Maternal Education and Health-Related Behaviors: A Preliminary Analysis of the 1993 Indonesian Family Life Survey

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Abstract. *In a number of studies of the determinants of infant and child health, maternal education emerges as perhaps the strongest socioeconomic predictor of infant and child health (Cochrane et al. 1980; Cleland and van Ginnekin 1988; United Nations 1985; Hobcraft et al. 1985). However, efforts to explain why more educated mothers have healthier children have been largely inconclusive. If maternal education alters infant and child health risks, it must affect factor directly related to health, such as nutrien intake, exposure to pathogens, susceptibility to pathogens, and two dimensions of behavior that potentially affect infant and child health and survival: knowledge and use of health services, and characteristics of the home environment that might affect the transmission of diseases. Our result demonstrate a strong relationship between maternal education and a number of health-related factors: the absence of trash and waste in the vicinity of the home, adequate ventilation, drinking and bathing water sources inside the home, electrification, ability to identify specific health proders, early use of prenatal care and delivery assistance. The relationships are robust to controls for household economic status, childhood residence, and even to very rigorous controls for residence.*

Keywords: education of women; child survival; infant mortality; statistical analysis.

1. Introduction

In a number of studies of the determinants of infant and child health, maternal education emerges as perhaps the strongest socioeconomic predictor of infant and child health (Cochrane et al. 1980; Cleland and van Ginnekin 1988; United Nations 1985; Hobcraft et al. 1985). Calculations from recent Demographic and Health Surveys in 28 developing countries reveal that relative risks of under-five mortality are on average 30 percent greater for children of mothers with no education in comparison to children whose mothers have some primary school education (Sullivan, Rutstein, and Bicego 1994). Indonesia, the focus of this analysis, exhibits considerable survival differentials

by level of maternal education as well. Results from the 1991 Indonesian DHS indicate that under-five mortality risks are 13% higher for children of women with no education (again, in comparison to women with some primary school), while children of women with more than a primary school education experience risks about 60% lower than the reference group. Large differentials in infant mortality by maternal education are found in data from the 1987 National Indonesian Contraceptive Prevalence Survey and from the 1980 and 1971 censuses (NICPS 1987; Hugo et al. 1987).

This paper analyzes the relationship between maternal education and two dimensions of behavior that potentially affect infant and child health and survival: knowledge and use of health services, and characteristics of the home environment that might affect the transmission of diseases. The paper does not examine *why* maternal education might affect behaviors in these dimensions, nor does it explore whether household characteristics and health care use are in turn related to child health outcomes.

2. Framework for Analysis

Although substantial evidence documents a strong association between child health and maternal education in many settings, efforts to explain why more educated mothers tend to have healthier children have been largely inconclusive (Bicego and Boerma 1992; Hobcraft 1993; Cleland 1989). Researchers generally agree that if maternal education alters infant and child health risks, it must do so by affecting factors directly related to health, such as nutrient intake, exposure to pathogens, susceptibility to pathogens, and management of illness (Mosley and Chen 1984). Efforts have focused both on providing theoretical explanations for why maternal education causes or is associated with behaviors that promote infant and child health and identifying the specific proximate behaviors through which maternal education exerts its impact.

Several theoretical explanations exist for why the association between maternal education and child health is causal. First, literacy and numeracy acquired through schooling may facilitate use of child survival technologies such as ORS. Additionally women who go to school may learn about the biological processes that determine health and so consciously practice habits that reduce exposure to pathogens and susceptibility to disease. Other theories are broader in scope. Exposure to non-traditional ideas in school may later in life encourage adoption of non-traditional behaviors that improve health, such as use of immunization. Schooling may improve a woman's ability to acquire and apply information about health-promoting practices. Another possibility is that education improves a woman's standing within the household vis-a-vis her husband and older family members. Improved standing, in turn, may increase

a woman's ability to direct resources to her children and adopt non-traditional behaviors/technologies that improve health.

Explanations have also been offered for why observed differentials in child health by maternal education might not reflect a causal relationship. These explanations tend to focus on excluded, confounding factors such as income, ability, and childhood background/socioeconomic status. Most efforts to control for potentially confounding factors have reduced but not eliminated the relationship between maternal education and child survival (Cleland and van Ginnekin 1988; but see Behrman and Wolfe 1987, for exceptions).

Researchers have also tried to identify health-related behaviors that differ by level of maternal education. The underlying reasoning is that maternal education must affect infant and child health risks by affecting factors such as nutrient intake, exposure to pathogens, susceptibility to pathogens, and management of illness. By examining the relationships between maternal education and indicators of these factors, we can clarify the channels through which maternal education affects child health.

In this analysis we explore two broad dimensions through which maternal education may affect child health. One of these dimensions concerns characteristics of the housing in which mothers and children live. A common hypothesis in the literature on socioeconomic differentials in child health outcomes is that superior hygiene and sanitation habits among educated women reduce the level of pathogens to which their children are exposed (Lindenbaum, Elias, and Chakraborty 1985; Cleland 1989; Bhuiya, Streatfield, and Meyer 1989). We construct variables that are likely to be correlated with level of exposure to pathogens in the household, either directly (e.g. interviewer observations of household cleanliness) or because the variables reflect housing characteristics that facilitate good hygiene (e.g. a source of bathing water inside the house).

A second hypothesis is that education enables women to choose and use health services more effectively. Educated women may be better able to distinguish high quality from low quality care, they may be more likely to seek preventive care, they may seek curative care more quickly and more persistently, and they may be better equipped to understand and carry out the treatment instructions of health service providers. More effective use of health services on the part of educated women should lead to better management of children's illness, reduce exposure to pathogens, and lower susceptibility to diseases.

