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# CHILD IMMUNIZATION IN VIETNAM: SITUATION AND BARRIERS TO COVERAGE

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**Summary.** This paper addresses the overall performance and inequalities in the immunization of children in Vietnam. Descriptive and logistic analysis of cross-national demographic and health data was used to examine inequality in immunization, identify the most vulnerable groups in immunization coverage, and identify the gap in coverage between hard-to-access people and the remainder of the population. The gap in the coverage was found to occur primarily in vulnerable groups such as the poor minority or poor rural children. No evidence was found of a difference in immunization coverage because of sex or birth order. However, the age of children showed a significant influence on the rate of immunization. Mother's education and regular watching of television had a significant influence on child immunization. In order to improve child immunization coverage in Vietnam, efforts should be concentrated on poor children from minority groups and those living in rural areas, especially remote ones. Community development, investment for immunization and re-organization of immunization services at the grassroots level are also key factors to remove the barriers to immunization for vulnerable populations in Vietnam.

## Introduction

Although Vietnam is one of the poorest countries in Asia, the overall state of health in the country is much better than would be expected, based on a comparison of *per capita* income (Bhushan *et al*., 2001). Among its impressive improvements in health status, infant mortality rate (IMR) – a commonly used indicator of health status – reduced by about 60% over the ten years between 1992 and 2002 (NCPFP, 1998; CPFC, 2002).

The relative high achievements in child health have been attributed to various factors: the country's socialist character, which prompted it to invest considerable resources in establishing a vast network of primary health facilities (Do, 1999a); the high rate of adult literacy; and especially the economic reform programme known as *Doi Moi*, initiated in 1986 (Gellert, 1995). The remarkable achievements in health care have also been attributed to the Vietnamese Government's great concern for health care promotion and prevention (Do, 1999b; Pham & Le, 1999).



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Around the world millions of deaths have been prevented each year through national immunization programmes since the launch of the Expanded Program on Immunization (EPI) in 1974 (WHO, 2002). According to UNICEF, the EPI, which was implemented on a pilot scale in Vietnam in 1982 and expanded to the whole country in 1985, could be considered one of the crucial factors in the country's dramatic decline in child mortality (UNICEF, 2001).

The Vietnamese Government has given much attention to immunization. Priority has been given to people in remote areas, as part of the national programme for poverty reduction and elimination of hunger. In Vietnam, community health centres are responsible for providing primary health care – including preventive, ambulatory and inpatient services. The EPI, as well as other national health programmes (e.g. mother and child health [MCH], family planning, acute respiratory infection and communicable disease control), is primarily implemented at community health centres (Nguyen *et al*., 1999). However, there are problems of instability and shortage of financial and human resources for community health centres that remain to be solved.

Market-oriented economic policies, while ushering in economic growth rates previously unheard of and reducing the number of people living below the poverty line, are undermining equity in access to health services (Do, 1999b; Bhushan *et al*., 2001). Thus the Vietnamese Government and international community must be concerned with the improvement and sustainability of child immunization, especially for the poor.

Although a number of health outcomes could have been examined in this study, the aim is to test empirically whether there has been any increase in income-based inequities in access to immunization services in Vietnam. Those subgroups most vulnerable to not receiving vaccinations, and the factors that most influence these subgroups, are also determined.

## Literature review

While global immunization coverage for six diseases (diphtheria, measles, pertussis, polio, tetanus and tuberculosis) originally targeted by the World Health Organization (WHO) has improved significantly since the mid-1970s, coverage rates are still low for children living in the poorest countries. WHO data indicate that the poorest countries of the world have vaccination rates about 26% below the global average of 82%. Even though Vietnam has achieved a higher rate of immunized children than some of the poorest countries, the DHS 2002 indicated that one-third of children are not fully immunized, with especially low coverage in rural areas, where it is 25% lower than in urban areas (CPFC, 2003).

Many studies have found evidence that lack of access to health services and low vaccination coverage is increasingly concentrated in poor households, among minorities and among people living in rural and remote areas (General Accounting Office, 1999; Schwartz & Loevinsohn, 1999; Pande & Yazbek, 2002; WHO, 2002; Gauri & Khaleghian, 2002; Schwartz & Bhushan, 2003; Bonu *et al*., 2003). These studies have also shown evidence of sex inequities in vaccination coverage. The roles of religious status, mother's education and mother's access to the media, as well as communication, on the rate of coverage of immunization programmes have also been documented in this literature. Education, information and communication for

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immunization programmes have become more important for the understanding of why people get vaccinated and generate demand for vaccines, especially when there is evidence of inconsistencies and instabilities in the immunization coverage.

A number of studies have examined health inequality and immunization issues in the Mekong Region (Phonboon *et al*., 1989; Schwartz & Loevinsohn, 1999; Bhushan *et al.*, 2001; Thang & Popkin 2003b; Schwartz & Bhushan, 2003). Only a few studies, however, have investigated the gap between the poor and the rich in obtaining vaccinations, changes over periods of socioeconomic development, and factors that sustain the low rate of immunization in groups of poor people in these countries. Identification of the most vulnerable groups needing immunization, and key factors that contribute to the low rate of immunization coverage in Vietnam, is rarely seen in current publications, even though most current health surveys are easily available.

