

ECONOMIC GROWTH CENTER

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CENTER DISCUSSION PAPER NO. 633

MEASUREMENT OF CHILD HEALTH:

MATERNAL RESPONSE BIAS

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June 1991

Notes: Center Discussion Papers are preliminary materials circulated to stimulate discussion and critical comments.

This is a revised version of the paper originally written September 1990.

## ABSTRACT

Researchers are increasingly relying on health interview data to assess the health of individuals in developing countries. We take advantage of an opportunity to compare alternative types of indicators of child health in a single survey to learn about the relative merits of different types of measures. Some measures, such as anthropometries, are objective, but others, such as maternal reports of illness, are subjective and thus likely to be contaminated by response error. Focussing on the correlation between maternal education and indicators of child healthiness, we demonstrate that the correlation is positive for more objective indicators and those morbidities which are easily detected. For some illnesses, however, the reverse is true: children of better educated mothers are *more* likely to be reported as having respiratory diseases. We argue this reflects response error and suggest, therefore, that health interview survey data should be interpreted with considerable care.

**Keywords:** Child health, measurement, maternal education

Sindelar acknowledges financial assistance from the Rockefeller Foundation. We are grateful to Warren Sanderson and Paul Gertler for providing us with the data and documentation. We have benefitted from the comments of Jere Behrman, Juliana Pakes, T. Paul Schultz and John Strauss; Juliana Pakes and Paul McGuire assisted with the computations.

## 1. INTRODUCTION

In many parts of the world, public health policy is guided by scanty knowledge about the prevalence and impact of disease in a community. Even less is known about how illness varies by socio-economic and demographic characteristics, information that is critical for the design of effective public policy. Lack of appropriate data has constrained the acquisition of knowledge. The collection of clinically based data from a random sample of a population is prohibitively expensive for large scale national surveys, especially in poor countries. Thus health facility records have been used to assess the health of a community; these are indicative only of a select part of the community, those who use medical services. In the last decade, several developing countries have implemented household interview surveys focusing on health issues and health interview modules are increasingly becoming a component of more general surveys.<sup>1</sup>

There is a growing awareness of the importance of health in human resource and development planning. As a consequence, there has been an expansion in the collection of interview data. Thus researchers and policy makers are increasingly relying on self-reports of health status and, in the case of children, proxy reports usually by the mother. Research based on data from industrialized countries has suggested that self-reports may be a reliable source of information in many situations (for example see Maddox and Douglas, 1973, Waldron *et al.*, 1982, and Butler *et al.*, 1987) although some evidence suggests that results from these surveys are sensitive to methodology (National Center for Health Statistics, 1972;

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<sup>1</sup>The Demographic and Health Surveys which have been implemented in about 55 countries world wide have had a dramatic impact on the kinds of information that are now available. Multi-purpose surveys, such as the Living Standards Surveys implemented by The World Bank, routinely include one or more health modules. In response to this trend, the United Nations Household Survey Capability Programme has recently commissioned a set of guidelines to aid the implementation of health surveys (Hill and Mamdani, 1989).

Cartwright, 1983). In developing countries, there is little evidence on the reliability of self-reported morbidities and even less on how to interpret these data. For discussions of many of the issues, see Kroege, (1985) and Ross and Vaughan (1986).

In this study, we attempt to evaluate the evidence regarding the role of errors in respondent reports of evaluation of health status and determine how these errors might affect inferences drawn from health interview surveys.<sup>2</sup> In particular, we examine maternal response to questions about the health of their children.

Using a national household survey from Peru we take advantage of a unique opportunity in a large scale survey to compare alternative measures of child health. Included in this survey are the following categories of child health indicators: 1) anthropometries- objective indicators measured by trained personnel; 2) maternal reports of child illness- these are more subjective and possibly contaminated by response error; and 3) use of medical care- some suggest that medical care utilization can be used as an indicator of poor health. For the first two categories we have multiple measures. In the case of anthropometries, we have height, weight and arm circumference. For maternal reports of illness we have the presence of illnesses elicited in two different modules in the same survey: general questions about morbidities in which the respondent reports diagnoses or symptoms and also, for children, responses to specific questions about particular illnesses. Finally, each mother reports the proportion of child she has ever born who are still alive. Our aim is to evaluate the kind of information contained in these indicators.

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<sup>2</sup>For an excellent general review of problems associated with sampling, questionnaire design and health interview survey implementation, see Ross and Vaughan (1986).

We do not have experimental or clinical evidence against which we can compare these indicators; instead we set up a quasi-experiment using the interview survey data themselves. We maintain that maternal education is positively correlated with child health and that this correlation holds, on average, across all our indicators of child health.<sup>3</sup> This is based on previous research and some corroborating evidence is provided below. We examine the relationship between maternal education and a series of indicators of child health to determine what researchers would infer about this relationships based on different measures.

## 2. THE INTERPRETATION OF HEALTH INTERVIEW SURVEY DATA

Health interview surveys have been incorporated into many national and international data collection systems over the last few years. These surveys have much to offer; they are relatively inexpensive to field, can be integrated into more general household surveys and often cover large population based samples. However, they are likely to suffer from response errors that may vary across both the type of questions elicited and the socio-economic and demographic characteristics of the respondent. Researchers need to incorporate knowledge of these response errors into their studies in order to obtain accurate inferences about relationships under study. At present, however, we just do not know enough about these sorts of errors.

A natural way to measure the extent of response error in interview surveys would be to compare respondent reports with "true" measures of an individual's health. One would assume that health status,  $H$ , could be thought of as a

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<sup>3</sup> We acknowledge that there may be some diseases or types of accidents that are positively correlated with education, but we submit that these would be very specific diseases or types of accidents, not the type of health indicators that we are using in this study nor the type that would typically be used in population based surveys.

unidimensional concept that could be measured. Measured health would then be equal to true health status,  $H^*$ , and an error,  $\varepsilon$ , due to mis-reporting:

$$H = H^* + \varepsilon$$

Measuring the extent of response error in this way is difficult for several reasons. Such experiments are difficult to design and are expensive to undertake.