Educated women are likely to have other characteristics that affect their behaviors with respect both to sanitation and hygiene and to knowledge and use of health services. These factors must be controlled or the relationships between maternal education and the behaviors of interest will be confounded. One of

these factors is income. Educated women often live in households with higher levels of income and so are better able to afford quality housing and expensive medical care. A related factor might be described as level of initiative or determination. If a particular characteristic motivates certain women to obtain education and carries over to other aspects of their lives, it may be this level of motivation/initiative that affects children's health rather than education. Another potentially confounding factor is childhood background. If educated women come from households of high socioeconomic status and if they are exposed to relatively high standards of living during their childhood, they may well replicate these standards in their own households. Finally, it is important to control for residence. To the extent that educated women live disproportionately in areas where infrastructure and health services are well-developed and to the extent that these services tend to improve health outcomes, failure to control for such access will overstate education's impact.

3. Data

Our data are from the household component of the 1993 Indonesian Family Life Survey. The IFLS interviewed around 20,000 adults in 7,225 households spread across 321 enumeration areas. Detailed information was collected about individuals and families. Approximately 5,800 of these respondents were ever married women between the ages of 15 and 49. In the IFLS all women under age 50 provided a pregnancy history, which includes data on the survival status of all children, and for pregnancies in the five years before the survey, information on prenatal care, site of and attendant at delivery, and birth outcomes. Additionally, women were asked to provide the name, location, expected travel time and cost, and expected service cost of various types of health care providers.

The IFLS also contains considerable information about characteristics of the home environment, such as source and location of drinking water, method of garbage disposal, type of toilet, and floor material. In addition, interviewers were asked to evaluate the cleanliness of the household and yard. Information on labor earnings, assets, gifts and inheritances, and expenditures on a variety of items in the last week, month, or year was collected at the household and individual level. In this analysis household economic status is measured as per capita household expenditure for a given time period (e.g. a month). This approach provides a straight forward method for measuring long-term income, which is thought to be more relevant than current income for behaviors such as use of medical services or source of drinking water (Deaton 1982; Behrman and Wolfe 1987).

Our analyses are conducted at two levels of observation. For characteristics of the household at the time of the interview, and for knowledge of health care services, the unit of observation is a woman who has experienced a live birth in the five years before the survey. For behaviors related to pregnancy and delivery, the unit of observation is a pregnancy or delivery that occurred in the five years before the survey.

We analyze a number of dependent variables. Our goal is to give broad-minded consideration to an array of behaviors and choices that may both affect child health and result partly from education, so *a priori* we consider a wide range of factors.[1] The dependent variables we analyze can be divided into two broad groupings: those related to knowledge and use of health care and those related to hygiene and sanitation.

One class of these variables encompasses knowledge and use of health services. We construct four variables, each measuring whether a mother can identify a health care provider or facility of a particular type. The four types of providers/facilities are: a government health center or subcenter (*puskesmas or puskesmas pembantu*), a doctor, a private clinic, and a nurse/ paramedic/midwife. The IFLS queried women as to whether they, a family member, a friend, or someone else they knew had ever used a health provider of each of the four types described above. When women responded affirmatively, they were asked to provide the name and location of a provider of each of the four types. When women responded negatively, they were asked if they knew any provider of that type, and if so, were asked about the name and location of the provider. Women who could provide the name of a facility were coded as knowing of a facility of that type, while women who could not provide the name of a specific provider were coded as having no knowledge of that type of provider.

The other variables in this class reflect decisions made during pregnancy and delivery regarding whether to seek prenatal care, when during the pregnancy first to seek prenatal care (age of gestation, in weeks), where to seek prenatal care, and where and with whom to deliver the baby (hospital, private clinic or practitioner's office, health center, home with midwife's assistance, or home with a *dukun's* assistance).[2]

The other broad class of variables measures characteristics of the house/home environment that potentially affect exposure to pathogens, either directly or by facilitating good hygiene and sanitation practices. Three of these variables reflect interviewers' assessments of the respondent's home, such as whether human or animal excrement or trash was visible in the yard or exterior of the home and whether the home was adequately ventilated. Other variables reflect the physical infrastructure of the home, such as whether the floors are dirt, whether electricity is available in the home, whether the sources of water for

drinking and for laundry and bathing are within the home, the methods of garbage and sewage disposal as well as toilet.

Of our explanatory variables, education is of greatest interest. Women were asked to identify the highest level of schooling they attended, the number of grades completed at that level, and whether they had graduated from that level. With this information, educational attainment can be measured either as number of years of schooling or as level of schooling. Cross-tabulations of our dependent variables by levels of education are presented in Tables 1-6.

Table 1 displays the relationship between level of maternal education and knowledge of four types of health providers/facilities. Knowledge of a government health center or subcenter rises with education, peaks among women who have completed primary school, then dropping slightly. Most Indonesian mothers know the location of a health center. Their knowledge of a nurse, paramedic, or midwife's practice is lower than of health centers but is highest among women who have completed primary school. Differentials in knowledge of clinics and doctors by educational level are much sharper than those of health centers or of midwives. Women with at least some senior high school are four (fifteen) times more likely to be able to identify a doctor (clinic) than are women with no education. In summary, we see from Table 1 that increasing levels of education are generally associated with greater knowledge of health care providers, particularly of the more expensive (and potentially higher quality) providers such as doctors or private clinics. At the highest levels of education, knowledge of government health centers and midwives tends to decrease slightly.

Table 1
KNOWLEDGE OF HEALTH SERVICES AND PROVIDERS BY EDUCATION: INDONESIA, 1993
(percent)

Educational Level	Know Location of:			
	Health Center	Clinic	Doctor	Midwife/ Nurses/ Paramedics
None	89.1	2.2	18.2	61.2
Some Primary	95.0	3.3	27.3	72.4
Comp. Primary	96.3	9.0	42.7	80.0
Junior High	92.0	22.2	59.2	79.6
Sr. High Plus	92.8	32.4	78.6	76.9

Note: N=2317. Women giving birth 1988-1993

Table 2 displays aspects of prenatal care use (any care, mean age of gestation at time of first care, and source of care) by educational level. More educated women are more likely to seek prenatal care and receive care earlier in

the pregnancy.[3] More educated women also tend to seek prenatal care at hospitals or health centers or from private clinics, doctors, and midwives. Women with less than a primary school education are more likely to receive prenatal care from traditional midwives than are women who have completed primary school.