Most studies use household surveys and explain variance in childhood immunization using the characteristics of the children's mothers and their households – often, but not always, including community characteristics.

This study uses cross-national DHS data from Vietnam: (1) to examine inequality in immunization, (2) to identify the most vulnerable groups for immunization coverage – when examining the changes of interaction factors, and (3) to identify the gap in coverage between hard-to-access people and the remainder of the population. Both descriptive analysis (to illustrate the situation as of 2002 and changes in immunization coverage that have taken place over the five-year period 1997–2002) and logistic regression (to show both individual and community factors influenced on immunization) were used in this study.

## Data

Data were from the Vietnam DHS of 1997 and 2002. For DHS 1997, 205 enumeration districts were selected. A total of 7001 households and 5664 ever-married women were successfully interviewed. There were 1775 children (of interviewed women) – who were born three years prior to the survey – included in the analysis of immunization coverage; these included 619 children aged 11–23 months (NCPFP, 1998).

DHS 2002 was conducted to provide updated estimates of demographic and health indicators to evaluate trends in population, family planning, mother and child health (MCH) and related areas for the five years between DHS 1997 and DHS 2002. The DHS 2002 sample consisted of 205 sample points selected from the list of enumeration areas of the 1999 Population Census. A total of 7048 households and their 5665 ever-married women completed interviews. This survey included 1317 children (of interviewed women) – who were born three years prior to the survey – 468 of which were aged 11–23 months (CPFC, 2003).

## Methods

### *Measurement of key parameters*

Research variables were created from (a) household, (b) women and (c) community data from three questionnaires used in DHS 1997 and 2002. The *Household*

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*Questionnaire* was used to collect information on household members and characteristics of the household's dwelling unit and ownership of various durable goods. The *Woman's Questionnaire* was used to collect information on ever-married women, aged 15–49, in the surveyed households. The questionnaire included background characteristics, reproductive history, contraceptive knowledge and use, antenatal and delivery care, breast-feeding and infant feeding practices, child immunization and recent illnesses, and so forth. The *Community/Health Facility Questionnaire* was used to collect information on all communities in which the interviewed women lived and on services offered at the nearest health facilities. The information collected from health facilities included types of services offered including immunization services. The service availability collected by both surveys, however, presents limitations in analysis and interpretation. First, the data reflect perceived rather than actual availability of services. Selected informants were asked to identify the nearest facility without attention to whether or not it was used or preferred by community residents. Thus those informants who had not used a facility probably were less knowledgeable about the services it provides. Consequently the information about services is less accurate in areas with low service use, as compared with those areas where use is prevalent. Second, the underlying assumption that the nearest facility is the one people used or preferred may not hold true in areas where households have a wide array of facilities with different levels of quality from which to choose. Despite these limitations, the facility data do provide important information on the health service environment that is difficult to obtain from other sources.

Although a number of immunization outcomes could have been examined, this study focused on two dependent variables as extreme outcomes of the immunization programme in order to provide a general figure of the coverage: (1) *fully immunized children* (FIC) and (2) *children who did not receive a single vaccination*.

According to the WHO definition, a child is considered fully vaccinated if he or she has received a Bacillus Calmette-Guerin (BCG) vaccination against tuberculosis; three doses of diphtheria, pertussis and tetanus (DPT) vaccine; at least three doses of polio vaccine; and one dose of measles vaccine. These vaccines should all be received by the time a child is 9 months old. Data on immunization status were collected from vaccination cards and, in cases where a vaccination card was not available or a vaccination was not recorded on the card, the mother's recall of vaccination was accepted. This analysis included children aged 11–23 months, as children at these ages should have received all their vaccinations.

The study focused on three groups of independent variables: (1) variables related to individual characteristics; (2) variables related to socioeconomic measures and inequalities; and (3) variables related to immunization services in the community. Three measures of inequality – poverty status, rural status and minority status – and the interaction of poverty with selected independent variables that are expected to be major influences on the gap in immunization coverage in Vietnam, were also emphasized when examining socioeconomic measures.

*Variables related to individual characteristics*. Factors that have often been shown in previous studies to be related to the demand for immunization, including mother and child characteristics, are:

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- *Sex of child.* Categorized as boy or girl.
- *Order of birth.* Indicates if the child is the first, second, third or greater order of birth of the interviewed woman.
- *Age of child.* Indicated in months.
- *Mother's education*. Categorized as no education, incomplete primary school, complete primary school, complete lower secondary school, complete higher secondary school, or above secondary school.
- *Mother's religious status*. Categorized as non-religious and religious. The religious were not categorized into Buddhist, Christian or other religion as their sample sizes were small and no difference was found in the analysis.
- *Watching television.* Considered a factor that can influence women's behaviour about immunization. As a number of TV programmes promote immunization, watching TV is expected to be a positive factor for child immunization. The variable was categorized 1 if a woman watched TV every week, and 0 otherwise.