In addition, health is multi-faceted even in conceptualization and there is no single comprehensive measure of health. Few such experiments have typically been implemented and then only with one clinical observation (see Frydman, 1980, and Vandvik *et al.*, 1988, for examples in developed countries and also Belcher *et al.*, 1976, for an experiment in a developing country). In principle, these experiments simply compared self-reported  $H$  with a set of clinical measures  $H^*$ .

Most often the researcher does not have experimental data but rather has data from health interview surveys. In these surveys there may be a variety of questions on health that are either self-reported or, in the case of children, reported by the mother. Health interview surveys typically report a series of indicators of health status,  $\theta$ :

$$\theta = \theta^* + v \quad [1]$$

where  $\theta^*$  is the true underlying status and  $v$  reflects contamination due to reporting error. Notice that each of the three elements of [1] are vectors, that is, there are several indicators of health, each possibly corresponding to a different aspect of health and each with a potentially different response error. There is no way to link  $H$  and  $\theta$ , nor to compare one dimension of  $\theta$  with another.

What we do instead is exploit the richness of a large scale household survey which contains several different observations of health status,  $\theta$ , of the same child. Some are observed by interviewers, whereas others, such as diagnoses of ill-health, are reported by the mother of the child, thus the response errors are likely to differ across the different types of health information.

Our aim is to check for consistency across these indicators of health by examining how mother's education relates to reported child health. To do this we must assume some structure. We maintain that maternal education,  $E$ , has a positive impact on all indicators of child health status  $\theta^*$ . We do not, however, know how maternal education affects the errors,  $v$ , and thus reported health although several hypotheses are discussed below. In any case, differentiating [1] with respect to maternal education, its impact on each measure of child health is:

$$\theta_E = \theta_E^* + v_E \quad [2]$$

where the derivative is denoted by the subscript  $E$ . Rather than compare levels of child health,  $\theta$ , we will examine its relationship with mother's education,  $\theta_E$ , and compare this correlation across a series of health indicators. By imposing the structure in [2], and the assumption that  $\theta_E^*$  is positive, we have set up a quasi-experiment using the health interview survey data alone which permits us to better understand what they measure.

It is critical that our assumption about the positive correlation between a child's true health status and maternal education is correct: we present evidence in support of this below. If  $\theta_E^*$  is positive and  $v_E$  is non-negative, the observed correlation between maternal education and child health,  $\theta_E$ , will also be positive. In this case, we will not be able to separately identify the role of reporting error. If well-educated women report their children's health status with greater error than less educated women then  $v_E$  will be positive. If however, better educated women accurately report their children's health and women with less education tend to under-report health problems, then  $v_E$  will be negative. Clearly, if the observed correlation between education and reported health status,  $\theta_E$ , is negative, then  $v_E$  must not only be negative but it must also outweigh the positive effect of mothers education on child health. A negative measured effect would demonstrate that the response error is not only large but is so large that it leads

to an incorrect conclusion about the effect of mother's education on child health. In general, for our quasi-experiment to have power, we need  $v_E$  to be negative and to be at least as large in absolute size as  $\theta_E^*$ . We discuss below the possible direction of  $v_E$ : whether it is negative and large is, of course, an empirical issue.

### 3. DATA

We will compare the impact of maternal education on a series of alternative measures of child health using the *Encuesta Nacional de Nutricion y Salud* (ENNSA), a large scale, national nutrition and health survey conducted in Peru in 1984 by the Ministry of Health. The survey was designed to gather detailed information on the health status and utilization of medical care of a random sample of the Peruvian population. From April through November, 1984, some 18,000 households (nearly 100,000 individuals) were enumerated. Detailed information on morbidity was recorded for each family member. Individuals reported whether they had been ill in the previous fortnight and, if so, named up to two symptoms or diagnoses. Similar, but slightly different, information on child morbidity was also gathered in a separate module which asked detailed questions about the incidence of a series of specific illnesses over the previous fortnight. Thus we have two reports on child morbidity that refer to the same time frame but use different survey methodologies. All respondents were asked whether or not they had sought medical care, independently of whether they reported being sick. Women aged 14 to 49 years provided an abbreviated birth history and were asked specific questions about the health of their children. Anthropometric measures, height, weight, and arm-circumference, were recorded for children six years old and younger.

We restrict our sample to that of children under six years of age in order to have data on a variety of different measures of health for each child. We

further restrict the sample to those children whose mothers report the illness information in both morbidity modules and thereby avoid potential additional contamination associated with other respondent characteristics.<sup>4</sup> After these restrictions, there are 9,666 children in our sample.

#### 4. MEASURES OF CHILD HEALTH

The key to our quasi-experiment is that we have health interview data with several dimensions of  $\theta$  and that some of these are measured without maternal response error. We discuss these measures below.

##### *Anthropometrics*

*Child anthropometrics* have been proposed as objective and easily measured indicators of the health and nutritional status of pre-adolescent children. In the ENNSA data, child anthropometric measurements are made by trained anthropometrists with well-specified instructions and calibrated instruments. Thus measurement errors,  $v$ , are unlikely to be related to the characteristics of the mother and so  $v_E = 0$ . There are a large number of studies in the bio-medical and social science literatures which have demonstrated a positive correlation between parental, and especially maternal, education and each of these anthropometric measures; there is little doubt in the literature that  $\theta_E^*$ , and thus  $\theta_E$ , are positive. (Martorell and Ho, 1984; Behrman, 1990). We examine three measures. Height (conditional on age and sex) is said to be an indicator of long run nutritional status and health. Arm circumference (conditional on age and sex) and weight (conditional on height) are said to be shorter run measures (Martorell, Habicht and Klein, 1982).

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<sup>4</sup>See Belcher *et al.* (1976) who find maternal respondents are substantially more accurate than other household members. In the ENNSA data, mothers report illness information for about 80% of the children. The substance of our results does not change when all young children in the survey are included in the sample.