Table 2
USE OF PRENATAL CARE BY EDUCATION OF MOTHER: INDONESIA, 1993
(percent)

Educational	Any Prenatal I Care	Average # of Weeks Pregnant at 1st Visit	Source of Prenatal Care: Hospital	Health Center	Doctor/ Clinic	Midwife	Dukun*	Other/ Home
None	57.9	18.2	3.8	49.9	0.5	19.6	14.4	11.7
Some	76.8	14.3	4.7	58.4	1.4	25.1	3.9	6.4
Comp. Primary	90.2	12.9	4.6	54.1	3.0	27.5	2.2	8.7
Jr. High	91.8	11.4	8.1	39.4	5.3	35.2	0.8	11.3
Sr. High Plus	98.7	9.7	14.5	32.7	15.7	30.8	0.6	5.7
N=	3215	2678	2678					

Note: Live Births 1988-1993. *Dukun = Traditional Midwife

Table 3, which shows choices women make about where to deliver their babies and who to use as an assistant, reiterates the patterns that appear in Table 2. Education increases the chance that women give birth in medical institutions with the assistance of a biomedically-oriented provider. At low levels of education, women tend to deliver at home with the assistance of a traditional midwife.

Table 3
LOCATION OF AND ATTENDANT AT DELIVERY BY EDUCATION OF MOTHER: INDONESIA, 1993
(percent)

Educational level	Hospital Center Midwife	Health Clinic/	Doctor Clinic	Midwife's Midwife	Home/	Home/ Dukun
None	1.6	0.6	3.5	2.5	3.3	88.5
Some Primary	3.2	1.1	5.3	2.6	9.6	78.1
Comp. Primary	4.1	3.4	13.2	3.0	11.7	64.5
Jr. High	12.3	7.8	23.9	2.6	16.8	36.6
Sr. High Plus	28.0	3.1	33.0	2.8	17.8	15.3

Note: N=3215. Live Births 1988-1993.

The other dependent variables we consider concern housing characteristics that affect household hygiene and sanitation. Interviewer observations about conditions of the household by level of education are shown in Table 4. Some of these variables, such as whether there is trash or human/animal waste visible in the yard, whether the floor is dirt, or whether there is adequate ventilation, represent factors that potentially increase exposure to pathogens.[4]

Table 4
HOUSING CHARACTERISTICS BY EDUCATION: INDONESIA, 1993
(percent)

Educational Level	Interviewer Observation: Human/Animal Waste Around Building	Trash Around Building	Poor Ventilation	Dirt Floor	Electricity in Home	Drinking Water Source Indoors	Bathing/ Laundry Water Source Indoors
None	20.7	30.3	55.5	53.0	42.2	9.1	9.5
Some Primary	13.5	20.8	43.1	43.6	50.1	16.9	17.7
Comp. Primary	14.2	16.7	38.7	33.7	64.8	15.5	16.2
Jr. High	13.3	13.5	29.8	15.1	76.9	32.8	32.2
Sr. High Plus	4.3	9.8	15.8	3.3	93.8	50.4	55.6

Note: N = 2317. Women giving birth 1988-1993.

Table 5
WATER SOURCE BY LEVEL OF EDUCATION: INDONESIA, 1993
(percent)

A. Drinking Water / Educational Level	Source: Piped	Well, Pump	Well, no pump	Spring	Rain, river	Purchased
None	3.8	15.0	54.8	12.9	12.1	1.4
Some Primary	6.4	15.0	54.1	12.6	9.6	2.3
Comp. Primary	9.0	15.7	57.4	9.9	5.5	2.4
Jr. High	9.9	14.5	53.3	9.9	6.2	6.2
Sr. High Plus	20.0	30.8	36.4	4.8	2.0	6.0
B. Bathing/Laundry Water						
None	1.2	12.9	48.2	11.0	26.7	0.0
Some Primary	4.3	12.1	49.5	10.9	22.9	0.3
Comp. Primary	6.2	15.0	51.2	10.9	16.5	0.4
Jr. High	8.2	19.3	51.9	6.6	13.2	0.8
Sr. High Plus	20.1	34.1	36.1	4.4	4.0	1.2

Other variables, such as whether the house has electricity and whether the sources of drinking water and water for bathing/cleaning are indoors reflect the presence of technologies that facilitate good hygiene practices. The results in the table indicate that the least educated are more likely to live in the seemingly least healthy conditions and less frequently have amenities that facilitate good hygiene.

Table 6
TYPE OF TOILET BY LEVEL OF EDUCATION: INDONESIA, 1993
(percent)

A. Type of Toilet Educational Level	Own Toilet	Shared Toilet	River, Field	Other
None	22.4	11.7	59.7	6.2
Some Primary	29.9	14.1	49.7	6.4
Comp. Primary	33.4	15.9	42.4	8.2
Jr. High	46.5	16.0	35.0	2.5
Sr. High Plus	76.1	8.4	12.4	3.2

Note: N=2317

The bivariate relationships we have reviewed so far are consistent in the expected direction. Although we anticipated that most of the relationships would hold, we are somewhat surprised that maternal education appears to be so strongly associated with so many factors potentially related to child health. Part of the explanation may be that levels of maternal education are strongly correlated with other aspects of socioeconomic status such as household income and residence.