*Variables related to socioeconomic measures and inequality*:

- *Poor and non-poor (poverty status).* In the absence of income or consumption data collected by the household surveys, physical characteristics of a household and household ownership of assets – which served as proxies for household wealth – were used as the basis for constructing a household wealth index. Previous studies have shown that a wealth index generated from household assets is a robust measure of income (Sahn & Stifel, 2003). The household wealth index was the weighted sum of different consumer durables owned by the household and other household characteristics that may be related to wealth. The weights for the assets in the index were generated by a principal component analysis on the correlation matrix. The cut-offs were set based on the rate of poverty at the time of each survey to create a poverty line for this analysis. In this study, a household that had a household wealth score that was below the poverty level was defined as 'poor', otherwise as 'non-poor'.
- *Minorities*. There are officially 53 ethnic groups in Vietnam. Ethnic minorities were defined as those who were not members of the dominant lowland ethnic Vietnamese group known as Kinh, which represents about 85% of the population and dominates socioeconomic affairs in Vietnam. This variable is considered a major one, since previous studies of health inequalities in Vietnam have indicated that ethnic minorities are among the most vulnerable groups (World Bank, 1999; Bhushan *et al.*, 2001). In this analysis, ethnicity was categorized as 'ethnic minority' or 'non-minority' (Kinh).
- *Rural*. The type of residence was categorized as urban or rural. The variable is 1 if a child lived in rural areas, otherwise 0.

*Variables related to immunization services in the community:*

- *Availability of immunization services at community health centres or at the nearest health centre*. These two variables were created from the information about whether the community health centre or the nearest health centre can provide immunizations. If a child lives in a locality where the centre can provide immunizations, the value of the variable is 1; otherwise 0.

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- *Number of days a week that a community health centre or nearest health centre is open for immunization services*. If a community heath centre *or* the nearest health centre has no days when it is open to provide immunizations, the value of the variable is 0. If it is open one or more days a week, the value is 1.
- *Vaccines run out during the last six months*. If a community health centre *or* the nearest health centre ever ran out of a vaccine during the last six months, the value of the variable is 1; otherwise 0.

In this analysis, a dummy variable was included in the final pooled data from the two surveys to indicate the year of the survey. The value of the variable is 0 if the data were collected in 1997 and 1 if they were collected in 2002. The interaction between poor status and other factors was also examined: poor households in minority groups, poor households in rural areas, poor households with a mother not completing elementary school, poor households that did not watch television regularly, poor households in a locality with no communication service (from a community health centre or nearest health centre), and so forth. The interaction factors were expected to detect the most vulnerable groups for improving immunization coverage. In regression analysis, these variables were classified into two groups: *Interaction factors* and *Quality of services* (Table 3).

*Method of analysis*

Descriptive analysis was used to calculate:

i. The percentage of children aged 11–23 months who were fully immunized or had not received any vaccine at the time of the two surveys.
ii. The changes in the rate of FIC and having no vaccine over the last five years according to individual characteristics such as sex of the child, birth order, education level of the mother, mother's religious status, mother's regular watching of television; as well as socieoeconomic disparities, i.e. poor households, minority groups and rural populations.
iii. The availability of immunization in the community and at the nearest health facilities. This is determined by the percentage of children who were living in the locality where (1) immunization is available at a community health centre, (2) immunization services were open regularly, (3) vaccines were available at a community health centre during the last 6–12 months, and (4) the same indicators (i.e. 1–3) for the nearest health facilities.

Logistic regression was used to examine the likelihood of FIC and children who received no vaccine among poor households, minority groups and rural populations in comparison with those from non-poor households, non-minority groups and of urban residence. The sex of children, birth order, age of children, education level of the mother, mother's religious status, mother's regular watching of television, community variables, and interaction factors of poverty were also included in the model to examine the significant impact of these independent variables. Prediction under regression procedures was used to estimate the net effect of the interactions of poverty factors.

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## Results

*Descriptive analysis*

Table 1 shows the general status of immunization in Vietnam in 1997 and 2002, as well as the changes over five years for children aged 11–23 months. In 2002, there were still 4·7% of the children who received no vaccine; the rate had increased 1·2% over five years (from 1997). Even though the percentage receiving BCG, the first DPT, and the first polio vaccinations was high, there were a considerable number of children who had not received these doses. There was some decline in the first DPT and the first polio dose vaccinations – 3·4% for DPT and 1·7% for polio in the five years from 1997 to 2002. Moreover, the percentage of children who dropped out between the first and last DPT and polio vaccinations in 2002 is significant – 18% ((88·4 − 72·4)/88·4) for DPT and 18·3% ((93·1 − 76·1)/93·1) for polio. Compared with the fact that 27·7% ((91·8 − 66·4)/91·8) for DPT and 35·1% ((94·8 − 61·5)/94·8) for polio dropped out in 1997, there was quite a reduction in drop-outs between 1997 and 2002. It was noteworthy that 66·7% of children aged 11–23 months had been fully immunized in 2002: an increase of 16·5% over the five years. However, the figure also implies that a third of children were not fully immunized, but needed to be.