### *Survival rates*

Another commonly used measure of child health status, for a given mother, is the ratio of the number of children currently alive to the number ever born to a woman, *the child survival rate*. This is reported by the mother. Whereas the number of living children is likely to be reported accurately, there is some evidence that women tend to forget children who died, especially those who lived for only a short time or who died long ago. Reported survival rates tend, therefore, to be overestimates of the true rate and these errors tend to be larger for less well educated and older mothers (Trussell and Preston, 1982). Thus for maternal reports of child survival,  $v_E$  is likely to be negative. One of the few facts that has been repeatedly demonstrated in this literature, nevertheless, is the positive correlation between maternal education and child survival rates (see Cochrane, Leslie and O'Hara, 1982). Thus despite the reporting errors, studies still estimate a positive effect of mother's education on child health. This suggests that the reporting error and its derivative with respect to education, are both relatively small.

### *Morbidities*

Both child survival rates and anthropometries indicate little, if anything, about the incidence of particular diseases. Disease specific information is, however, important for the evaluation of specific treatments and policies such as immunization campaigns. Researchers and policy-makers have turned, therefore, to child morbidities.

Maternal reports of *child morbidities*, however, are unlikely to be measured without error: neither  $v$  nor  $v_E$  will, in general, be zero. And in some cases, both may be quite large. This can occur for several reasons, some of which are discussed below. Also, the response error could vary systematically by a variety of characteristics of the respondent or the type of information elicited. We focus

below largely on errors systematically associated with maternal education.

First, even if different women observe the same health problem in their children, their reports of it may vary with the educational attainment of the woman. This may occur because their perception of good health differs, for example, better educated women may have higher standards for the health of their children. In addition, a woman's ability to prevent, treat, or otherwise ameliorate ill-health is also likely to differ with education; a woman who cannot effectively respond to her child's sickness may be less likely to acknowledge and hence report the problem.

Better educated mothers are likely to be more knowledgeable about diseases. This greater knowledge could come from their greater ability to access information generally (Thomas, Strauss and Henriques, 1991) and also because they are more likely to seek medical attention for their children. Furthermore, better educated mothers may be more vigilant regarding their children's health.

For all of these reasons, for exactly the same level of child health, a better educated mother may be more likely to report that the child is ill than is a less educated mother. We suggest that the better educated mother will report a higher level of morbidities, *ceteris paribus*. This may be more accurate reporting or possibly over-reporting by the better educated mother.

The impact of better knowledge may vary not only by the mother's education but also by the difficulty of diagnosis and the subtlety of symptoms. That is, education may play a greater role the when a disease is more difficult to observe or to identify or when the propensity to seek medical care varies substantially across disease by mother's education.

There are also biases associated with the recall period (see Freij and Wall (1977) for some evidence comparing daily recall with fortnightly recall). If the recall period is long, then respondents are likely to forget events from the

beginning of the period, or respondents may tire and abbreviate their responses; it is unclear whether better educated mothers are more or less likely to make these sorts of errors. Interview surveys also suffer from problems of "telescoping" of events which occurred prior to the recall period. It is likely that telescoping will be more frequent for more important events. On the one hand, if children of poorly educated mothers are prone to more severe bouts of ill health, then their reports may suffer from more telescoping. On the other hand, better educated mothers may be more likely to recall events out of the specified time frame due to their greater vigilance.

In addition, the definition of ill-health may vary with the characteristics of the local community. On the one hand, in an area where a particular disease is widespread, a woman may be inclined to accept it as normal and would thus tend to under-report the problem. Alternatively, it may be because the disease is widespread that she knows about the problem and so recognizes that it afflicts her own children. The availability of clinics, health information, or immunization campaigns in a local area may also affect the extent to which mothers recognize health problems in their children. Mothers with different educational levels are likely to live in different neighborhoods, and thus could face different local conditions and could also respond differently.

Given these types of response error, the relationship between maternal education and the direction of the potential bias in maternal reported child morbidities is *a priori* ambiguous. However, there is clearly scope for error and there is no reason to expect  $v_E$  to be zero. Almost all researchers have, however, either ignored the problem of maternal reporting error or have implicitly assumed that the error is uncorrelated with child and parental characteristics. If this assumption is wrong then inference based on studies of maternal-reported morbidity data may have been severely misleading.

### *Use of medical care*

Finally, we will examine the *use of medical care* which has been proposed as a good indicator of severe problems of ill health (Hill and Mamdani, 1989). While there is some intuitive appeal to the argument that the severely ill will seek medical treatment, this indicator of ill health suffers from two important problems. First, all the response errors discussed above apply to the reported use of medical care. Furthermore, and perhaps more importantly, use of medical care does not only reflect an individual's health status, it also reflects a behavioral decision which depends on preferences and resource constraints. All of these factors might be affected by the same characteristics, including maternal education. Thus it is very difficult to see how one can disentangle the role of health status from the behavioral response to perceived ill-health.

## 5. RESULTS

Our results based on the ENNSA data are summarized in Table 1. For each of the indicators of child health status,  $\theta$ , the first column reports the mean level of the outcome. Columns 2 to 5 report means stratifying by levels of maternal education. The derivative,  $\theta_E$ , is reported in column 6; these are the coefficients on maternal education in linear regressions using the health indicators as dependent variables. Since we do not want to restrict the impact of maternal education to be linear, the last three columns report the effect of maternal education, its square and a  $\chi^2$  test statistic for the joint significance of both coefficients.<sup>5</sup> In all the regressions, we attempt to account for unobserved

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<sup>5</sup>For very large samples like these, it is probably prudent to adopt a Bayesian approach to testing and reduce the size of test in order to better balance Type I and Type II errors. Schwarz (1978) proposed a critical value of the number of restrictions multiplied by the logarithm of the number of observations. For the child sample results in Table 1, the critical  $\chi^2$  is 18.4.

heterogeneity in the local environment by also including controls for: the geographic region of residence (called Departments, of which there are 22 in the survey), whether the household lives in a rural area, and the month of enumeration. These are intended to control for variation in the disease environment, the availability of information and availability of health facilities all of which have been demonstrated to affect child health (see Cebu Team, 1988; Thomas Strauss and Henriques, 1990; Thomas and Strauss, 1991; Thomas, Strauss and Lavy, 1991).<sup>6</sup> Those regressions based on child level observations (i.e. anthropometries, morbidities, and medical use) also include as independent variables the child's age and gender. Survival rates are measured for each mother and those regressions include (polynomials of) her age in addition to the other included variables.