In our multivariate models, explanatory variables other than education serve primarily as controls. These control variables include age of the mother, per capita household expenditure level, whether the woman was living in a village, small town, or large city at 12 years of age, and whether her current residence is in an urban or rural location. These variables are meant to capture the potentially confounding effects of the factors mentioned above.[5]

4. Methods and Results

We employ two estimation strategies. In the first, we estimate straight-forward binomial and multinomial response models.

The dependent variables in our analysis measure housing characteristics and knowledge and use of health care. Such choices are determined not only by

the characteristics of the women and their families, but also by the characteristics of the communities. For example, regardless of a woman's education or income, the probability that she uses a collection service to dispose of household garbage is greatly diminished if no such service exists in the community. Similarly, the likelihood that a woman can identify a hospital or doctor diminishes when such providers are rare in her community, regardless of the woman's socioeconomic status.

To the extent that women with above average levels of education and income tend to live in areas with above average availability of infrastructure, the effects of education and income on choices about housing characteristics and knowledge and use of health care will be overstated. In the first set of specifications we control for the effect of community attributes by including a term measuring whether women live in urban or rural areas. This measure is only a very rough control for community characteristics.

Another alternative is to implement a "case-control" approach where women living in the same enumeration area are paired and differences in their choices regarding housing characteristics and use of health care are related to differences in their educational levels (see Elo 1992, for an implementation of this approach with Peruvian data). Because women are matched at the level of the village, they share common community characteristics.

Chamberlain (1980) has formulated a statistical approach for covariance models with discrete dependent variables (econometricians frequently refer to this method as a fixed-effects approach). Random pairs of women are generated, where each member of the pair lives in the same village. If education affects choices regarding health care, sanitation, and net of community infrastructure, then the choices of the two members of the pair should differ given differences in levels of education. Because choices are compared for a pair within the same village, conditions of that village that attract women of high socioeconomic status, are held constant for that pair and so do not affect parameter estimates (Chamberlain 1980).

We first present results from binomial and multinomial response models. In these models education is specified as a categorical variable, where some primary school is used as the reference category and parameters are estimated for no school, completed primary school, junior secondary school (some or completed), and senior secondary school and beyond. We control for household socioeconomic status by including terms for monthly per capita household expenditure, and the square of that term. To control for maternal background, we include covariates indicating whether, at age 12, the mother resided in a small town or a big city, in comparison to a village. Finally, to control for the effects of current residence on choices about health care use and sanitation and hygiene, we include a control for urban residence. For each model, we test whether the

education terms add to the explanatory power of the model, using Likelihood ratio tests.

In Table 7 we present the results for interviewer observations on household cleanliness, adequacy of ventilation, whether the floor is dirt, and whether sources of drinking and washing water are indoors. The numbers in this table (and in other tables) are odds ratios: the odds of the behavior in question for someone with a particular characteristic, relative to the odds for someone in the reference category.[6]

Table 7
HOUSING CHARACTERISTICS
EXPONENTIATED PARAMETERS, LOGISTIC REGRESSION:
WOMEN GIVING BIRTH, 1988-1993

Covariates	Interviewer Observation: Human/ Animal Waste Around Building	Trash Around Building	Poor Ventilation	Dirt Floor	Electricity in the Home	Drinking Water Indoors	Bath/ Laundry Water Indoors
Age	1.002	1.018 *	.991	.978 *	1.008	1.013	1.017
Education							
No Education	1.713 **	1.168	1.503 **	1.455 *	.961	.517 **	.573 *
Some Primary	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Comp. Primary	1.180	.777	.866	.702 *	1.967 **	.966	.989
Junior Secondary	1.087	.670	.598 **	.265 **	2.355 **	1.399 *	1.343
Sr Secondary +	.412 **	.479 **	.363 **	.113 **	5.064 **	1.651 **	2.358 **
Monthly Per Capita Expenditure:							
PC Exp.	.999	.999	.998 **	.995 **	1.004 **	1.004 **	1.004 **
PC Exp 2	1.000	1.000	1.000 **	1.000 *	.999 **	.999 **	.999 **
Residence Age 12							
Village	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Small Town	1.187	1.046	1.019	.630 *	.968	1.089	1.020
Big City	.777	1.058	1.089	.449 **	1.004	1.708 **	1.533 *
Urban	.539 **	.751 *	1.376 *	.341 **	6.366 **	5.049 **	4.713 **
Ref: Rural							
N	2317	2317	2317	2317	2317	2317	2317
Prob. Chi2	.0000	.0000	.0000	.0000	.0000	.0000	.0000

Notes: * = .05, ** = .01

For each behavior we are considering, increasing levels of education tend to increase the chance of a "healthy" behavior. For example, women with no education are 1.5 times more likely to live in homes rated as having poor ventilation by the interviewer than are women with some primary school education, while women with at least some senior secondary education are about one-third as likely to live in such homes. Relationships of similar magnitude hold for interviewer evaluations of the presence of waste in the vicinity of the

home and whether the source of water for drinking and cooking is located in the home. In each model the joint effects of the education variables are significant at the 0.01 level.

In sum, more educated women are significantly less likely to live in homes characterized by interviewers as having waste or trash in the vicinity or being poorly ventilated. More educated women are also less likely to live in homes with dirt floors, but are more likely to live in homes with electricity where the drinking water source is inside and in homes where the source of water for bathing and for laundry is inside. The existence of these relationships net of controls for per capita expenditure level of the household suggests us that in addition to make certain behaviors or amenities affordable, education affects tastes for certain behaviors that are conducive to good health. Whether these behaviors are practiced because of their health consequences or for other reasons is unknown.

