

LITERACY AND HEALTH STATUS IN DEVELOPING COUNTRIES

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INTRODUCTION

In *The Health of Nations*, Sagan (69) described studying historical data collected from almost 150 nations spanning the gamut from pre-modern to highly complex post modern societies, searching for the characteristics that would best predict life expectancy. After applying statistical tests to determine which factor(s) appeared to be causal, he found that "by far the most consistently powerful predictor of life expectancy was the prevalence of literacy."

The association of literacy and health has been reported repeatedly in analyses of the post World War II decline of mortality in developing countries and of mortality differentials within their populations. The strength and significance of this relationship appear similar across cultural regions and time. But uncertainties remain. What is the direction of causation? Are health status and literacy jointly determined by other societal forces? What are the mechanisms through which literacy influences health?

The recognition of literacy as a major determinant of health status in developing countries emerged in the literature in the late 1970s. The rapid mortality decline after World War II in developing countries was at first thought to parallel the experience of Europe and America, where economic development had been seen as leading to a rise in life expectancy (78).

Gradually the theory of economic growth as a general explanation of levels of life expectancy lost credence as it was realized that the experience of the West did not always apply to the developing countries (18). High levels of health in some of the relatively poor areas, such as Sri Lanka and the Indian state of Kerala, and low life expectancy in some wealthier countries, such as Brazil and Nigeria, demonstrated that the relationship between income and health was not general (27). By the late 1960s, declines in mortality were attributed largely to technological advances and the growth and expansion of public health and medical care services. Health interventions were viewed as improving health status independent of economic level (4, 46a, 74). Preston found that a country's level of income accounted for only 10 to 25% of the growth in life expectancy for the world as a whole between the 1930s and the 1960s. He hypothesized that the unexplained portion was the result of health and medical technologies (61).

Despite some remarkable successes, the role of public health and medical care was also challenged. The inability of public health programs to explain much of the decrease in mortality was mainly due to their limited coverage of the population (25, 66a, 82, 88). Sanitation and water supply programs, earlier hailed as panaceas for health improvement, failed to reduce disease incidence in some countries (10, 23, 70a). Although food policies were important, they too did not seem to explain the rapid gains in life expectancy or the variation in levels of life expectancy in developing countries (36).

The association of mortality with socioeconomic class has been documented since 1851 in Britain and then in Europe and North America by using occupational group, income, rental values, and education as proxies for class (1, 48). More recent studies in the US found value in analyzing the effects of components of socioeconomic factors and documented the strong, significant, and independent association of health with education (5, 46, 49, 33, 19). Summarizing the results of this work Grossman noted (34):

A number of studies in the United States indicate that among socioeconomic variables years of schooling completed is probably the most important correlate of good health in adult populations. This finding emerges whether health levels are measured by mortality rates, morbidity rates, or self-evaluation of health status, and whether the units of observation are individuals or groups. The relationship is usually statistically significant at levels of confidence of .05 or better in both simple and partial correlations. Moreover, a significant and large schooling effect is observed with income held constant.

A number of studies of developing countries had shown a relationship between literacy and mortality, but, as Caldwell (11) pointed out, there was "an almost universal tendency to take the level of maternal education as a proxy for general economic development or as a reflection of socio-economic status generated primarily by other conditions, such as husband's income."

Beginning in 1979, literacy came to be recognized as a critical factor

influencing infant and child mortality by conveying knowledge and altering behavior and habits. Definitions of literacy vary with purpose and culture (30, 42, 58). When countries were the units of analysis, correlations of health status in developing countries used reports from governments. As collected by international agencies, the adult literacy rate is defined as the percentage of persons aged 15 and over who can read and write. How this number is established is not uniform; some minimum number of years of schooling is a typical criterion. Studies of individuals usually presented data in terms of years of education completed, less often the ability to read and write.

LITERACY AS A DETERMINANT OF MORTALITY

The Bellagio Population Conference held in April 1979 focused on health considerations in developing countries. The background paper on mortality and life expectancy concluded (31):

Statistical analysis indicates that, among the variables for which comparable information is available, social factors (represented by levels of literacy and school enrollment) seem dominant explainers of variations in infant mortality and life expectancy among developing countries.

Preston reported finding high explanatory power and significance for both literacy and income for 1940 and 1970 in regression analyses including more and less developed countries (63). He argued that "the cost-effectiveness of literacy gains in reducing mortality is so great that it may well exceed that of expenditures directed at health problems" (62).

In 1979 the World Health Organization and the United Nations organized a meeting on the socioeconomic determinants of mortality (89). Studies were presented documenting the empirical association between literacy or schooling and health in sub-Saharan Africa by the Economic Commission for Africa (84), in Latin America by Behm (8), and in Asia by Arriaga (3), using individuals or households as the units of analysis. Countries were used as the unit of analysis with the same conclusion for the Middle East by Seklani (70) and for Asia and the Pacific by Hashmi (39).

Caldwell's paper on Nigeria concluded (11, p. 408):

Maternal education is the single most significant determinant of these marked differences in child mortality. These are also affected by a range of other socio-economic factors, but no other factor comes close to explaining the effect of maternal education. Clearly, maternal education cannot be employed as a proxy for general social and economic change but must be examined as a force in its own right.

