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Maternal Education and Child Immunization

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This article explores the hypothesis that formal education of women results in increased child survival because of greater knowledge of the protective function of the major childhood immunizations. Education is also associated with greater awareness of proper immunization schedules. Irrespective of mother's formal education level, specific immunization knowledge is associated with an increased likelihood of using immunization. The Indonesian analysis is important as a model for preventive health campaigns among other populations with low education levels among women.

Demographic studies of infant and child mortality differentials have shown that maternal education, or literacy, is one of the most important and powerful factors explaining different mortality levels within and between societies. This pattern persists even when income and economic status are controlled (Cleland 1989, p. 3).

In his recent review of possible pathways whereby maternal education results in reduced risk of child mortality, Cleland concluded that education probably "enhances knowledge about effective ways to prevent, recognize, and treat childhood illnesses" (1989, p. 17). This is consistent with much of Caldwell's work (1979, 1981; Caldwell, Gajanake, Caldwell, & Pieris 1989). Cleland also argued that the lack of any apparent threshold in terms of years of schooling means that the formal content of schooling is of relatively little importance in directly changing health knowledge and beliefs, compared with the greater effects on individual mentality. This implies that educated mothers gain greater access to, and are more receptive to, modern health information (1989, pp. 7, 17). Consequently, there should be a link between level of education and level of modern health knowledge. Surprisingly, there is little evidence for such a relationship.

As indicated, in many demographic analyses of the relationship between education and infant and child mortality, there is a tendency to neglect to explain the mechanism whereby education exerts its beneficial effect on health. Partly in response to this deficiency, Mosley and Chen (1984) constructed a "proximate determinants" framework for the study of the biosocial mechanisms through which they claim that all socioeconomic determinants of mortality must operate (pp. 25–45). They divided the 14 proximate determinants into five groups: maternal factors, environmental factors, nutritional factors, injury, and personal

illness control (preventive and curative health behaviors). In this study we will explore the last group, in particular, preventive measures to control illness.

We hypothesize that if a higher level of maternal education results in improved child survival, then health services that effectively prevent fatal childhood diseases must be used to a greater extent by mothers with higher education than those with little or no education. Specifically, the hypotheses suggest that compared with mothers with little education, mothers with higher education are more likely

1. to have heard of immunization and specific immunization services (vaccinations);
2. to know in what age range children should be immunized and how many doses are required;
3. to know which diseases are prevented by immunization;
4. to have used those immunization services.

The analyses used to test these hypotheses will also necessarily incorporate a number of variables, other than education, that may influence acceptance of immunization. These include household economic status, ages of the mother and the child, birth order of the child, husband's education and occupation, and hamlet of residence as a reflection of physical access to health facilities.

Background

The study was conducted in two villages in the subdistrict of Sukomulyo in Kulon Progo, the western district of Yogyakarta, Indonesia. This area is fairly typical of the province in terms of economic status and access to both local facilities and those in the provincial capital. These villages comprised a range of hamlets in terms of economic status, education levels, and access. They varied from the generally well-off village of Wijimulyo (good roads, close to the main western trunk road, primary school and health clinic, and a population making a fairly satisfactory living, primarily from wet-rice agriculture) to the relatively poor village of Tanjunghardjo situated in the dry hills to the northwest. There, agriculture was largely limited to the production of low-yield dry rice, cassava, and vegetables. The roads were not sealed and access was more difficult, particularly during the wet season when the river separating the two villages flooded and became impassable. Access to the Wijimulyo health clinic during those months required a relatively lengthy round-trip by road. Wijimulyo was composed of 11 hamlets and had a population of 4,722; Tanjunghardjo had 8 hamlets and a population of 3,755.

The majority of the women (55%) and their husbands (70%) had completed primary school, and few had no schooling at all (11% of women; 6% of men). Almost two-thirds (63%) of the respondents' husbands worked as farmers on their own land (41%), rented land (9%), or sharecropped land (13%). One-quarter of the women also worked in agriculture. Another 20% of the women worked as sellers, either in shops or in the street, and 24% worked as weavers of cloth or mats. Many of these latter jobs involved part-time employment. Almost one-quarter (22.5%) did not work at all. The houses were generally made of bamboo (52%) or brick (41%; for the better off). Even the brick houses often had packed earth floors (68% of all), and virtually all houses had tiled roofs. Some households in Wijimulyo owned a motorbike; but few did in Tanjunghardjo, though many owned bicycles.