The analysis shows differences in rate of FIC for all independent variables (Table 2). Both DHS surveys showed that more girls were fully immunized than boys, but the difference was just a few per cent. There were some differences in rate of FIC among children by birth order. The first-born seemed to be taken better care of than subsequent birth order children. However, these absolute figures did not appear to be significant.

Education of the mother showed an important finding. Women with higher education not only had a considerable higher rate of FIC but also gained the highest increase in rate of FIC over five years. For example, in 2002 women who completed high school, or above, had 82·9% of their children fully immunized. This was about twice the rate than for children of illiterate women (82·9% vs 39·5%). While the rate of FIC did not increase for illiterate women, the increase was 21·1% during the five-year period for women who completed high school or above.

In 1997, the children of mothers who did not follow any religion seemed to have a higher rate of FIC than those whose mothers followed a religion. This difference no longer existed in the 2002 data. Mothers who regularly watched television displayed large differences in the rate of FIC. For example, in 2002 the rate of FIC among mothers who watched television regularly was 33·3% higher than among mothers who did not (72·6% vs 39·3%). Also, over the five years, the increase in the rate of FIC was 17·9% among mothers who watched television regularly, while there was no progress for those did not watch television regularly.

The differences were consistent and considerable between poor and non-poor households, minority and non-minority groups, and rural and urban residents. Noteworthy were the gaps of immunization coverage between minorities and non-minorities that increased over the five years. In 1997, the rate of FIC among minorities was 10·2% (data not show) lower than among non-minority. The gap increased to 34·9% in 2002 (73·0% vs 38·1%). Also, non-minorities had a 20·4% increase of FIC over the five years compared with the decrease of 4·3% for minority

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**Table 1.** The percentage of children aged 11–23 months who had received each vaccine in 1997 and 2002 and the increase over 5 years

| | BCG (%) | DPT 1 (%) | DPT 2 (%) | DPT 3 (%) | Polio 1 (%) | Polio 2 (%) | Polio 3 (%) | Measles (%) | FIC (%) | No vaccinations (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| DHS 2002 | 93·4 | 88·4 | 83·9 | 72·4 | 93·1 | 88·6 | 76·1 | 83·2 | 66·7 | 4·7 |
| DHS 1997 | 89·5 | 91·8 | 86·7 | 66·4 | 94·8 | 86·9 | 61·5 | 77·1 | 50·2 | 3·5 |
| Increase over five years | 3·9 | − 3·4 | − 2·8 | 6·0 | − 1·7 | 1·7 | 14·6 | 6·1 | 16·5 | 1·2 |

**Table 2.** The percentage and changes over 5 years of fully immunized and non-immunized children aged 11–23 months by individual characteristics, household socioeconomic status and the availability of immunization services in the community

| | Fully immunized children | | | Non-immunized children | | |
|---|---|---|---|---|---|---|
| | 2002 | Change | *n* | 2002 | Change | *n* |
| Sex of child | | | | | | |
| Boy | 65·9 | 16·8 | 243 | 4·0 | 0·8 | 243 |
| Girl | 67·6 | 16·0 | 225 | 5·6 | − 3·6 | 225 |
| Order of birth | | | | | | |
| First | 67·3 | 12·1 | 200 | 4·1 | − 2·0 | 200 |
| Second | 67·8 | 18·0 | 173 | 3·9 | − 2·2 | 173 |
| Third and above | 63·6 | 18·3 | 95 | 7·6 | − 1·0 | 95 |
| Education of mother | | | | | | |
| Illiterate | 39·5 | − 4·3 | 33 | 30·9 | − 21·5 | 33 |
| Lower primary | 50·0 | 7·8 | 74 | 4·1 | 4·6 | 74 |
| Completed primary | 63·5 | 14·7 | 157 | 3·9 | − 2·0 | 157 |
| Completed secondary | 77·4 | 23·9 | 122 | 2·3 | − 0·1 | 122 |
| Completed high school + | 82·9 | 21·1 | 83 | 0·0 | 0·0 | 83 |
| Mother's religious status | | | | | | |
| Non-religious | 66·0 | 12·8 | 381 | 4·9 | − 1·1 | 381 |
| Religious | 68·6 | 27·1 | 87 | 4·0 | − 1·4 | 87 |
| Mother watches TV regularly | | | | | | |
| No | 39·3 | − 2·0 | 83 | 18·9 | − 11·8 | 83 |
| Yes | 72·6 | 17·9 | 385 | 1·7 | 0·0 | 385 |
| Minority | | | | | | |
| Non-minority | 73·0 | 20·4 | 385 | 3·3 | − 0·2 | 385 |
| Minority | 38·1 | − 4·3 | 84 | 11·3 | − 6·6 | 84 |
| Type of residence | | | | | | |
| Urban | 87·1 | 26·9 | 87 | 0·9 | 0·8 | 87 |
| Rural | 62·1 | 13·8 | 382 | 5·6 | − 1·8 | 382 |
| Socioeconomic status | | | | | | |
| Non-poor | 75·4 | 20·3 | 332 | 1·4 | 0·3 | 332 |
| Poor | 45·5 | 4·2 | 136 | 12·8 | − 6·1 | 136 |
| Vaccination at community health centre (CHC) | | | | | | |
| No | 86·3 | 60·3 | 5 | 0·0 | 16·6 | 5 |
| Yes | 66·5 | 15·2 | 464 | 4·8 | − 1·9 | 464 |
| Days CHC open for vaccination | | | | | | |
| <1 day/week | 67·6 | 12·7 | 321 | 3·7 | − 1·4 | 321 |
| ≥1 day/week | 64·1 | 22·5 | 143 | 7·1 | − 2·6 | 143 |