#### *Child survival*

Each woman aged 12 to 49 years old was asked how many live children she had ever borne and how many children were still living at the survey date. Taking the ratio of the latter to the former, we calculated child survival rates for these 13,622 women.<sup>7</sup> The relation between child survival rates and maternal education is shown graphically in Figure 1a for all mothers and also for mothers 40-49 years old. Restricting our sample to the 3,492 women aged 40-49 helps to adjust, albeit crudely, for mortality exposure: this sample comprises those women who are likely to have completed their fertility well before the survey so that none of their children is in the high risk age groups of infancy or pre-school years. Table 1 indicates the same relationship. The first five columns of Table 1 report the mean proportion of children who survived to the survey date for all mothers by

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<sup>6</sup>Replacing the Department fixed effects estimates with controls for region of residence (of which there are four) has no impact on the substance or significance of any of the results reported in Table 1.

<sup>7</sup>Note this sample of women differs from the child level sample used in the rest of this study.

educational attainment. Among those mothers who have no education, the proportion of children who survive to the survey date is almost 81%; among women with at least 12 years of education, that proportion rises to almost 97%. In the 40-49 year old subsample, the difference in the survival rates is larger; the rates are 77% for women with no education and 94% for those with twelve years or more.

In a regression of the ratio of surviving children to the number ever born for the full sample of women, estimates of the effect of maternal education,  $\theta_E$ , are reported in column 6 of Table 1. The coefficient on years of mother's education is 0.88 (with a t-statistic of 25.3). Including a quadratic in maternal education shows that child survival increases at a decreasing rate (Table 1, columns 7-9). Restricting the sample to the women aged 40-49, the linear education effect is 1.03 (with a t of 14.0). Again, the quadratic term is negative. Thus the Peruvian data conform to the large literature that documents a positive relationship between child survival and maternal education.

We turn next to the sample of children and begin with objective measures of child health. We then examine the relation between maternal education and maternal reports of child morbidities.

#### *Child anthropometry*

The height, weight and arm-circumference of each child under six was measured by trained anthropometrists who were given detailed and specific instructions conforming to the World Health Organization's procedures.<sup>8</sup> These anthropometric

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<sup>8</sup>The anthropometrists were given special equipment and were told to work in teams and to do repeated measurements to enhance accuracy. For example, children under a year old were weighed hanging in a Salter scale; older children stood on the scale. Most clothes were removed from the children prior to weighing. In those cases when this was not possible (e.g. during cold weather), the clothing worn was recorded and the child's weight was subsequently adjusted using standard tables of clothing weight. Recumbent length of children less than two years old was taken while older children's heights were measured standing up. Specifications were given on how to measure consistently the mid-point of the arm using a fiberglass tape to get comparable arm locations.

measures have been standardized using United States standards.<sup>9</sup>

On average, the height and arm circumference, given age, of a Peruvian child is about 94% that of the median child in a well nourished United States population. Conditional on height, however, the average Peruvian child in the survey is heavier with a weight, of about 104% of the median US child.

All three anthropometric measures rise with the education of the mother as can be seen graphically in Figure 1b. Standardized height and arm circumference track each other very closely<sup>10</sup> (with the possible exception of the top of the education distribution where height appears to stabilize). The average height and arm circumference of a child whose mother has no education is about 91% of the US median; these rise to more than 97% for children whose mothers have at least twelve years of education (Table 1). Weight for height rises less rapidly from 103% at the bottom to 106% at the top of the maternal education distribution.

Estimates of the effects of maternal education on child anthropometries are reported in column 6 of Table 1 for z-scores of height for age, arm circumference and weight for height.<sup>11</sup> Since these indicators of child health status are measured independently of the mother,  $v_E$  is zero, and so these are estimates of both  $\theta_E$  and  $\theta_E^*$ . In all three cases, the estimated maternal education effects are large, positive and significant; children of better educated mothers are clearly healthier

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<sup>9</sup>Height is standardized given age and sex, weight is standardized given height using NCHS standards (NCHS, 1976); arm circumference, conditional on age and sex, is standardized with the 1976-1980 NCHS standards (NCHS, 1987). There is some debate about the usefulness of standardizing arm circumference for height (see Martorell, Habicht and Klein, 1982; Chen, Chowdhury and Huffman, 1980, for a discussion).

<sup>10</sup>This contrasts with the results presented by Martorell, Habicht and Klein (1982) who find arm circumference and weight for height are highly correlated.

<sup>11</sup> The use of z-scores, rather than percentage of medians permits standard deviations to vary with child age and sex. Inference based on the regression results is identical for both standardization.

when measured in terms of anthropometric outcomes. Only in the height for age case is there evidence for non-linearity in the regression function; this is due to the flattening of the function at the top of the maternal education distribution.

Taking the child survival and anthropometry results together, there can be little doubt that maternal education and these indicators of overall child health are positively correlated. This we conclude to be a genuine relationship because the anthropometries are measured objectively and, for survival, we presume the effect of education on reporting error,  $v_E$ , is small in comparison with the impact of education on survival,  $\theta_E^*$ . We turn next to child morbidities as reported by the mother.

