Socio-demographic and programme factors	TT immunization during pregnancy		Full imunization of children	
	Odds ratio	N	Odds ratio	N
Mother's age				
<20 (ref.)	1.0	1181	1.0	249
20–29	0.8	2421	1.2	558
30+	0.6***	743	1.4	155
Mother's education				
None (ref.)	1.0	2542	1.0	564
Primary incomplete	1.1	795	1.1	168
Primary complete	1.8***	1008	1.7*	230
Birth order				
1 (ref.)	see Figure 2 for	1064	1.0	224
2+	interaction effect	3281	0.9	738
Mother's mobility				
Can go to health clinic (ref.)	1.0	3286	1.0	750
Cannot go to health clinic	0.7***	758	0.9	156
Other	0.7*	301	1.1	56
Mother's affiliation with development organization				
Non member (ref.)	1.0	864	1.0	178
Member	1.3***	3481	1.3	784
Sex of the child				
Male	NA		1.0	485
Female			0.7*	477
Region				
Khulna (ref.)	see Figure 5 for	985	1.0	229
Chittagong	interaction effect	1068	0.4***	258
Dhaka		1224	0.3***	259
Rajshahi		1068	0.6*	216
Economic status				
Owns 0–1 articles (ref.)	see Figure 3 for	2110	1.0	456
Owns 2–3 articles	interaction effect	1347	1.2	302
Owns 4–6 articles		888	1.8*	204
Media exposure				
Has no radio, and does not listen (ref.)	1.0	1021	NA	
Has no radio, but listens to radio	1.4***	657		
Has radio	1.3*	2667		
Household visits by fieldworkers				
No visit in 6 months (ref.)	see Figures 3+4 for	2130	1.0	489
Visited in 6 months	interaction effect	2215	1.2	473
Health worker works in the village				
No (ref.) 1.0	4008	1.0	894	
Yes	1.5**	337	1.3	68
Distance to outreach clinic				
In the village/within 2 miles (ref.)	1.0	3408	1.0	757
Not held/DK	0.8**	937	0.7**	205
Distance to static health facility				
Within 2 miles (ref.)	see Figures 4+5 for	3188	1.0	707
More than 2 miles	interaction effects	1157	0.8	255
Interaction effects[1]				
Between fieldworker visit and birth order	see Figure 2		NA	
Between fieldworker visit and economic status	see Figure 3		NA	
Between distance to static health facility and economic status	see Figure 4		NA	
Between distance to static health facility and region	see Figure 5		NA	
All		4345		962

***P < .001 ** P < .01 * P < .05
ref. = reference category
[1] All interaction effects included in the model were statistically significant at P < .05

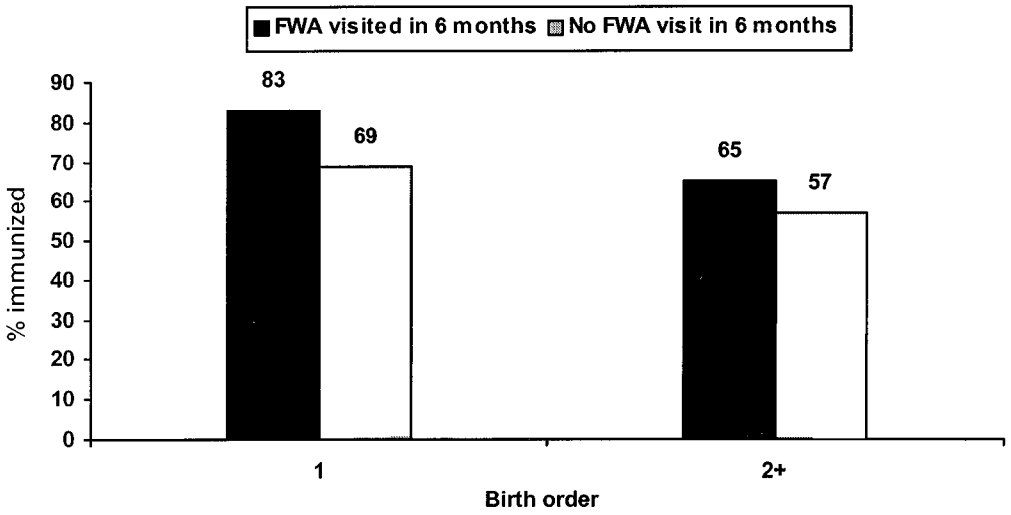

Figure 1. Percentage of births for which mothers received TT immunization during pregnancy by birth order and fieldworker (FWA) visit pattern