Of the control variables, expenditure levels show consistent effects on the behaviors we consider. Greater levels of household resources are associated with "healthier" housing characteristics, although the effects are not significant for the variables reflecting interviewer observations of trash and waste in the vicinity of the home. Urban residence is associated with healthy housing characteristics, except for ventilation. Generally, infrastructure levels and municipal services are stronger and more developed in urban areas, so it is not surprising to find large effects of urban residence on the choice electricity and of indoor water connections. High population densities, however, may prevent adequately ventilated homes. *A priori* it is difficult to anticipate the effect of urban residence on interviewer evaluations of household cleanliness. On one hand, crowding and inadequate landfills could contribute to more trash in the environment. On the other hand, collection services may be better developed and social norms may discourage casual disposal of trash and waste in high density areas.

Maternal residence in childhood has no impact on the interviewer assessments of cleanliness and ventilation, but women who spent their childhood in cities are considerably more likely to live in houses with indoors water sources and less likely to live in houses with dirt floors. That these effects occur in the presence of controls for levels of household resources suggests that childhood experiences shape women's choices later in life.

Table 8 displays the results of multinomial logistic regression models predicting source of drinking water. The models were estimated separately by rural and urban residence because only urban residents purchase drinking water. Additionally, use of rain, river, and spring water is considerably less common in urban than in rural areas.[7] In both areas, water from a well without an electric or manual pump is the comparison group.

Table 8
SOURCE OF DRINKING WATER EXPONENTIATED PARAMETER ESTIMATES, MULTINOMIAL LOGISTIC REGRESSION: HOUSES WITH WOMEN GIVING BIRTH, 1988-1993

Covariates	Piped Water	Well, with pump	Spring, Rain, River	Purchased
A. Urban				
Age	1.009	.976	.975	.947 **
Education				
No Education	.548	1.211	.623	.740
Some Primary	1.000	1.000	1.000	1.000
Comp. Primary	1.039	1.359	.168 **	.714
Junior Secondary	1.039	1.031	.221 *	.778
Sr Secondary +	2.206 **	2.380 **	.330 *	.693
Monthly Per Capita Expenditure				
PC Exp.	1.003 **	1.002 **	1.003	1.003 **
PC Exp 2	.999 **	.999 **	.999	.999
Residence at Age 12				
Village	1.000	1.000	1.000	1.000
Small Town	1.447	1.018	.984	.894
Big City	2.328 **	2.501 **	.894	2.373 **
N = 1016, Prob. Chi2 < .000				
B. Rural				
Age	.985	1.000	1.041 *	.988
Education				
No Education	.810	1.054	1.041	.960
Some Primary	1.000	1.000	1.000	1.000
Comp. Primary	1.097	.717	.818	.438 **
Junior Secondary	1.361	.451 *	1.265	.491 *
Sr Secondary +	2.277 *	1.339	1.666	.519
Monthly Per Capita Expenditure:				
PC Exp.	1.003 **	1.003	.999	1.000
PC Exp	2.999	.999	1.000	.999
Residence at Age 12				
Village	1.000	1.000	1.000	1.000
Small Town	.446	1.455	.575	1.555
Big City	.525	.284	.713	1.087
N = 1299, Prob. Chi2 < .0000				

Note: Comparison Group: well water, no pump

The education terms are jointly significant in the urban and the rural models, although educational differentials appear to be larger in urban than in rural areas. In urban areas education increases the probability of having piped water or water from a well with a pump and decreases the probability of relying on spring, rain, or river water, relative to water from a well. Expenditure level and childhood residence are also important determinants of drinking water source in urban areas. Higher expenditures and childhood residence in a city are associated with the choice of purchased, piped, or pumped water over well water.

In rural areas, covariate effects are considerably weaker, possibly because choices are more limited. Women with at least some senior high school education are more than twice as likely to choose piped water over well water than are women with some primary school education. Women with at least a

primary school education are less likely to drink rain or river water than well water. Rising expenditures increase the chance of piped drinking water, but have no impact on choosing another source over well water.

Table 9 presents results from the analysis of source of water for bathing and laundry (urban and rural residents are pooled). Again, well water serves as the comparison of water source. In this model, increasing levels of education increase the chance that piped or pumped water supplies needs for bathing and cooking and decreases the chance that rain or river water is used. Rising expenditure levels increase the likelihood of choosing piped or pumped water. Childhood residence in a city increases the probability of relying on piped or pumped water and decreases the probability of use of rain or river water.

Table 9
SOURCE OF WATER FOR BATHING AND LAUNDRY EXPONENTIATED PARAMETER ESTIMATES, MULTINOMIAL LOGISTIC REGRESSION: HOUSES OF WOMEN GIVING BIRTH, 1988-1993

Covariates	Piped	Well, pump	Spring	Rain/River
Age	1.002	.979 *	1.025 *	.984
Education				
No Education	.429 *	1.141	1.149	.892
Some Primary	1.000	1.000	1.000	1.000
Comp. Primary	1.003	1.127	.985	.536 **
Junior Secondary	1.179	1.047	1.222	.478 **
Sr Secondary +	3.083 **	2.110 **	1.685	.469 **
Monthly Per Capita Expenditure				
PC Exp.	1.003 **	1.002 **	.999	.999
PC Exp 2	.999 **	.999 **	1.000	1.000
Residence at Age 12				
Village	1.000	1.000	1.000	1.000
Small Town	1.127	.888	.537 *	1.279
Big City	1.387	1.695 **	.455	1.224
Urban	4.602 **	3.347 **	.290 **	.279 **
Ref: Rural				

Note: N = 2286, Prob. Chi2 = .0000, * = .05, ** = .01

Table 10 shows the effect of various factors on toilet type. The likelihood of sharing a toilet, using the yard or river, and "other" are contrasted with having a private toilet in the home. Differentials are in the expected direction and almost all the covariates are significant. In this model, the comparison group represents the most hygienic option and therefore the "healthiest" behavior. Not surprisingly, increasing levels of education and economic resources decrease the probability of choosing something other than a private toilet in the home, as does childhood residence in a small town or city. Residence in an urban area increases the probability of sharing a toilet, but decreases the probability of using a river or yard.