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**Table 2.** *Continued*

| | Fully immunized children | | | Non-immunized children | | |
|---|---|---|---|---|---|---|
| | 2002 | Change | *n* | 2002 | Change | *n* |
| Vaccines ran out at CHC in the last 6 months | | | | | | |
| No | 67·4 | 18·8 | 331 | 4·9 | 0·2 | 331 |
| Yes | 64·3 | 12·8 | 133 | 4·4 | − 1·8 | 133 |
| Vaccination at nearest clinics | | | | | | |
| No | 80·8 | 27·6 | 86 | 0·0 | 6·6 | 86 |
| Yes | 62·8 | 12·3 | 344 | 6·1 | − 3·5 | 344 |
| Days nearest clinics open for vaccination | | | | | | |
| <1 day/week | 59·4 | 5·4 | 149 | 5·5 | − 3·4 | 149 |
| ≥1 day/week | 65·3 | 17·7 | 195 | 6·7 | − 3·6 | 195 |
| Vaccines ran out at nearest clinics in the last 6 months | | | | | | |
| No | 64·1 | 10·3 | 216 | 5·4 | − 5·4 | 216 |
| Yes | 56·6 | 6·7 | 110 | 8·1 | − 5·7 | 110 |
| **Total** | **66·7** | **16·5** | **468** | **4·7** | **1·2** | **468** |

Note: Due to missing data in some community measurements, the total line was not represented for community descriptions.

children. The tendency was about the same for rural and urban residents, as well as for the poor and non-poor.

The descriptive analysis did not show consistent figures for the rate of FIC according to availability of immunization at community health centres and nearest clinics, or for health centre and nearest clinic opening times and vaccine availability. However, if community health centres and nearest clinics were open for immunization for more than one day a week and if vaccines did not run out, the rate of FIC increased considerably over the five-year period 1997–2002. For example, in communities where the health centre was open more than one day a week, the increase in rate of FIC was 9·8% higher than in those where the health centre was open less than one day a week (22·5% vs 12·7%). The increase was 6% higher for communities where vaccines did not run out than it was for communities where vaccines did run out (18·8% vs 12·8%).

In general, the percentage of children who had not received any vaccine in 2002 was 4·7% – an increase of 1·2% over the five years. Analysis showed variations in the rate of children who received no vaccine for a number of background characteristics; however, the level of variation is different between variables.

Consistent with FIC, the rate of children who received no vaccine was lower for the first birth but higher for subsequent births. Examination of the mother's education and television watching showed a large gap in the non-immunized rate. For example, in 2002, while none of the women with an education level of 'completed high

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school and above' had a child with no immunization, 30·9% of children whose mothers were illiterate had no immunization. Similarly, while the rate of children who received no vaccine was stable at 1·7% over five years for those whose mothers watched TV regularly, the rate for those whose mothers did not was 18·9% in 2002 – 11·8% higher than five years earlier (1997). Table 2 also shows that neither the sex of the child nor the mother's religious status showed much difference in the rate of children with no immunization.

Poverty status, minority classification and type of residence showed large differences in the rate of children with no immunization, especially in 2002. For example, in 2002, there were 11·3% of children in minority groups who received no vaccine – about three times higher than for children in non-minority groups (11·3% vs 3·3%). The differences were about six to nine times higher between rural and urban children and between poor and non-poor children, respectively (5·6% vs 0·9% and 12·8 vs 1·4%). Inequality of immunization coverage increased over the five-year period. In 1997, the gap between poor and non-poor children who did not receive any vaccine was about four times higher for non-poor children (data not show). In 2002, this gap was about nine times higher for non-poor children (12·8 vs 1·4%).

Only where vaccines were running out at the nearest clinics were there differences in the rate of children with no immunization; other community variables did not show a clear tendency in the rate of immunization coverage.