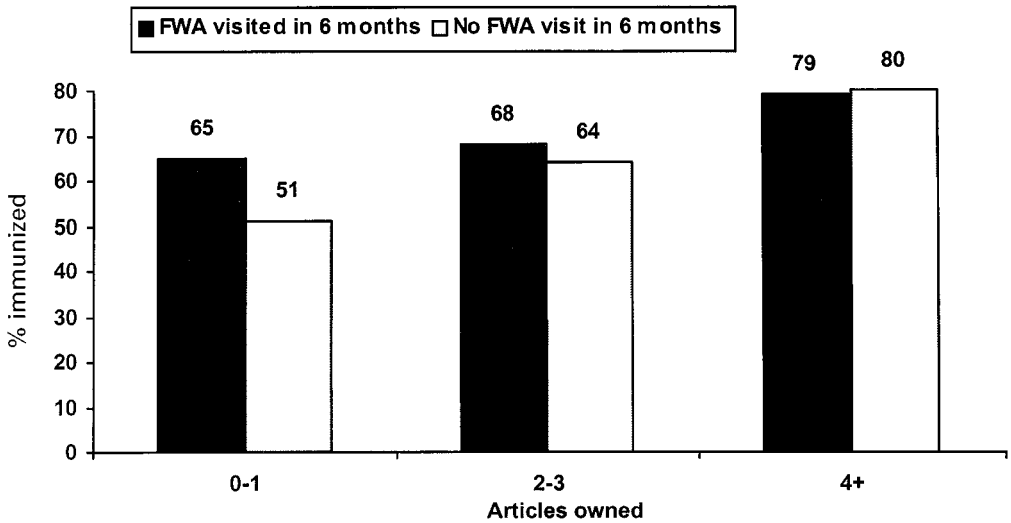

Figure 2. Percentage of births for which mothers received TT immunization during pregnancy by economic status and fieldworker (FWA) visit pattern

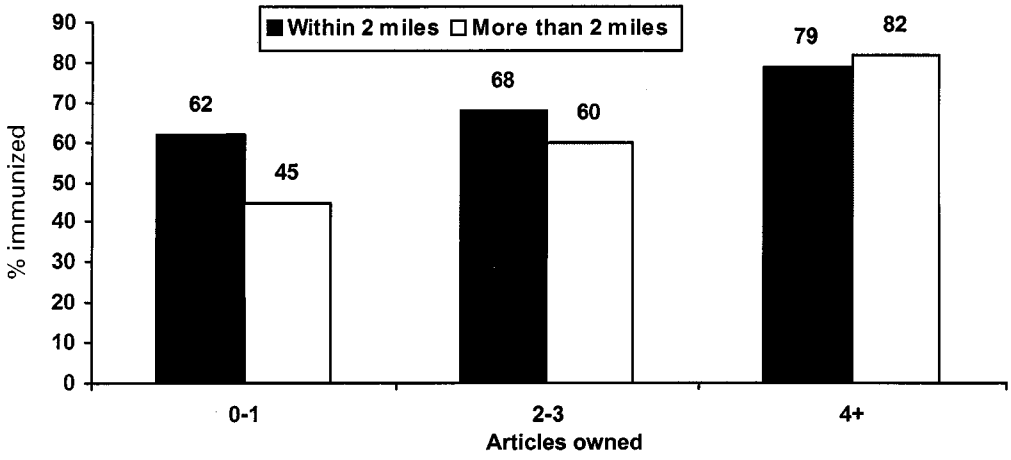

Figure 3. Percentage of births for which mothers received TT immunization during pregnancy by economic status and distance to static health facility