Table 10
TYPE OF TOILET EXPONENTIATED PARAMETERS, MULTINOMIAL LOGISTIC REGRESSION: HOUSES OF WOMEN GIVING BIRTH, 1988-1993

Covariates	Shared Toilet	River,Yard	Other
Age	0.949 **	0.969 **	1.008
Education			
No Education	0.933	1.267	1.098
Some Primary	1.000	1.000	1.000
Comp. Primary	0.889	0.588 **	0.800
Junior Secondary	0.668 *	0.444 **	0.499 *
Sr Secondary +	0.368 **	0.204 **	0.403 **
Ref: Some Prim.			
Monthly Per Capita Expenditure:			
PC Exp.	0.998 *	0.997 **	0.997 **
PC Exp 2	1.000	1.000	1.000
Residence at Age 12			
Village	1.000	1.000	1.000
Small Town	0.623 **	0.710 *	0.655
Big City	0.589	0.497 **	0.519
Urban	1.439 *	0.393 **	0.539 **
Ref: Rural			

Note: Comparison Group: own toilet N = 2317
Prob. Chi2 = .0000, * = .05 ** = .01

The other broad category of variables we consider encompasses knowledge of health services and providers and use of health care during pregnancy and delivery. Table 11 displays the results of logistic models of knowledge of the four different health care providers: government health centers and subcenters, clinics, doctors, and midwife/nurse/paramedics. Few of the covariates affect knowledge of a health center, probably because most women were able to identify a health center. Strikingly, however, women with no education are about half as likely to know of a health center as women with some primary education. Jointly the education effects are significant. Urban residence significantly decreases the likelihood of knowing the location of a health center. Taken together the residence and education results suggest that health centers are most relevant to the rural "middle class".

Table 11
KNOWLEDGE OF HEALTH FACILITIES AND PROVIDERS EXPONENTIATED PARAMETERS, LOGISTIC REGRESSION: WOMEN GIVING BIRTH, 1988-1993

Covariates	Know Health Center	Know Clinic	Know Doctor	Know Midwife, Nurse, or Paramedic
Age	1.009	1.016	1.002	1.001
Education				
No Education	.474 **	.504 *	.700 *	.601 **
Some Primary	1.000	1.000	1.000	1.000
Comp. Primary	1.322	2.153 **	1.876 **	1.339 *
Junior Secondary	.921	3.173 **	4.816 **	1.089
Sr Secondary +	.824	3.180 **	4.826 **	1.089
Ref: Some Primary				
Monthly Per Capita Expenditure:				
PC Exp.	.999	1.002 **	1.004 **	1.001 *
PC Exp 2	1.000	.999 **	.999 **	.999 *
Residence at Age 12				
Village	1.000	1.000	1.000	1.000
Small Town	1.070	.929	1.504 **	1.476 **
Big City	1.175	1.795 **	1.633 **	.742 **
Urban	.629 *	3.897 **	2.394 **	.742 **
Ref: Rural				
N	2317	2317	2317	2317
Prob. Chi2	.0001	.0000	.0000	.0000

Notes: * = .05 ** = .01

The education effects are strong when the dependent variable is knowledge of a clinic, a doctor, or midwife/nurse/paramedic. Women who have completed primary school are more than twice as likely to identify a clinic, 1.9 times more likely to identify a doctor, and 1.3 times more likely to identify a midwife than women with some primary school education. Women with more than a primary school education are about three times more likely to identify clinics and doctors as are women with some primary school. Women with no education are half to two-thirds as likely to identify clinics, doctors, and midwives as women with some primary school. The education effects are strong and consistent: educated women are far more likely to be able to identify health providers than are uneducated women. Current residence, childhood residence, and current expenditure levels also affect knowledge of private providers. Differentials in knowledge by socioeconomic status are stronger for those who have knowledge of private clinics and doctors than for those who have knowledge of public clinics or of midwives, nurses, and paramedics. This result likely reflects the fact that certain providers appeal particularly to certain socioeconomic strata.

The remaining health service-related variables we consider concern health care use during pregnancy and delivery. Accordingly, these variables are

pregnancy-specific and the unit of observation is a pregnancy rather than a woman. The first group, summarized in Table 12, consists of whether prenatal care was received, length of the gestation at the time prenatal care was first sought, and source of prenatal care. Maternal education drastically increases the likelihood of obtaining prenatal care. Women without education are about half as likely to seek prenatal care as women with some primary school, while women with at least some senior high school are *seven* times more likely to seek prenatal care than their counterparts with some primary school education. Expenditure levels have no effect on prenatal care use, but current and childhood urban residence significantly increase the likelihood of seeking care.

Table 12
USE, SOURCE, AND TIMING OF PRENATAL CARE
EXPONENTIATED PARAMETERS, LOGISTIC REGRESSION:
LIVE BIRTHS, 1988-1993

Covariates			Source:				
	Any Prenatal Care?	Age of Gestation at First Visit for Care	Hospital	Doctor/ Clinic	Midwife	Dukun	Home/ Other
Age	.964 **	.082 **	1.040 **	1.031	1.008	.956 *	.994
Education							
No Education	.462 **	.827	.862	1.000	.772	2.834 **	2.187**
Some Primary	1.000		1.000	1.000	1.000	1.000	1.000
Comp. Primary	2.091 **	-1.367 **	1.209	1.341	1.164	.461 **	1.307
Junior Secondary	2.691 **	-2.468 **	1.271	2.233 **	1.194	.397 *	1.655*
Sr Secondary +	7.054 **	-3.544 **	2.107 **	4.353 **	1.213	.240 *	1.608
Monthly Per Capita Expenditure:							
PC Exp.	1.002	-.004 **	1.004 **	1.004 **	1.003 **	1.000	.999
PC Exp 2	1.000	.000 **	.999 **	.999 **	.999 **	1.000	1.000
Residence at Age 12							
Village	1.000						
Small Town	.926	-.19363					
Big City	1.728 *	-1.292 **					
Urban	2.215 **	-1.386 **	5.107 **	3.477 **	2.299 **	.271**	1.114
Ref: Rural							
Estimation Technique	Binomial Logit	OLS Logit	Multinomial				
N	3216	2679	2679				