*Logistic regression*

Two different models were used in the logistic regression analysis. Model I was used to show the influences of the independent variables in each group: individual factors, poverty factors, availability of immunization, interaction factors, and the quality of immunization services at the grassroots level. Model II was used to examine changes in the likelihood of dependent variables when all individual factors – poverty, availability of immunization variables, and the interactions of the poor – were entered. Coefficients calculated from Model II were used to predict the net effect of the poverty factors on the changes of receiving full immunization or children having no immunization among children aged 11–23 months.

There was no evidence throughout the logistic analysis that sex or birth order made any difference to the rate of either fully immunized children or children having no immunization (Table 3).

Children's age had a significant influence on the likelihood of FIC but not on children having no immunization. For FIC, the logistic analysis presented in Model II indicates that children at older ages (in months) were more likely to receive full immunization. The likelihood of receiving full immunization was 1·06 times higher for each additional month of age.

Similarly to descriptive analysis, regression confirms that mother's education is one of the key factors for immunization coverage. Analysis indicated that the likelihood of getting a child fully immunized for a higher educated woman remained significant when all poverty factors and interactions of poverty were included. An odds ratio of 1·25 means that a higher education level increases the probability of

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**Table 3.** Logistic regression for the impact of selected individual, household and community variables on the likelihood of fully immunized children and of children with no immunization, aged 11–23 months

| | Fully immunized children | | Children with no immunization | |
|---|---|---|---|---|
| | Model I[a] | Model II[b] | Model I[a] | Model II[b] |
| Individual factors | | | | |
| Girl | 1·13 | 1·14 | 0·67 | 0·70 |
| Birth order | 0·94 | 0·97 | 1·34 | 1·48 |
| Age of child | 1·04* | 1·06*** | 1·02 | 1·03 |
| Education of mother | 1·27*** | 1·25*** | 0·51*** | 0·36*** |
| Non-religious | 1·02 | 1·19 | 1·18 | 0·99 |
| Mother watches TV regularly | 1·65*** | 1·08 | 0·36** | 0·17** |
| Poverty factors | | | | |
| Poor (below poverty level) | 0·59*** | 1·06 | 1·28 | 0·79 |
| Minority | 0·64* | 1·02 | 1·04 | 0·49 |
| Rural | 0·67* | 0·64* | 4·69*** | 9·38 |
| Availability of immunization | | | | |
| At community health centre (CHC) | 2·88* | 0·27 | 0·20** | 0·13 |
| At nearest facility | 0·90 | 1·01 | 1·15 | 0·37 |
| Interaction factors | | | | |
| Poor; time | 0·50*** | 0·50*** | 0·68 | 0·42* |
| Poor; no access to TV | 0·72 | 0·78 | 2·34 | 0·30 |
| Poor; low education | 0·89 | 1·28 | 2·39 | 0·41 |
| Poor; minority | 0·61 | 0·60 | 1·31 | 0·11 |
| Poor; rural | 1·51 | 1·71 | 2·36 | 1·56 |
| Poor; no immunization at CHC | 0·31 | 0·08 | 1·23 | 0·28 |
| Poor; no immunization at clinic | 1·04 | 0·92 | 1·02 | 0·43 |
| Quality of services | | | | |
| Open at CHC regularly | 0·66 | | 10·74 | |
| Vaccines ran out at CHC | 0·80 | | 0·11 | |
| Open at clinic regularly | 1·28 | | 0·22 | |
| Vaccines ran out at clinic | 0·81 | | 0·57 | |
| Poor; CHC not open regularly | 0·43* | | 9·94 | |
| Poor; vaccines ran out at CHC | 0·77 | | 3·98 | |
| Poor; clinic not open for immunization regularly | 2·09 | | 0·22 | |
| Poor; vaccines ran out at clinic | 1·00 | | 3·10 | |

[a]Includes only variables within each group; [b]includes all variables except quality of service. For 'Quality of service' group, $n=692$. For all other regressions, $n=1087$.
*$p<0·05$; **$p<0·01$; ***$p<0·1$.

receiving full immunization by 25%. Education also showed a significant impact on reducing the rate of children with no immunization in both models. The chance of children of higher educated women having received at least one vaccine was about

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2·7 times more than for children of less educated women (0·36 reversed). This is strong evidence that the education of a mother might play an important role in reducing the number of children who do not receive any immunization in Vietnam.

Mother's watching of TV was significant for either dependent variable, especially when examining the likelihood of children with no immunization. A mother's watching TV was significant in reducing the likelihood of children receiving no vaccine in either model. Watching TV remained significant when both individual and poverty factors were added.

Religious status was not significant in either model for either FIC or children with no immunization.