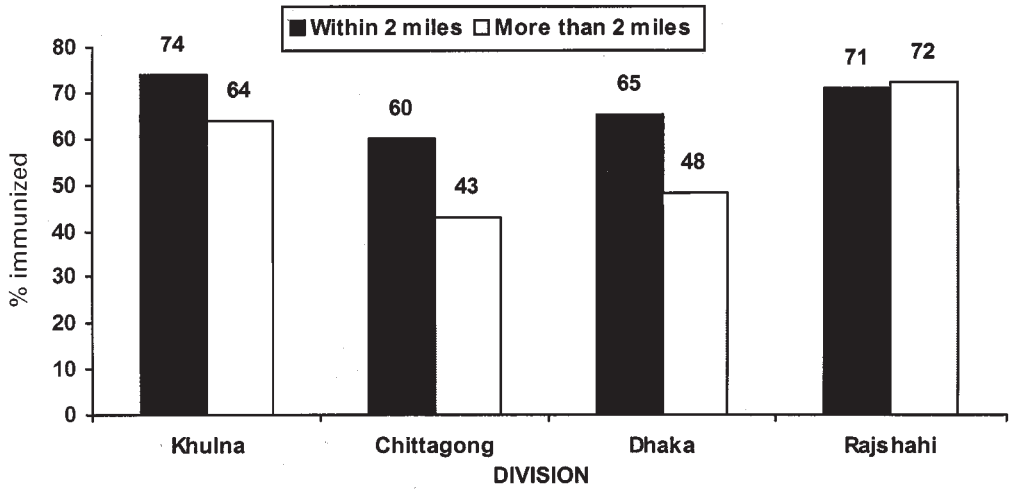

Figure 4. Percentage of births for which mothers received TT immunization during pregnancy by region and distance to static health facility

also explored whether the health programme inputs affected various groups differently.

TT IMMUNIZATION: LOGISTIC REGRESSION RESULTS

Results of the multivariate analysis of the relationship between acceptance of TT immunization and health programme factors and other variables are shown in Table 3 and Figures 1–4. For this analysis the results are best expressed through odds ratio for the main effects and through estimated proportions of births immunized for the statistically significant interaction terms.

Socio-demographic and economic factors

Younger and more educated mothers were more likely to receive TT shots during pregnancy. The probability of being immunized during pregnancy was significantly different (40% lower) for women who were 30 years or older compared to those under 20 years of age. Mothers who had completed primary level of education were 1.8 times more likely to be immunized during pregnancy compared to mothers who had no schooling. There was no significant difference in immunization acceptance between mothers with no education and those who had schooling below primary level.

Mothers whose physical mobility was restricted had a 30% lower chance of being immunized compared to mothers who could go to health centres alone or with a child. The difference was statistically significant. Mothers who were members of any development organization (like BRAC, Grameen, etc.) had a significantly higher likelihood of being immunized, probably reflecting the effects of exposure to formal and informal information on health improvement strategies.

Listening to radio had a significant positive association with acceptance of TT immunization. Those who did not own a radio, but listened to radio at least once a week, had a 40% higher chance of being immunized compared to those who did not listen to radio as frequently. This is an interesting finding since it indicates that access to radio even at the community level could have the desired effects without personally owning a radio. Those who had a radio were also more likely to be immunized compared to those who did not own or listened to radio. But the latter difference probably captured combined effects of better economic condition and media exposure and not pure media exposure effect. One of the reasons for the success of EPI in Bangladesh is the efforts that it undertook to create demand for immunization services through extensive programme communication tools, where media like radio, television, theatres, etc. were used to inform people of the benefits of immunization (Abed et al. 1991). The findings of this paper affirm the positive effects of a mass media approach on acceptance of immunization in rural Bangladesh.

Health programme factors

Four measures of health programme inputs were considered using data collected through the BDHS and they are: whether the respondent's household was visited by a health/family planning fieldworker in the last six months; whether any health worker worked in the respondent's village/community; proximity to outreach sites; and distance to the nearest static clinic, such as Family Welfare Centre, Thana Health Complex or a hospital.

Accessibility to all the health facilities/workers included in the model positively influenced acceptance of immunization in rural Bangladesh. In villages where health workers were present, pregnant women were 50% more likely to receive TT shots compared to mothers who lived in villages that had no health workers. The difference was statistically significant. Proximity of outreach sites had a significant positive association with acceptance of TT immunization. The chance of receiving TT vaccination was 20% lower for those who lived in villages where outreach clinics were not held within two miles.

The effects of household visits by family planning fieldworkers and accessibility to static health centres depended on other factors and are discussed below.