Methodology

The eligible respondents were all of the married women with a child under the age of 5 years in the selected villages. The survey focused on the youngest such child, known as *anak bungsu*. The mother–child dyad is the unit of analysis in this study. Of the 519 respondents (mothers), 125 had two children less than 5 years old, and certain questions

were asked about the elder sibling; those data are not considered in this article. The 519 respondents comprise 87% of the estimated 594 eligible respondents in the study villages. It was not possible to include the remainder because (a) they had migrated out of the village ($n = 24$), or (b) their child had already turned 5 years old since the most recent village listing, which in some cases recorded only year of birth not month ($n = 45$), or (c) they could not be met after three attempted home visits by the interviewers ($n = 6$). It is possible that some of the last group of mothers may have intentionally avoided the interviewers because their child had not been immunized.

The purpose of this study was primarily to understand why many mothers did not ensure that their children were fully or even partially immunized. A team of nine female interviewers (anthropology honor students) and one supervisor carried out the fieldwork.

Immunization Services in the Study Area

The responsibility for providing immunization services falls to the Health Department, which uses an approach known as YANDU (from *pelayanan terpadu*, meaning integrated services) that includes family planning, sanitation, general health care, baby weighing in some areas, and immunization. The YANDU team—nurses, health worker in charge of sanitation, and vaccinator—usually travel from their base in a Health Clinic (*puskesmas*) to several Assistant Health Clinics (AHC; *puskesmas pembantu*) each week so that each AHC is visited between one and four times a month on a prearranged day and time.

In addition to this, the vaccinators, known locally as JURIM (for *juru imunisasi*) or *mantri cacar* (smallpox vaccinators), are expected to travel widely within their subdistricts visiting less formal immunization sessions held in conjunction with baby-weighing clinics. These are often held bimonthly in the house of the hamlet headman (*pak dukuh*), with the headman's wife usually taking responsibility for recording weights, preparing food supplements for the children, and caring for the weighing equipment. There may also be other types of vaccination posts. The vaccinators were provided with a UNICEF kit, weighing about 8 kg and containing a Thermos flask for the vaccines, syringes and needles, a small stove to sterilize the vaccination needles, and the like. They each had a Health Department bicycle, but in some areas, where the terrain was difficult or the area large, the vaccinators purchased their own motorbikes. In the study subdistrict the single vaccinator was responsible for a population of 25,177 spread over 36 km^2 of hilly terrain.

Results

Knowledge of Immunization According to Education

The pattern of knowledge of immunization in general increases slightly with higher education, but knowledge is virtually universal (97.7% of those with 0–2 years to 100.0% of those with 7 or more years of education). As we will show, having heard the term "immunization" does not necessarily imply having accurate knowledge of the functions of specific types of immunization.

For each of the three types of immunization (as shown in Table 1), the level of correct knowledge about which diseases the immunization prevents rises with increasing education. The overall levels are rather low in the case of DPT and BCG vaccines (Diptheria, Pertussis, and Tetanus and Bacille Calmett Guerin, respectively), and there is a threshold effect wherein those women with less than secondary school all have similarly low levels of knowledge of these two immunizations. Levels of knowledge of the function of anti-polio vaccine are much higher than for the other two types, probably because the name of the vaccine incorporates the name of the disease. Therefore, it may be useful to publicize BCG as "anti-TB" and DPT as "anti-tetanus" rather than only using their current uninformative names.

Table 1. Proportion of Respondents (%) Having Correct Knowledge of Diseases Protected Against (A), Appropriate Age Range (B), and Required Number of Doses (C) of DPT, BCG, and Anti-Polio Immunization, According to Level of Maternal Education (years)

Variable	Not literate, 0–2	Some primary, 3–5	Complete primary, 6	Secondary school, 7+*
A				
DPT	5.7	6.2	10.2	25.3
BCG	1.1	2.1	6.6	38.5
Anti-polio	14.9	31.0	46.9	80.2
B				
DPT	57.5	71.0	77.6	85.7
BCG	54.0	63.4	78.1	82.4
Anti-polio	50.6	58.6	66.8	80.2
C				
DPT	55.2	57.9	67.3	87.9
BCG	27.6	46.2	57.1	65.9
Anti-polio	24.2	27.6	32.1	54.9
n	87	145	196	91

Note: $N = 519$.