The finding that children in poor families, minority children and children in rural areas were less likely to receive full immunization is noteworthy. Model I shows that the likelihood for children in poor families, minority children and children in rural areas receiving full immunization is only 0·59, 0·64 and 0·67 times the likelihood for children in non-poor families, non-minority children and children in urban areas receiving full immunization, respectively. The chances of receiving full immunization were changed for the first two variables when individual variables, interactions of poverty and the availability of immunization services in communities were included. However, in Model II, even though poverty itself did not show a significant impact on the likelihood of FIC, the likelihood of receiving full immunization for a child, who lived in a poor family in 1997, was only 50% of the likelihood for the rest of the children (non-poor in 1997, either poor or non-poor in 2002). It meant that poverty status remained a significant factor for the immunization gap and that inequality increased over the five-year period 1997–2002.

Poverty factors didn't show a significant influence on the rate of children with no immunization, except the rural factor in Model I. However, as in later analysis, the prediction from coefficients of Model II suffered considerably among minorities and the poor. There was no evidence of inequality in the minimum coverage of immunization, so even though immunizations were not fully covered nationwide, the programme did pay some attention to having no child left without any immunization at all.

No other significant impacts were found from interactions of poverty status in either dependent variable. This indicates that poor households, minority children, children in rural areas, and especially children with a combination of being poor and a minority, were the groups where immunization should be improved to narrow the gap in full immunization.

Based on the coefficients produced by the regression analysis for FIC variables in Table 3, Figs 1 and 2 predict the net effects of changes in the key parameters of poverty, minority status and rural residence. The greatest value of the figure lies in its capacity to predict the potential improvements in children's immunization corresponding to various changes in their socioeconomic status and to allow a concentration of resources to be applied to the socioeconomic areas with the greatest potential for change in health improvement. The data presented in each bar are the difference in the net effect of predicted interaction factors and the estimate of FIC or children with no immunization.

For example, the probability of receiving full immunization for *poor* children who were a *minority* living in *rural* areas was 21·3% lower than the national average.

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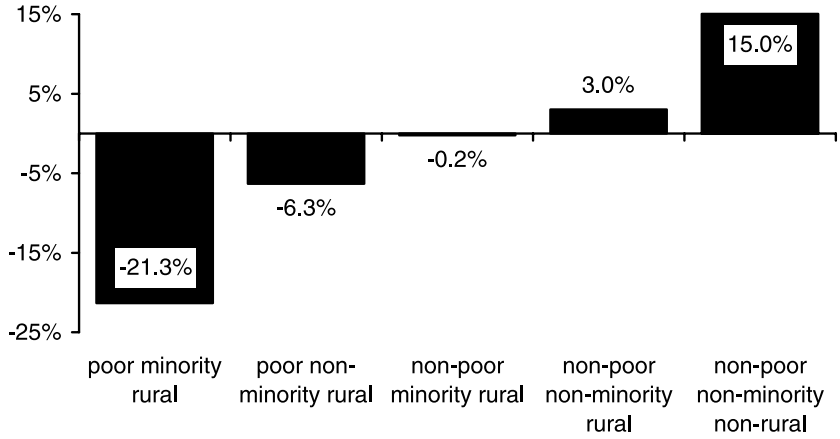



**Fig. 1.** Prediction of the net effect of poverty, minority and rural residence on the probability of FIC. Differences with the estimation of mean FIC. Note: zero line illustrates the prediction of mean FIC.

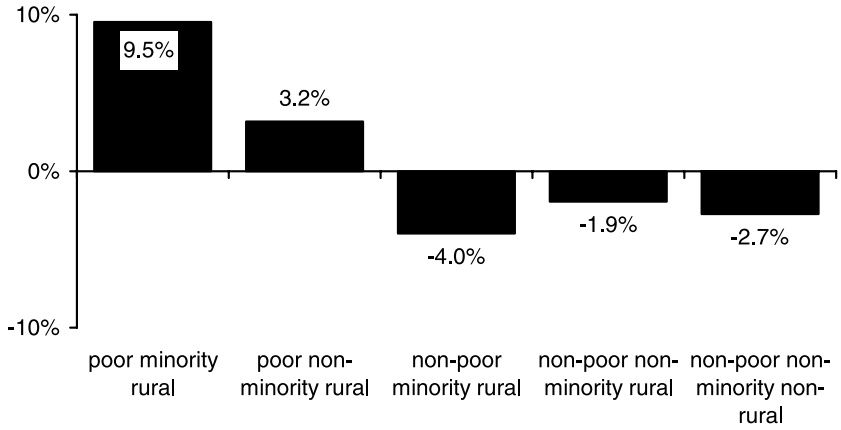



**Fig. 2.** Prediction of the net effect of poverty, minority and rural residence on probability of non-immunized children. Differences with the estimation of mean of no immunization. Note: zero line illustrates the prediction of mean value for no immunization.