### *Child morbidity*

General morbidity questions were completed for every member of the household. A respondent reported whether each child in the household had been ill during the previous fortnight and, if so, the respondent was asked to specify the nature of the problem corresponding to a battery of diseases and symptoms. The responses were recorded either as self-reported diagnoses or as symptoms. Symptoms were later categorized into diseases by physicians although the dichotomy between symptoms and diagnoses was maintained in the data set. Up to two problems could be reported for each individual. For an individual these problems may overlap and, in many of the children for whom two problems are reported, one is a symptom associated with an illness and the second is a diagnosis of that illness.

Digestive or diarrhea problems, together with respiratory problems are by far the most common ailments among small children in developing countries, and this is also true in the ENNSA data. Over half the children in the sample were reported to have had some kind of illness in the preceding two weeks.<sup>12</sup> Almost 40% of

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<sup>12</sup>The incidence of illness tends to rise with age, until about the end of the first year of life (presumably reflecting the effects of weaning of the child during the first year of life and the eroding of the child's immunity passed from

children had respiratory problems and 23% of children had digestive problems (12% had other problems of which about 20% were parasites). We focus, therefore, on respiratory and digestive problems.

A separate part of the survey, morbidity module 2, focused on children aged six or less and asked very specific questions about the incidence and severity of diarrhea and about breathing problems as well. Both modules 1 and 2 refer to the same time period, the fortnight prior to the survey.

The fact that child morbidity data are reported in these two different modules offers an opportunity to examine the internal consistency of maternal reports of illness based on general health questions as compared to very specific questions. Comparing reports of digestive problems (from Module 1) with the incidence of diarrhea (from Module 2),<sup>13</sup> we find that ninety-nine percent of those children under six with reported diarrhea are also reported to have digestive problems and 90% of those with digestive problems also have diarrhea. Thus digestive problems and diarrhea are almost interchangeable.

For respiratory problems, however, the correspondence is not as good. Only 13% of those under six years of age with breathing problems (as reported in Module 2) are also reported as having respiratory problems and 86% of those with respiratory problems are not reported to have breathing problems.<sup>14</sup> In part, this

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the mother). After these young ages, the incidence declines with age. This age profile is consistent with many other surveys (Hill and Mamdani, 1989) and provides another check on the quality of the ENNSA data.

<sup>13</sup>Module 1 includes in the category of digestive problems the *symptoms* of: vomiting, diarrhea, stomach ache, colitis, abdominal pains, pain in the appendix, pain in the liver, and vesicula pain and includes in the *diagnostic* category: gastroenteritis, colitis, enterocolitis, gastritis, appendicitis, and hepatitis. Module 2 asks if the child has had diarrhea in the last two weeks and if so for how many days as well as the average number of evacuations per day.

<sup>14</sup> Respiratory problems in Module 1 record the following *symptoms*: nasal secretions, bronchial problems, cough, sore throat, hoarseness, difficulty breathing, and tonsil pain; included for *diagnoses* are: bronchitis, tonsillitis,

reflects the fact that respiratory problems and breathing problems are not the same thing. It suggests, however, that respiratory problems are quite hard to categorize although, recall, they are the most commonly reported ailment affecting small children in Peru. Furthermore, respiratory problems are more likely to be reported as diagnoses, rather than symptoms; whereas digestive problems are more likely to be reported as symptoms. This suggests that respiratory problems are also more difficult to detect than are digestive problems and, in fact, the same relationship is reported in an experiment conducted in Ghana (Belcher *et al.*, 1976).<sup>15</sup>

In terms of our model, we can say nothing with confidence about the magnitude of reporting error,  $v$ , for digestive and respiratory problems. It is likely, however, that the derivative with respect to education will be greater (in absolute size) the more difficult it is to detect the problem. We expect, therefore, that  $v_E$  will be (absolutely) larger for respiratory problems. We turn next to the relationship between reported child morbidity and maternal education.

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a cold, influenza, sinusitis, asthma, pneumonia, broncho pneumonia, and pleurisy. Module 2 asks if children have had breathing problems.

<sup>15</sup> This study compared respondent evaluations of morbidities with physician reports of the health of the same people one to four days later. In comparing the percentages of the population that were found to have specific diseases and conditions by interview to physician examination, they found that both diarrhea and respiratory problems were under-reported (using the physician reports as the standard), but the under-reporting was far greater for respiratory than digestive problems (27% versus 1%). They found generally better agreement in the younger (0-14) age group (where mothers were the respondents) than in the overall population. When case by case comparisons were done, diarrhea had a much better agreement (the same was not done for respiratory problems). Evidence on other diseases and conditions gives credence to the view that more readily observed (and severe) conditions were reported more accurately; blindness and leprosy had the highest correspondence between the self-reports and physician examinations.

The probability that a child was reported as being sick with any disease in the fortnight preceding the survey is graphed in Figure 1c.<sup>16</sup> The probability rises from about 0.5 among women with no education to nearly 0.7 for children of mothers with 10 years of education (who are around the third quartile of the distribution). The probability then declines again to about 0.5. The same relationship is indicated in the regression results;<sup>17</sup> the quadratic specification mimics the curvature in the figure although the maternal education effects are not jointly significant. This is in sharp contrast to the monotonically positive relation between child health and maternal education using survival and anthropometries.

One might conclude on the basis of these results that while children of better educated mothers are in better general health (as indicated by anthropometries); they are just as likely to be ill at any time as any other child. It turns out, however, that looking a little deeper, and distinguishing illnesses, tells a different story.

The proportion of children with digestive problems is approximately constant for mothers with less than ten years of education and then declines (Figure 1d). This relationship is mirrored in columns 2 to 5 of Table 1. In regressions of digestive problems, there is a significant negative correlation between maternal education and the probability that a child is reported as having digestive problems (with a t-statistic of 5.8). The quadratic specification also reveals a significantly negative squared term. Almost all digestive problems are reported by symptoms and so the probability that a child is reported as having symptoms of

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<sup>16</sup> In the following we use data from Module 1 with the exception of the number of evacuations per day which comes from Module 2.