* The chi-squared tests for levels of knowledge of DPT, BCG, and Anti-polio for A, B, and C indicate that for each there is a statistically significant difference between education groups at a level of $p < .001$.

The levels of correct knowledge of the appropriate age range for the three types of immunization (see Table 1) are much higher than for knowledge of the diseases prevented. Different sources of information were not always consistent about the appropriate starting age for DPT and anti-polio (sometimes 6 weeks, sometimes 2 months), so a lower cutoff of 1 month was accepted for correct knowledge. Within each education category, the levels of knowledge are similar for the three types of vaccination. In each case, though, the relationship between level of education and level of knowledge is positive and statistically significant.

Knowledge of how many doses are required for each type of immunization was investigated with open-ended questions. As with the other two kinds of knowledge, correct knowledge of doses is also positively related to educational level (see Table 1), with something of a threshold effect apparent for respondents with secondary high school education or more. The level of correct knowledge is high for DPT, although, since at the time of the survey the Indonesian Health Department recommended only two rather than three doses as sufficient, both two and three doses were accepted as correct answers. The proportion knowing that a single dose of BCG is sufficient was surprisingly low, with about one-third thinking that at least two doses were necessary. There may have been confusion between types of vaccine or with antibiotics, or possibly the use of inactive vaccine may sometimes have resulted in the need for revaccination. Knowledge about anti-polio is also rather low, as might be expected when three doses must be obtained for full protection.

The lower level of correct knowledge of the functions of DPT, BCG, and anti-polio compared with knowledge of the age range and frequency of immunization may well be related to the source of that knowledge. As shown in table 2 of Streatfield and Singarimbun (1988, p. 1239), the major source was the hamlet headman or headwoman. Such a person may be expected to convey practical information related to when, where, and how often to obtain immunization, but they may not be fully aware of the functional side of immuni-

zation, that is, what diseases can be prevented. Such technical information might rather be expected from a medically qualified person. Note that the higher educated women (completed primary school or more) were much more likely (51.7%) to obtain their immunization knowledge from a medical source (doctor, nurse, vaccinator) than those women who had completed less than primary school (34.3%).

Patterns of knowledge of immunizable diseases and information given by health workers, according to maternal education, is presented in Streatfield, Singarimbun, and Singarimbun (1986).

Practice of Immunization According to Education

Finally, how does the educational level of the mother affect the probability of her child's being immunized? The pattern of completeness of immunization according to maternal education is confounded somewhat by the typical developing-country pattern of the less educated women's being, on average, older than the well educated women. Just as the illiterate mothers are a little older than the others, so their children are, on average, a little older than the children of the better educated women (Table 2). Thus in this analysis, the levels of completeness have been standardized for age of the mother. This is conventional direct standardization wherein the overall age structure is applied to the age-specific immunization coverage rates in each education category.

Levels of "complete" coverage do not follow a clear linear pattern according to educational level. The illiterate group and the highly educated group have higher coverage levels (45%) than the some primary (31%) or completed primary (34%) groups, but more than half (55%) of the children of the group with secondary school have complete immunization. All education groups have an equally small proportion (1.1–3.5%) who have never obtained ("none" category) any immunization for their children.

The explanation proposed in an earlier paper on social factors influencing immunization uptake (Streatfield & Singarimbun 1988, p. 1241) was based on the observation that less educated women in Indonesia appeared more likely than well educated women to abide by the instructions of village and government authorities to use immunization, regardless of

Table 2. Completeness of Immunization (%) for Children Aged 6 Months or More by Education of Mother, Standardized by Age of Mother

	Education (years)			
Variable	Not literate, 0–2	Some primary, 3–5	Complete primary, 6	Secondary school, 7+
Immunization				
Complete	45.1	31.1	33.6	54.9*
Incomplete—high	20.4	24.2	34.0	20.7
Incomplete—low	31.0	41.5	31.4	21.5
None	3.5	3.2	1.1	3.0
Mean age				
Mother (years)	33.5	31.1	29.5	29.3
Child (months)	35.4	28.0	26.0	26.1
n	78	129	177	81

Note: $N = 519$.