Interaction effects

The logistic regression analysis revealed that the effects of household visits by health\family planning fieldworker (FW) and proximity to static health centres were dependent on birth order, economic status of the household and region of residence. For these statistically significant interaction effects, the proportion receiving TT immunization was calculated for each category of pairs of programmatic and socio-demographic and economic variables. These are presented in Figures 1–4.

a) Household visits by fieldworkers and birth order: Women visited at their households by health\family planning fieldworkers had a significantly higher chance of accepting TT immunization during pregnancy (Figure 1). However, fieldworker household visits were slightly more important in increasing the acceptance of TT immunization among first-birth order relative to higher birth orders. This probably reflects that mothers with no previous experience of births were more likely to be influenced by information and motivation provided by fieldworkers.

b) Household visits by fieldworker and households' economic status: The effects of health\family planning fieldworker household visits on TT immunization acceptance are much greater in economically disadvantaged households (Figure 2). The economic status of the household had a substantial positive effect on TT immunization, but this effect diminishes as fieldworker household visits increase. For example, among the relatively poorest households (who owned at most one of the specified articles mentioned in the BDHS) and those who received no fieldworker visits, the percentage immunized was 51%, while among those who owned 2–3 articles and were not visited by fieldworkers, the percentage immunized was 64%. In both the economic groups, if a fieldworker visited the household the proportion immunized rose to almost the same level (66% and 68% respectively). The effect of fieldworkers household visits on the relatively better-off households (those who owned 4–6 articles specified in BDHS) was at most marginal. This indicates that motivation and information provided by health\family planning fieldworkers have substantial influence on acceptance of TT immunization in the more economically disadvantaged households.

c) Proximity to static health centres and economic status: Distance to static health centres had a more substantial effect on being immunized during pregnancy for the most economically disadvantaged group (Figure 3). TT immunization in the 'best-off' economic group of the BDHS rural sample (those who owned 4–6 articles) was not affected negatively if distance to health centres increased. Among the most disadvantaged economic group, having a static health centres within two miles increased the proportion receiving TT immunization from 45% to 62%.

d) Proximity to static health centres and region of residence: Figure 4 shows that distance to static health facilities is a more important factor in TT immunization acceptance in some regions than others. For example, in rural Dhaka and Chittagong those who lived in areas where health centres were available within two miles had at least a 35% higher chance of receiving TT immunization in both the regions than those who lived further away. In Khulna, the effect was smaller, about 16%, and in Rajshahi accessibility to static health centres did not affect TT immunization. With improvement in accessibility, regional differences in immunization still remain but become less prominent.

FULL IMMUNIZATION OF CHILDREN: LOGISTIC REGRESSION RESULTS

Results of the multivariate analysis of the relationship between full immunization of children and health programme-related and other variables are shown in Table 3. In the analysis of full immunization coverage the findings indicate that socio-demographic and economic characteristics of individuals/households are more likely to affect the chance of a child being fully immunized than health programme factors.

Socio-demographic and economic factors

Mothers' education, sex of the child, region of residence, and economic status of the household are factors that were significantly associated with full immunization among children aged 12–23 months. Mothers who completed at least primary level of education were 1.7 times more likely to have their children fully immunized compared to those who had no education. However, there was no significant difference in immunization coverage of children among mothers who had no schooling and who had lower than complete primary level of schooling. Compared to the most economically disadvantaged groups (owning at most one household article), children of the relatively better-off households (those who owned 4–6 articles) had a 80% higher chance of being fully immunized.

Sex discrimination exists in child immunization in the rural areas of Bangladesh. Female children were 30% less likely to be fully immunized compared to male children.

Variations in full immunization coverage among divisions were apparent and highly significant. Children in rural Dhaka and Chittagong were 60% and 70%, respectively, less likely to be immunized than those residing in Khulna. Children in rural Rajshahi were also disadvantaged compared to Khulna; in the former, children were 40% less likely to be fully immunized compared to the latter. In rural Rajshahi acceptance of immunization (in terms of TT and partial immunization of children) was as high as in Khulna, however it lagged behind the latter in full immunization coverage among children.

None of the other socio-demographic factors (namely, mothers' age, mobility, and affiliation to a development organization) or any interaction were found to be significantly associated with child immunization.