<sup>17</sup> In this section, all the dependent variables (except the number of evacuations) are dichotomous. In each of these cases, we assume that the regression error is distributed as a gaussian and estimate the resultant probit by maximum likelihood. The number of evacuations is treated as a tobit which takes account of the fact that zeroes are reported by all mothers who do not report diarrhea.

digestive problems tracks the overall incidence function very closely. The coefficient on mother's education in the regression of digestive symptoms is negative and significant.<sup>18</sup> In contrast, the probability that a mother reports digestive problems as a diagnosis is constant across the education distribution.

Mothers were also asked about the frequency of evacuations for those children with diarrhea (from Module 2). Conditional on reporting diarrhea, the number of evacuations per day declines with maternal education. We can not tell whether this means that diarrheal severity is greater for children of poorly educated mothers or whether poorly educated mothers are less likely to report mild diarrhea. But we can conclude that mother's education is negatively correlated with the reporting of digestive problems and, in particular, symptoms of digestive problems.

The reverse is true for respiratory problems: they are more commonly reported by *better* educated mothers. This is displayed in Figure 1d. Table 1, columns 2 to 5, show that on average, mothers with no education report 37% of their children as having respiratory problems; this proportion rises to 42% for mothers with at least 12 years of education. The positive correlation between reported respiratory problems and maternal education is also reflected in the regression coefficients (which are significant). Furthermore, better educated mothers report more *diagnoses* of respiratory problems whereas reports of symptoms are independent of maternal education. This is seen in both the percentages reporting problems as well as in the estimated coefficients. This is exactly the opposite of the findings for digestive problems.

It is possible that children of better educated mothers are less healthy as measured by (diagnosed) respiratory problems. This seems unlikely given the evidence above regarding the positive correlation between maternal education and

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<sup>18</sup>Exactly the same patterns are revealed when the dependent variable is reported diarrhea from morbidity module 2.

more general measures of child health as well as the probability of reported as being free from digestive problems.

An alternative explanation would be that better educated mothers are more aware of respiratory problems and are better able to categorize them as such. This is consistent with the increased reporting of diagnosis of respiratory problems as education increases and is also consistent with the lower internal consistency across respiratory and breathing problems. Whereas diarrheal symptoms are easy to observe, respiratory problems are probably harder to recognize, the symptoms less obvious and, therefore, less readily diagnosed. Results from an experimental study in Ghana support these conclusions (Belcher *et al.*, 1976).

#### *Use of medical care*

For each respondent in the Peruvian survey, a respondent was asked whether the child had received any medical treatment during the previous fortnight, independent of the answers to the morbidity questions. The probability of consulting a health care worker rises with maternal education (Table 1 columns 2 to 5); whereas only 8% of children whose mothers have no education seek medical treatment, this proportion rises more than three fold (to 27%) for children whose mothers have at least 12 years of education. In the regression analysis, an additional year of education is associated with an added 5% probability of seeking medical care (with a t-statistic of 12.0). This is consistent with the positive correlation between maternal education and diagnosis of respiratory problems, that is more educated mothers may be more likely to seek medical care and thus obtain a diagnosis.

Given the early findings of the positive relationship between the anthropometric measures and mother's education, the positive correlation between use of medical care and mother's education should not be interpreted to mean that children of better educated mothers are in poorer health. Rather the positive

coefficient on mother's education is more of a behavioral response, more educated mothers are more likely to seek medical care. The choice to use medical care reflects behavioral decisions, resource availability and healthiness. Misleading conclusions can be drawn if use of medical care is interpreted as an indicator of severity of illness (as proposed by many researchers; see Hill and Mamdani, 1989; Kroeger, 1985). For example, an interpretation of use of medical care as an indicator of poor health would then suggest that public policy should devote more resources to improving the health of children with better educated mothers, which is not necessarily a prudent choice.

Furthermore, many studies of the demand for medical care have conditioned their sample on those who have used some health services. Our results suggest that inferences based on analyses which fail to treat the decision to use some health care as endogenous may be seriously misleading.

## 6. CONCLUSION

We take advantage of the opportunity to compare several different measures of child health in a single household survey. We explore the role of response error in maternal reports of child health using the relationship between maternal education and child health as a guide to inferences that would be drawn using alternative child health indicators.

Consistent with many other studies, we find that child survival and child anthropometry are positively and significantly associated with maternal education. This conforms with many previous findings in both developed and developing nations and suggests that children of better educated mothers tend to be healthier. This we take as indicative of the true underlying relationship between child health and mother's education. In contrast, the probability a child was sick with any disease in the preceding two weeks, as reported by the mother, is independent of

her education. Part of these differences might be explained by the fact that the two sets of health measures capture different aspects of health. We suggest, however, that the conclusions are also affected by response errors and that these errors vary not only with maternal education but also with the nature of the disease such as the difficulty of detection. We find that the probability that a child is reported as having digestive problems declines with the mother's education; in sharp contrast, the probability that a respiratory problem is reported rises with education. This positive association between respiratory problems and mother education seems unlikely to represent the true underlying relationship given the positive association of good health of children and mother's education found using the other indicators. We believe, rather, that mother reported morbidities are contaminated by response errors and these errors are particularly acute for respiratory problems.

It has been suggested that the severity of ill-health may be measured by use of medical care (Hill and Mamdani, 1990). We argue on *a priori* grounds that use of medical care is a poor proxy for health status; we also find that use rises with the mother's education, again in contrast with the more objective measures of child health. Our own view is that it is a rather poor indicator of child ill health.

In summary, in this study we have drawn attention to potential biases introduced by using maternal reported measures of morbidity. Nonetheless self-reports are appealing based on their cost-effectiveness and applicability to large scale population based samples. In view of this advantage, and also the resources currently being devoted to collecting health information in surveys, there is a need for studies of the accuracy of self or maternal reported morbidities. Cross-validation studies, focussing on the heterogeneity across morbidities, distinguishing between symptoms and diagnoses and comparing different methods of

extracting information in health interview surveys are likely to yield substantial returns to policy makers, researchers and future data collection efforts.