Note: Comparison group: Health Center
* = .05 ** = .01

For women who obtained prenatal care we analyzed the gestational age at which the first visit was made. The results are similar to those for use of care. Education and current and childhood urban residence all decrease the duration of pregnancy at which care is first sought. Expenditure levels, as well, serve to decrease the gestational age at first prenatal care contact. The third variable in this trio is source of prenatal care. The reference category is a government

health center. Increasing levels of education and expenditures increase the chance that a hospital or a private doctor or clinic was used rather than health center, as does urban residence. Women with no education are more likely use traditional midwives (*dukun*) than they are to visit a health center. Urban residence decreases the chance of choosing a *dukun*.

The final sets of variables in these specifications relate to use of care at the time of delivery. Education, expenditure level, childhood residence in a town or city, and current urban residence all increase the chance that a modern provider (hospital, health center, doctor/clinic, or midwife) will be chosen over delivering the baby at home with the assistance of a *dukun*. Women with education are also more likely than uneducated women to deliver at home with the assistance of a midwife, rather than with a *dukun*.

Table 13
LOCATION OF AND ATTENDANT AT DELIVERY EXPONENTIATED PARAMETERS, LOGISTIC REGRESSION: LIVE BIRTHS, 1988-1993

Covariates	Hospital	Health Center	Doctor/ Clinic/ Midwife	Midwife's Clinic	Home-Midwife
Age	1.033 **	0.992	1.012	0.908 **	1.016
Education					
No Education	0.417 **	0.812	0.454 **	0.777	0.334 **
Some Primary	1.000	1.000	1.000	1.000	1.000
Comp. Primary	1.412	1.839 *	2.242 *	0.783	1.234
Junior Secondary	4.442 **	3.903 **	4.383 **	1.541	2.652 **
Sr Secondary +	11.443 **	5.938 **	7.462 **	2.769 **	4.786 **
Ref: Some Prim.					
Monthly Per Capita Expenditure:					
PC Exp.	1.005 **	1.007 **	1.005 **	1.003 **	1.003 **
PC Exp 2	.999 **	.999 *	.999 **	.999	.999 *
Residence at Age 12					
Village	1.000	1.000	1.000	1.000	1.000
Small Town	1.640 **	1.045	1.339 *	0.885	1.599 **
Big City	3.340 **	3.230 **	3.520 **	1.218	2.272 **
Urban	5.799 **	2.643 **	5.680 **	2.093 **	2.786 **
Ref: Rural					

Notes: Comparison group: At Home, with Dukun (traditional midwife)
N = 3355 * = .05 ** = .01

Throughout our discussion urban residence has typically increased the likelihood of a choice that represents a "healthy" behavior. In most cases this result is not surprising. Urban areas in Indonesia offer considerably more than rural areas do in the way of infrastructure and diversity of health practitioners,

facilitating a wider array of choices with respect to housing characteristics. Those affect hygiene, sanitation, and use of health services, as well as knowledge of health services. However, the dichotomy of urban versus rural residence only roughly captures the variation in infrastructure and institutions across the communities we analyze.

There are several more appealing ways to control the effects of residence. The approach we pursue in this paper is the one described earlier, where we estimate models with community "fixed effects". This procedure is an extreme means of controlling for differences across communities that affect the choices we analyze. If education remains a significant predictor in these specifications, we can be confident that the results do not merely reflect a correlation between education and community infrastructure only.

We selected a subset of the behaviors of interest and estimated fixed effects models of the effects of age, education, and expenditure level on these behaviors. In these models, each observation is a pair of mothers (births) from the same community. Within each pair, the observations differ on the outcome of interest. The question is whether a consistent pattern emerges across the pairs, whereby the mother with more education and higher household expenditures adopts healthier behaviors than her less advantaged counterpart (the other member of the pair). The dependent variables are all dichotomous. The models are logistic regression models, in which age, education, and expenditure levels are treated as scaled variables. Just as the dependent variable is the difference between the behaviors of two mothers in the pair, the independent variables are also the differences between the two mothers of pair in age, education, and expenditures. In these models education is specified as the number of years of completed schooling. The parameters are interpreted as follows: what is the effect of an extra year of education for the first mother relative to the second mother on the chance that the first mother will choose a healthy behavior while the second mother will not.

To summarize our procedures, we first created pairs of mothers (births) in the following manner. Within each village we randomly assigned women (births) to one of two roughly equal sized groups. We then paired each woman (birth) from the first group with a woman (birth) from the second group. For the pair to contribute to the model, the members must differ on the outcome of interest. Since the number of pairs that differ on the outcome of interest will vary depending on the outcome, the number of observations differs across the models.

The results of the fixed effects regressions are displayed in Tables 14, 15, and 16. Within any particular community, an additional year of maternal education significantly decreases the probability that the house is poorly ventilated, has dirt floors, or that human and animal wastes are present in the

vicinity of the house (Table 14). An additional year of education increases the probability that the house has electricity and sources of drinking and bathing water indoors. Expenditure effects work in the same direction for each of these outcomes: rising levels of expenditure are associated with healthier housing characteristics.