* The chi-squared tests for completeness of immunization indicate that there is a statistically significant difference between education groups at a level of $p < .05$.

their lower levels of knowledge and understanding. It is difficult to provide direct evidence in support of this argument, but indirect support comes from the reasons given by mothers whose children had not completed (in some cases not started) the courses of immunization. Illiterate mothers were twice as likely (39.7% of them) to give the reason that they had not done so because they had not been instructed to by the head of their village, compared with only 20.7% of the highly educated women giving that reason. The resulting U-shaped pattern of coverage according to education level has been observed in Indonesia not only for immunization but also for family planning use (Streatfield 1986, p. 125).

A further demographic factor that might be expected to operate here is that illiterate women, being older, are of higher average parity and consequently are more experienced mothers with a greater likelihood of having their children immunized. Indeed, illiterate mothers do have significantly more (at 5% level) children than mothers who have completed primary or secondary schooling. As will be shown in the multivariate analysis of the likelihood of a child being immunized, though, parity or birth order of the child is not a significant variable when other factors are controlled.

Multivariate Analysis

To assess the relative influence of the sociodemographic and behavioral characteristics introduced previously on the probability of immunization, we undertook a multivariate analysis. Immunization was defined by a dichotomous variable in which a child was considered to be completely immunized if she or he had received two or three DPT injections and three polio injections and not completely immunized if she or he had received any less than that. A number of sociodemographic and behavioral characteristics were considered. These are displayed in Table 3 and include the education and occupation of both the mother and her husband, economic status, ages of mother and child, hamlet of residence, numbers of children ever born and still living, and knowledge of the purpose of the injections.

Table 3. Regression Coefficients and Odds Ratios of Best Model to Predict the Probability of Immunization

Variable	Coefficient	Standard error	Odds ratio
Mother's education			
Illiterate	.00	—	1.00
Primary	−.36	.27	.70
Secondary	−.08	.36	.92
Age of child			
<12 months	.00	—	1.00
12–35 months	.48	.24	1.62
36+ months	−1.14	.27	.32
Husband's occupation			
Non–civil servant	.00	—	1.00
Civil servant	.54	.27	1.72
Knowledge of immunization			
Knows DPT	.00	—	1.00
Does not know DPT	−.99	.33	.37
Knows polio	.00	—	1.00
Does not know polio	−.56	.21	.57

Note: Goodness of fit, deviance = 609.3, df = 511.

The multivariate approach used is logistic regression. This fits the model

$$\ln \frac{(p)}{(1-p)} = a + \sum_{i=1}^{k} b_i x_i,$$

where p is the probability of a child's being completely immunized; a, b_i are estimated regression coefficients; and x_i are the background characteristics.

We estimated the models by using the GLIM statistical package (Royal Statistical Society 1986). We used a stepwise approach and selected the model by a combination of forward selection and backward elimination.

The regression coefficients for the best model are displayed in Table 3 with their respective odds ratios. The best model is additive and includes mother's education, husband's occupation, child's age, and knowledge of both immunizations. A number of the categories of each of the first three variables have been collapsed so that the results reflect statistically significant differences between categories. The effects can best be summarized through the odds ratios. Thus mother's education has the nonlinear relationship described earlier. Mother's with primary education are around .7 times less likely to have their children immunized than are those having either no formal education or secondary education. Children's ages also has a nonlinear effect. Children older than 3 years are much less likely (around 5 times) to be immunized than those aged 1–3 years—largely because major immunization programs