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Table 1

**Child health**  
**Survival, anthropometry and mother reported morbidities**

|                                                        | Means |                                     |       |       |       | Regression coefficients |                 |                            |                |
|--------------------------------------------------------|-------|-------------------------------------|-------|-------|-------|-------------------------|-----------------|----------------------------|----------------|
|                                                        | All   | Years of mother's education<br>None | 1-5   | 6-11  | ≥12   | Mother's education      | Mother's educ   | Mother's educ <sup>2</sup> | χ <sup>2</sup> |
|                                                        | (1)   | (2)                                 | (3)   | (4)   | (5)   | (6)                     | (7)             | (8)                        | (9)            |
| <b>Child survival<sup>1</sup></b>                      |       |                                     |       |       |       |                         |                 |                            |                |
| All women 14-49                                        | 89.2  | 80.5                                | 88.3  | 93.5  | 96.5  | 0.87<br>[24.7]          | 1.60<br>[15.7]  | -0.05<br>[7.7]             | 330.6          |
| Women aged 40-49                                       | 84.5  | 77.4                                | 86.2  | 91.3  | 94.0  | 1.01<br>[13.6]          | 2.25<br>[11.0]  | -0.09<br>[6.5]             | 114.8          |
| <b>Child anthropometry<sup>2</sup></b>                 |       |                                     |       |       |       |                         |                 |                            |                |
| Height for age                                         | 94.1  | 91.2                                | 93.5  | 95.5  | 97.5  | 8.32<br>[26.3]          | 10.17<br>[11.5] | -0.13<br>[2.2]             | 348.0          |
| Arm circumference                                      | 93.8  | 90.6                                | 93.2  | 95.3  | 97.2  | 3.82<br>[14.2]          | 4.95<br>[6.6]   | -0.08<br>[1.6]             | 102.6          |
| Weight for height                                      | 104.3 | 103.2                               | 104.0 | 104.6 | 105.9 | 0.93<br>[3.8]           | 0.68<br>[1.0]   | 0.02<br>[0.4]              | 7.5            |
| <b>Child morbidity<sup>3</sup></b>                     |       |                                     |       |       |       |                         |                 |                            |                |
| <b>All problems</b>                                    |       |                                     |       |       |       |                         |                 |                            |                |
| (1) if any problem reported                            | 58.2  | 56.4                                | 57.6  | 64.5  | 57.1  | 0.36<br>[1.2]           | 1.96<br>[2.2]   | -0.11<br>[1.9]             | 5.3            |
| (1) if more than one morbidity                         | 17.2  | 18.0                                | 17.6  | 19.7  | 14.0  | -1.37<br>[3.8]          | 0.26<br>[1.2]   | -0.19<br>[2.6]             | 21.8           |
| <b>Digestive problems</b>                              |       |                                     |       |       |       |                         |                 |                            |                |
| (1) if problem reported                                | 22.8  | 25.4                                | 23.5  | 25.1  | 17.4  | -1.93<br>[5.8]          | -0.62<br>[0.6]  | -0.18<br>[2.7]             | 41.3           |
| -- as symptoms                                         | 22.8  | 25.4                                | 23.4  | 25.1  | 17.4  | -1.95<br>[5.8]          | -0.60<br>[0.6]  | -0.19<br>[2.7]             | 42.0           |
| -- as diagnosis                                        | 2.4   | 2.3                                 | 2.3   | 2.6   | 2.6   | -0.16<br>[0.3]          | 0.60<br>[0.3]   | 0.05<br>[0.4]              | 0.2            |
| # evacuations per day<br>(conditional or rpt diarrhea) | 4.6   | 5.0                                 | 4.5   | 4.6   | 4.4   | -1.44<br>[1.2]          | -2.67<br>[2.4]  | 0.47<br>[2.1]              | 2.9            |
| <b>Respiratory problems</b>                            |       |                                     |       |       |       |                         |                 |                            |                |
| (1) if problem reported                                | 39.8  | 36.9                                | 38.3  | 45.3  | 42.2  | 1.20<br>[5.8]           | 1.14<br>[1.3]   | 0.00<br>[0.1]              | 16.6           |
| -- as symptoms                                         | 33.2  | 33.4                                | 32.5  | 37.8  | 31.3  | -0.01<br>[0.0]          | 0.55<br>[0.6]   | -0.04<br>[0.7]             | 0.4            |
| -- as diagnosis                                        | 9.1   | 5.6                                 | 8.1   | 10.2  | 13.9  | 2.72<br>[6.7]           | 2.94<br>[2.3]   | -0.01<br>[0.2]             | 43.9           |
| <b>Other problems</b>                                  |       |                                     |       |       |       |                         |                 |                            |                |
| (1) if other problems reported                         | 12.4  | 11.7                                | 13.0  | 13.4  | 11.2  | -0.34<br>[0.9]          | 2.41<br>[2.1]   | -0.20<br>[2.5]             | 7.3            |
| <b>Medical care<sup>4</sup></b>                        |       |                                     |       |       |       |                         |                 |                            |                |
| (1) if medical care sought                             | 16.5  | 8.2                                 | 13.2  | 23.2  | 27.0  | 5.36<br>[15.5]          | 7.67<br>[7.1]   | -0.15<br>[2.3]             | 245.8          |
| # children /% of sample                                | 9666  | 20.6                                | 43.9  | 14.6  | 21.0  |                         |                 |                            |                |

**Notes**

All regressions include controls for the Department and sector of residence and the month of enumeration. The child survival regressions include mother's age. The child health regressions include child's age and gender.

<sup>1</sup> There are 13,622 women in the total sample, 3,492 of them are aged 40-49.

<sup>2</sup> Means of anthropometric measures are %ages of US medians; z scores are the dependent variables in regressions.

<sup>3</sup> All but one of the morbidity regressions are probits; likelihood ratio tests are reported in the final column.