Health programme factors

Among the four health programme inputs included in the model, only proximity to outreach clinics was found to be significantly associated with full immunization of children. Children in areas where outreach clinics were not held within

close proximity (distance of two miles) were 30% less likely to be immunized compared to those who lived in communities where outreach clinic sites were within two miles.

Discussion

Bangladesh's efforts in the creation of demand and provision of services for immunization have had significant successes. It is encouraging to see that the improvement in immunization coverage has occurred in all socio-economic groups, the increase over the years being higher for the relatively socio-economically disadvantaged groups. What is important for other sectors to learn is how the efforts of EPI in Bangladesh accelerated immunization coverage and were capable of reaching across all socio-economic groups within a short time.

In spite of the success some concerns remain. This study identifies some of the challenges of the immunization programme and attempts to point out where health programmes need to focus to become more effective.

Major improvements in immunization coverage are needed in certain geographic areas. Rural Chittagong and Dhaka are particularly low performing areas that need more programme attention. In mortality and contraceptive use also, Chittagong and Dhaka Divisions display poor performance compared to Khulna and Rajshahi (Huq and Cleland 1990; Mitra et al. 1994).

In rural Bangladesh, health programmes have significant positive influence on TT immunization; however, the impacts of some health programme are different for various socio-demographic and economic groups. Household visits by field-workers positively influence acceptance of TT immunization during pregnancy, pointing to the need for motivation, information and referral services provided by these workers in rural areas. However, the impact of these household visits is greater for mothers of economically disadvantaged households, and for first births. In fact, household visits by field-workers have hardly any influence on behaviour regarding TT immunization for those economically better off. Unfortunately, fieldworker visitation patterns reveal that women who need health worker contact most (those from poor households) are less likely to be visited by the female fieldworkers.

At a time when discussion on the possibility of introducing selective household visitation by fieldworkers and focusing visits on 'needy' groups has been raised (Government of Bangladesh 1994; Government of Bangladesh 1996; Janowitz et al. 1996), this study suggests that women from poor households should be considered among the priority groups for improving TT immunization acceptance. This argument is reinforced by another finding of this study, that for women of poor households proximity to static health centres has a significantly large influence on their decision to be immunized. Even when health services are provided free, the cost of accessing health care may not be negligible for the poorest households. Time and financial costs of getting to health facilities increase as distance to health centres increases. This cost imposes a greater burden on the more economically disadvantaged groups, negatively affecting their health-care-seeking behaviour. Outreach services should target women from poor households, particularly those who have less access to static health centres.

For the immunization programme another group of concern is mothers who say they cannot go to health centres alone or with a child; these mothers have a significantly lower chance of being immunized during pregnancy compared to women whose physical mobility is not restricted. While for contraceptive use, the needs of many women with limited mobility may be served by providing pills and condoms at the doorstep, as is currently done, a similar approach of service delivery may not be practical or effective for an immunization programme (Talukdar et al. 1991). The result emphasizes that in households where women's mobility is restricted, there is a greater need for educating other adult household members on the benefits of immunization so that the person in need of immunization has support from other family members (for example, accompanying the client to the service centre) in seeking immunization services at outreach service points or at static clinics.

In rural Bangladesh, distance to static health centres negatively affects acceptance of TT immunization, and the impact is particularly high in Dhaka and Chittagong. However, in Rajshahi proximity of static health centres does not affect immunization acceptance among women. One plausible explanation of this finding is that in Rajshahi, health programme inputs and mass communication tools have had a greater impact in creating a much stronger demand for TT immunization than elsewhere and accessibility of health centres plays a less significant role. An alternate interpretation is that outreach health sites function more efficiently in Rajshahi than in the other divisions, thus nullifying much of the need to seek services in the static health centres. If the latter is the case then the suggestion is that low performing divisions must strengthen their outreach health programme, so that women who live further way from static clinic sites are not deprived of services.

In spite of almost universal access to immunization services, sex discrimination against female children exists in seeking full immunization coverage in rural areas of Bangladesh. The lack of significant interaction of the effects of the sex of the child and the education level and economic status of households imply that the extent of discrimination is similar across education and economic groups. Similar findings are reported in other studies (Amin 1993; Bhuiya et al. 1995). Unfortunately sex discrimination against female children was also found in other types of health care seeking behaviour (Chen et al. 1981; Hossain and Glass 1988; Bhuiya and Streatfield 1992). This is partly responsible for the result that in Bangladesh among children aged 1–4 years, 1.33 girls die for every boy. Sex discrimination against female children by families is a difficult problem to overcome completely by health service providers. Possible suggestions to minimize this problem include more frequent contacts and greater motivational efforts by service providers in households that have female children who need to be vaccinated. Innovative interventions can also be tested and tried to increase coverage of female children.