Table 14
HOUSING CHARACTERISTICS, FIXED EFFECTS ESTIMATES (EXPONENTIATED PARAMETER ESTIMATES)

Covariates	Interviewer Observation						
	Human/ Animal Around Building	Trash Around Building	Poor Ventilation	Dirt Floor	Electricity	Drinking Water Indoors	Bath/ Laundry Water Indoors
Age	.973	1.008	.967 ***	.953 ***	1.032	1.027 **	1.026
Education	.907 ***	.909 ***	.886 ***	.741 ***	1.348 ***	1.140 **	1.153***
Expenditure	.998	.998	.998 **	.992 **	1.007 ***	1.002 **	1.004***
N	180	286	405	195	211	235	82
Prob. Chi2	.013	.002	.000	.000	.000	.000	.099

Table 15
KNOWLEDGE OF HEALTH CARE PROVIDERS FIXED EFFECTS ESTIMATES (EXPONENTIATED PARAMETER ESTIMATES)

Covariates	Know Location Of:		
	Health Center	Doctor	Clinic	Midwife/Nurse/ Parmedics
Age	1.011	.9971	1.024	.9989
Education	1.055	1.188 ***	1.151 ***	1.029
Expenditure	.999	1.005 ***	1.000	1.001
N	130	340	172	354
Prob. Chi2	.5364	.0000	.0000	1139

Table 16
USE OF HEALTH CARE DURING PREGNANCY AND DELIVERY FIXED EFFECTS (EXPONENTIATED PARAMETER ESTIMATES)

Covariates	Received Prenatal Care	Delivered at Home	Delivered With Medically-Trained Attendant	Age of Gestation at First PC Visit
Age	.954 **	.997	1.011	.093
Education	1.185 ***	.849 ***	1.211 ***	.329 ***
Expenditure	1.008 ***	.998 **	1.002 ***	-.001
N	306	358	387	1112
Prob. Chi2	.0000	.000	.000	

Maternal education also has a strong impact on knowledge of health practitioners and on use of care during pregnancy and delivery (Tables 15 and 16). An extra year of education raises the odds of knowing a doctor or clinic by more than 15%. Rising expenditure levels have little effect on knowledge of health practitioners within a community, except for knowledge of doctors.

Not only does education improve the likelihood that a woman knows about specific providers, it also increases the probability that a woman receives prenatal care, reduces the age of gestation at which the first prenatal care visit is made, reduces the chance of delivering the baby at home, and increases the chance that a doctor or medically-trained midwife delivers the baby rather than a *dukun*. Expenditure levels also affect these decisions, in the expected direction.

5. Conclusions

The goal of this analysis was to explore the relationship between maternal education and a number of specific behaviors and characteristics that represent sanitation and hygiene practices and knowledge and use of health services. Maternal education is related to almost all the behaviors and characteristics we examine. The relationships are robust to controls for household economic status, childhood residence, and even to very rigorous controls for residence. Although we expected to see differences in the outcomes of interest, we did not anticipate the strength and the consistency of the differentials that emerge.

As we draw conclusions from this analysis, two important caveats must be kept in mind. First, although it is logical to expect that the outcome variables we have considered affect exposure to pathogens, susceptibility to pathogens, and illness management, and so in turn affect health outcomes, we have not demonstrated that these relationships exist. Consequently, we cannot argue that the "healthy" behaviors we consider actually lead to healthy outcomes. Second, though differences in behaviors by educational level are strong and they emerge across a wide range of outcomes, we cannot conclude with certainty that the relationships are causal. The primary argument against such a conclusion is that we may not have controlled adequately either for childhood background or for personal characteristics such as initiative, that may lead women both to acquire education and to practice a variety of healthy behaviors.

Nevertheless, it appears that education is associated with a number of behaviors that potentially affect health. This finding suggests to us that efforts to identify *one* particular pathway through which education exerts its influence may be of limited use. Differentials in health status by educational level may result not from a few important behavioral shifts, but from a number of factors that together substantially reduce health risks.

Additionally, it appears that education exerts a separate effect from economic resources of the household. One might expect certain housing characteristics to be preferred by everyone simply because they are convenient (e.g. an indoor source of drinking or bath water), so that income is the principal determinant of those characteristics. Instead, we find that education consistently exerts an effect on such choices net of expenditure levels (our measure of household economic resources).

Several issues remain that we intend to address in future work. We would like to sharpen our controls for community characteristics by including data from the IFLS Community-Facility survey, add controls for husbands' characteristics, and refine our controls for maternal childhood background. We would also like to broaden the scope of the questions we are asking. In particular, we would like to establish a link between the behaviors and characteristics we have considered in this analysis and child health outcomes.

Notes

1. We stress that in this paper we do not establish a relationship between the behaviors we consider and health outcomes. When we refer to a particular behavior as "healthy" we do so on the grounds that it is plausible that this behavior leads to good health.

2. Dukuns are traditional birth attendants (traditional midwife).

3. Some caution should be exercised in interpreting the variable measuring age of gestation at first prenatal care visit, since accuracy in reporting gestational age at the time of the first prenatal care visit relies partly on ability to date conception, which in turn may vary with education. Differences in reporting accuracy that bias reports systematically in one direction for a particular educational level could bias differentials in duration of pregnancy at first prenatal care visit by level of education.

4. Interviewers were asked to observe the households in which they were conducting interviews and record their observations on the housing attributes described above.

5. Earlier we mentioned that a characteristic such as determination or initiative could drive both educational attainment and practices that promote children's health, leading to a spurious correlation between maternal education and children's health (or behaviors that promote health). We have no way to measure and include such a characteristic. However, it is likely that household expenditure levels, which measure economic success, will pick up some of the effect of motivation and initiative.

6. For age and expenditure level the comparison is between two women who differ in age or expenditure by one unit (a year in the case of age, 1000 Rupiah in the case of expenditures).

7. In the urban model the category "spring water" is combined with the category for rain/river water, while in the rural model separate categories are maintained.

8. These results are from an OLS specification. The numbers in the table are coefficients rather than odds ratios.

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