The number of evacuations in the last day is not dichotomous; OLS estimates are reported for the 1874 children whose mothers report the child has diarrhea. All regressions include Department fixed effects, controls for sector of residence, month of enumeration. Child survival regressions include mother's age. Child health regressions include child's age and gender.

<sup>4</sup> Treated as a probit.

The average mother has 5.42 years of education.

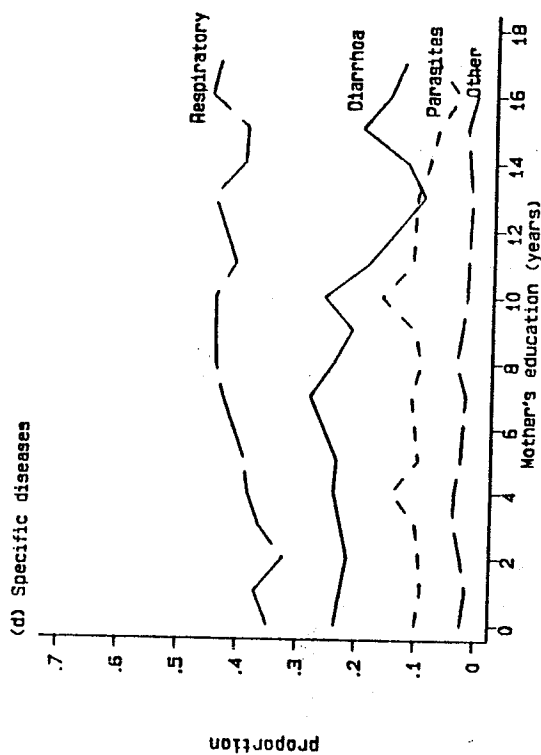
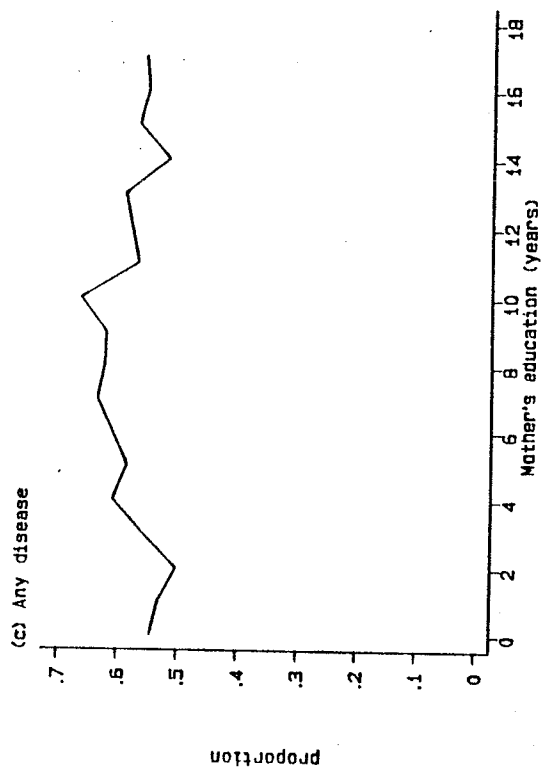
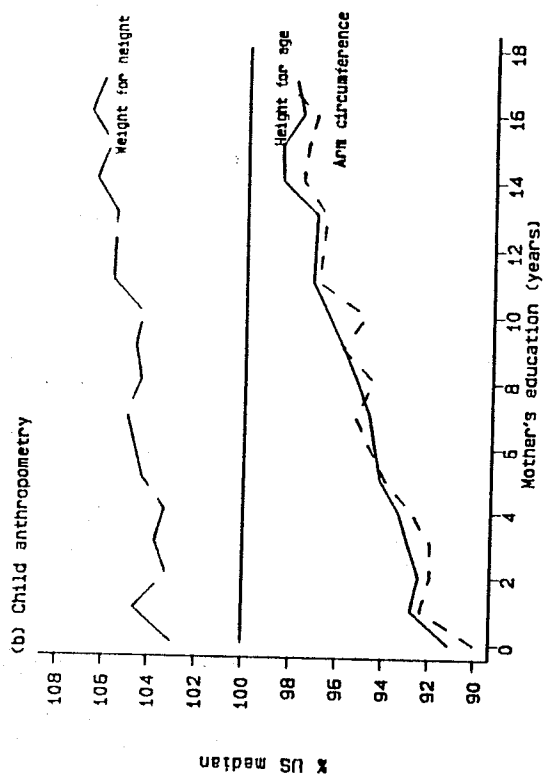
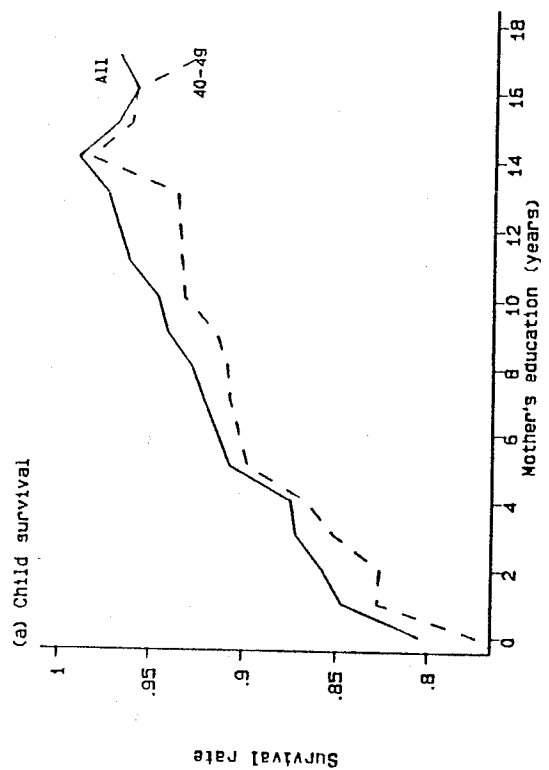


Figure 1 : Child health and maternal education