Meanwhile, the probability of receiving full immunization at the other extreme (non-poor, non-minority and non-children) was 15% higher than the national average. It made the net effect of extreme poverty about 36·3% lower than the urban, non-poor, non-minority children (21·3% + 15%). Specifically, if the mean FIC value in 2002 was 66·7%, the FIC predicted for the extreme poor would be 45·4% (66·7% − 21·3%) and the FIC predicted for the urban, non-poor, non-minority children would be 81·7% (66·7% + 15%). This means that the chance of the extreme non-poor receiving full immunization was about 1·8 times higher than for that of extremely poor children (81·7%/45·4%). The prediction of the regression procedure

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also indicates that the combination of being poor and a minority was the most vulnerable for not having immunization coverage. Rural residence became a key factor only for the non-poor and non-minority classes; the net effect of the rural factor was − 12% (3% vs 15%). No significant net effect of the rural factor was seen when children belonged to the poor and minority categories (most of the poor and minorities probably live in rural areas); therefore, this prediction was not included in the figure.

Similarly, the prediction of the regression analysis also indicated that a combination of being poor and a minority meant being in the group most vulnerable for not having immunization coverage.

Regression analysis revealed the important role of community health centres in improving vaccination coverage. Poor children living in communities with no immunization services at the community health centre had a significantly lower chance of receiving full immunization. Even if the immunization was available in community health centres, the number of days the centre was open for the service had a positive influence on the likelihood of receiving full immunization. The absence of a significant impact of many of the other service variables in this logistic analysis suggests that efforts to provide immunization services at the community level are not sufficient to improve immunization coverage.

Determinants of the rate of children with no immunization were not found among the variables of immunization services in this analysis.

## Discussion

A great achievement in immunization has been recognized in Vietnam: in 2002, more than 95% of children aged 11–23 months had received at least one vaccine to cover the six diseases of diphtheria, measles, pertussis, polio, tetanus and tuberculosis. An increased rate of fully immunized children (16·5%) was achieved over the five-year period 1997–2002. However, one-third of children had still had not received all of the above-mentioned required vaccines, meaning that a larger proportion of children, at 9 months of age, were not fully immunized. Additional calculations from DHS 2002 data showed there were 65·4% of children aged 9–11 months who had not been fully immunized. The immunization rate for children aged 9–23 months was 40% (data not shown). Findings from this study also strongly indicate that the likelihood of children receiving full immunization increases with their age. This finding suggests some reluctance or passivity in immunization coverage. The study did not find evidence to show an active factor to get children fully immunized at the required ages. Children seemed to passively receive more and more vaccines if they survived to an older age. The purpose of immunization to save a child's life, therefore, may not be fully achieved since Vietnam still needs to eradicate polio, eliminate neonatal tetanus, and is only in the process of launching efforts to control measles (Schwartz & Loevinsohn, 1999).

In the case of Vietnam, even though families prefer boys to girls in fertility preferences (Thang & Hirschman, 2002), both sexes seem to be treated equally regarding their health care. It is not clear if the first born are given more care than subsequent birth order children. No religious factor obligations to have

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children immunized were found in this study. The findings suggest that a number of social factors that effected immunization in other countries were not barriers for immunization programmes in Vietnam.

While many individual characteristics showed no influence on child immunization, household wealth, hard-to-reach geographic location, education and communication on immunization, and the availability of immunization services at the community level played key roles in the size of the gap in immunization coverage.

This study showed a large gap in immunization coverage between the poor and non-poor that was intensely unfavourable to the poor in minority or rural populations. Previous studies on health inequalities in Vietnam have determined that extremely vulnerable groups were children with the combined status of being poor, minority and rural resident (Thang & Popkin, 2003), and this was confirmed in the current study for immunization in Vietnam. Given the fact that the population consists of about 12% minority poor (estimated from national representative DHS surveys), efforts to improve the immunization coverage in Vietnam should focus on children in poor families living in mountainous or remote areas.

The inequalities in immunization rates found in this study suggest that an immunization programme could not be conducted separately from a national programme on poverty reduction. The immunization programme should also be integrated with other national and international funded social and development programmes. A close collaboration among international projects for Vietnam should also be unified to focus their resources on priority groups.

Given that, in 2002, among the 33·3% of children who were not fully immunized, 27·6% and 23·9%, respectively, were not fully DPT- and polio-vaccinated, DPT and polio vaccinations must be given priority in the immunization programme to reduce the drop-out rate for the second and third doses. The drop-out rate of 16% for DPT and 17% for polio in 2002 suggests that information, education and communication programmes (IEC) for immunization should be strengthened. That information campaign must be linked with other IEC activities of population, family planning, clean water, nutrition, and so forth at the grassroots level. The role of women's education in increasing the rate of fully immunized children and the rate of no immunization children, as demonstrated in this study, shows some weakness in IEC activities. Again, efforts should be focused on poor and minority populations living in remote areas.

Accessibility to immunization services also showed some weakness. Even though only a few communities reported having no immunization services, the availability of the service – such as the time a community health centre was open to provide immunizations to villagers – was one of the key measures for improving immunization coverage. The analysis also indicated that the availability of immunizations in a locality of poor people was probably the cause of the other large gap in immunization coverage.

While the services of inter-community clinics and district- and provincial-level health facilities are important, this study shows that the availability of services at the community level is more significant for improving immunization coverage. Thus immunization financing should be directed at the community level, rather than centralized at the district or provincial level.

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