Table 4. Estimated Probabilities of Child's Being Immunized

Characteristics	Estimated probability
Primary education; non–civil servant; child aged 36+ months; does not know functions of DPT or anti-polio	.12
Illiterate; civil servant; child aged 12–35 months; knows functions of both DPT and anti-polio	.89
Effect of knowledge of immunization for women with non–civil servant husband and child aged 12–35 months	
Mother is illiterate	
Knows function of DPT and anti-polio	.82
Knows function of DPT but not anti-polio	.73
Does not know function for DPT but knows anti-polio	.63
Does not know function of either DPT or anti-polio	.50
Mother has primary schooling	
Knows function of DPT and anti-polio	.76
Knows function of DPT but not anti-polio	.65
Does not know function for DPT but knows anti-polio	.55
Does not know function of either DPT or anti-polio	.41
Mother has secondary schooling	
Knows function of DPT and anti-polio	.81
Knows function of DPT but not anti-polio	.71
Does not know function for DPT but knows anti-polio	.61
Does not know function of either DPT or anti-polio	.48

Note: These probabilities are calculated from the estimated coefficients by using the following equation:

$$p = \exp\left(a + \sum_{i=1}^{k} b_i x_i\right) \Big/ \left[1 + \exp\left(a + \sum_{i=1}^{k} b_i x_i\right)\right]$$

have only recently been in place. They are only 3 times less likely than very young children, who may be expected to receive immunization at later ages. The influence of husband's occupation is simple—wives of civil servants are around 1.7 times more likely to have their child immunized than women with husbands in any other occupation, among whom there is no statistically significant difference. Finally, as might be expected, knowledge is crucial. Those who did not know the correct purpose of DPT were 3 times less likely to have their child immunized, whereas for polio the equivalent effect is .6 times.

It is important to know the probability that a woman with particular characteristics will have her child immunized. A selection of such probabilities is given in Table 4.

There is a wide range from .89 to .12, but perhaps the most interesting effects are those for knowledge of the purpose of immunization. For the most common group of sociodemographic characteristics—women with primary education, husbands who were not civil servants, and children aged 12–35 months—the effect of not knowing the purpose of DPT injections reduces the probability of immunization by .21 (from .76 to .55) and for polio by .11 (from .76 to .65). Not knowing the functions of either DPT or anti-polio reduces the probability of a child's being fully immunized by around 40–47%, depending on the level of maternal education. This is much greater than the impact of formal education.

The findings in Table 4 also indicate that the effect of formal education on the probability of a child's being fully immunized disappears when mothers have correct knowledge of the vaccine functions. This is consistent with Behrman and Wolfe's findings (1987, p. 202) that specific health knowledge may be more important than general formal education. It must be remembered that relatively few illiterate mothers have such knowledge, whereas the great majority of higher educated mothers have this knowledge. The illiterate women are also not receiving from knowledgeable health workers information that they could potentially pass on to their friends and relatives.

Conclusion

In support of our hypotheses, the data show clearly that maternal education is positively related to many aspects of knowledge of immunization that may be expected to influence the use of such a preventive health service.

The pattern of results supports the suggestion of a moderately high threshold effect whereby levels of knowledge are considerably greater for women with at least some secondary schooling. This is in contrast to Cleland's assertion (1989, p. 6) that no threshold effect of mother's education was observed in most studies (e.g., Basu 1989).

The U-shaped pattern of use of immunization possibly reflects two different sets of motivating factors at work: for the uneducated women, the exogenous factors of social conformity and compliance with local authority, and for the highly educated women, more endogenous demand factors derived from greater knowledge of the protective functions of immunization.

Virtually all of the respondents in this study had left school before the immunization program got seriously under way in the late 1970s. Thus the results suggest that it is not the content of what the educated mother learns at school that is important but, rather, the associated changes in her attitude to and position in the world. These changes increase her capacity to gain access to appropriate information and lead her to care more effectively for her children.

The findings imply that greater efforts to present information on the protective function of vaccines—both by health education campaigns and the use of informative names for vaccines—may increase immunization acceptance considerably. The unexpected finding that the probability of a child's being fully immunized was about the same for those with accurate knowledge of the functions of the vaccines irrespective of the level of formal

education is very positive. Effective health education campaigns have the potential to raise immunization coverage among nonliterate people to the same level as among those with substantial schooling. Child survival interventions, such as the Expanded Program of Immunization, may also be implemented effectively among other nonliterate populations in developing countries with village authority structures like those in Indonesia.

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