Maternal education is positively related to the chance of a child being fully immunized. Similar findings were observed in other studies in Bangladesh and elsewhere (Streatfield et al. 1990; Amin et al. 1993; Bhuiya et al. 1995). Since in rural areas the majority of mothers have no or very little schooling, a logical question is 'what kind of health interventions can improve the chance of children of illiterate mothers to be fully immunized?' A possible mechanism through which education influences child health-care-seeking behaviour is that maternal education increases knowledge of ways to prevent childhood illness and enables better understanding of information on preventive care (Cleland 1989; Chakrabarty and Streatfield 1989; Streatfield et al. 1990).

To improve full immunization coverage one must first understand the reasons for incomplete immunization. In rural Bangladesh while four out of five children are receiving at least one of the recommended vaccinations, only three in five are being fully immunized. Coverage is lowest for DPT3, Polio3 and Measles vaccinations. One likely reason for incomplete child immunization (in spite of high partial immunization) is that mothers lack understanding of the information on full immunization, like timing of immunization, doses required, benefits of full immunization, etc. The few studies that have investigated the reasons for incomplete child immunization found this to be so (Streatfield and Singarimbun 1988; De Silva et al. 1991). Mothers' insufficient understanding of full immunization could be because messages are not communicated in a way that they understand. Or the reason could be that information flowing from health education campaigns, Information, Education and Communication (IEC) materials, and health service providers are inadequate in areas where there is a knowledge gap. Experience in other developing countries shows that improving mothers knowledge of full immunization has the potential to reduce the gap in coverage between children of well-educated and non-literate mothers (Behrman and Wolfe 1987; Streatfield et al. 1990). This can be done by providing comprehensive and appropriate information through campaigns, mass media approaches and health service providers.

In recent years Bangladesh EPI has emphasized its focus on prevention of immunizable diseases rather than on expansion of immunization coverage per se. It has set goals to eradicate polio by the year 2000, and eliminate neonatal tetanus in every district of Bangladesh.[4] With these goals in mind, EPI Disease Surveillance has been set up with guidelines for improved notification, investigation and response for cases of acute flaccid paralysis, neonatal tetanus and outbreaks of measles (Government of Bangladesh, 1997). In addition, since 1995 Bangladesh has conducted National Immunization Days when supplementary doses of OPV are provided to all children under five years old, regardless of previous vaccination status. These initiatives have great potential in reaching the under-served population, identified in this study.

The global immunization initiative started with an attack against six vaccine preventable diseases of childhood but its ultimate goal is that it will serve as a catalyst in the development of primary health care delivery capability in the developing world (Foege 1984). Where does EPI in Bangladesh stand within this global perspective? EPI in Bangladesh has reached maturity, and even though some challenges still remain, the programme has moved in a direction that is consistent with the perspective of the global immunization initiative. Provision of immunization, selective maternal and child health care, and family planning services through combined EPI and satellite clinics marks the first step towards offering integrated services. Other pilot projects have been undertaken in Bangladesh where EPI has expanded to incorporate other primary health care service delivery. While the impact of these efforts must be carefully tried and evaluated, there is little doubt that the EPI programme in Bangladesh has made impressive strides towards the achievement of its comprehensive objectives.

Endnotes

[1] Although deaths due to neonatal tetanus have declined, it still accounts for 15% of deaths among neonates (Baqui et al. 1997).

[2] The administrative divisions of Barishal and Khulna are considered together in Khulna Division to avoid limitations of small sample size.

[3] The respondents were asked whether their household owned any of the following articles: bed, table, almirah, watch, radio or television. In this study, ownership of these articles was assumed to indicate the economic status of the respondent's household – the more articles the household has, the better the economic status. Three categories were considered: those who owned at most 1, 2–3 and 4–6 articles.

[4] Neonatal tetanus elimination is defined as the reduction of neonatal tetanus incidence to less than 1 per 1000 live births.

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