In 1981, sponsored by the Ford Foundation, The University of Michigan

convened a meeting of researchers concerned with the relationship of literacy and education to health in developing countries (32).

Cochrane et al (17) presented a summary of past intracountry empirical findings on the association between parental education and child nutritional status and a reanalysis of multivariate studies of the association between parental education and child mortality. They concluded that maternal education is closely related to child health whether measured by nutritional status or infant and child mortality, and that the evidence of the significance was unequivocal.

Caldwell & McDonald (13) presented data from the World Fertility Surveys of ten Third World countries that tested the conclusion of Caldwell's Nigerian study (11) that maternal education is important in reducing child mortality. Variables considered were mother's and father's education and occupation, and urban/rural residence. Their analysis confirmed the major importance of parental education, indicating that its impact is probably greater than both income factors and access to health facilities combined. Rural/urban differentials were of small importance once parental education was controlled, even though rural parents in most countries have lesser access to health facilities (13).

A later analysis using World Fertility Survey data by Hobcraft et al (41) considered socioeconomic differences in infant and child mortality for 28 countries. The effects of mothers' education and work status, husbands' occupation and education, and location of residence were examined. Considerable regional differences in the effect of levels of mother's education were found. It was particularly strongly associated with mortality during the first five years of life in the Asian countries, while husband's education was more important in the Americas. Child mortality in the four African countries studied were found to be relatively strongly associated with the husband's occupation and education.

Literacy has sometimes been considered a proxy for income or wealth, but the evidence points to literacy being directly linked to better health. For example, in an analysis of the nutritional status of children in Bangladesh, mothers were classified by education (literate or illiterate) and family monthly income. Income and mother's education were both significantly related to nutritional status of the child, and the interaction between income and education was also significant. The study showed that improvement of nutritional status of children of illiterate mothers with increasing income was slight. With literate mothers there was significant improvement of nutritional status with increasing income. It appears that once a threshold of income is reached, literacy becomes an important factor in improving nutritional status (6).

Mosley's study (52) of Kenyan data argued that literacy and family income were the dominant determinants of child survival, and that maternal education

was the most important. Nationally, 86% of the child mortality decline between 1962 and 1979 was explained by the increase in maternal education. Mosley believed it was reasonable to attribute the remaining 14% to improvement in the household economic situation (52).

In countries where income is more equitably distributed, the levels of mortality seemed better relative to countries where income levels are more skewed. This hypothesis was examined across nations by Rodgers, who observed a significant relationship between income distribution and life expectancy (67). A subsequent study by Flegg (24) confirmed the importance of income distribution as it affected infant mortality, but noted "the results show strikingly the potential impact on infant mortality of reducing illiteracy."

Palloni (57) compared countries with rapid and slow mortality decline, concluding that "mortality differentials across significant social groups cannot be explained by differentials in levels of economic growth or by income inequalities. It appears that the factor accounting for such differentials and *mutatis mutandis*, for their trends over time, is the existence of highly mobilized and integrated population as reflected, for example, in high literacy rates" (57).

In 1985 the United Nations published a study designed to test systematically a large number of factors associated with mortality in 15 developing countries. Variables studied included the occupational and educational status of parents, urban/rural residence, religion, ethnic group, and the availability of health facilities, piped water and flush lavatories. After all the other variables were entered into the UN's estimation equation, the effect of an additional year of mother's schooling was a reduction of 3.4% in mortality. The approximately ten years of schooling suggested as desirable in order to learn the basic skills of reading, writing, and calculating necessary for working successfully in modern sectors of industrialized economies, would be associated with a reduction of mortality of at least 34%, on average. The reduction would be still larger if the calculation were to take into account the indirect effect of education on other variables. Against this standard, most of the other factors in the UN analysis showed mild or weak effects when other variables were controlled. There were two exceptions, ethnic variation and father's education. Father's education had a sizable effect only in urban areas. Rural-urban residence per se had very little effect on child mortality. The effects of measures of economic status were usually relatively small. The studies concluded "that even the sum of 'direct' mortality effects of doubling everyone's income, providing every household with a flush lavatory and piped water, and turning every agricultural laborer into a professional/white collar worker would be less than the 'direct' effect of providing 10 years of schooling for each woman" (79).

The multivariate studies reviewed above have shown that the effects of

education are independent of income, that both are significant, and that literacy or schooling is usually the stronger correlate of mortality. Although the strong, significant, independent association of literacy or schooling with mortality in developing countries has been confirmed by repeated studies and is given support by similar findings in the US, the direction of causality and the mechanisms by which literacy influences health status are less clearly established.

CHANGES IN DETERMINANTS OVER TIME

The shifts in the views of determinants of mortality were in part caused by better information and insights, but there is also evidence that the relationships among the variables change with time period or stage of development.

Arriaga & Davis (4) found that until around 1930 mortality decline was extremely slow in economically poor Latin American countries, but that in more advanced countries of the region a more rapid decline had set in before that. After 1930, however, in both groups of countries the pace of decline was faster than ever, and it was virtually the same for both groups. Noting that this was typical of other less developed countries as well, they concluded that "mortality change seems increasingly independent of economic improvement and more dependent on the importation of preventative medicine and public health from the industrial countries" (4).

Grosse's multivariate analysis showed a shift from the 1960s to the 1970s in the relative importance of economic and social indicators. In 1960–1965 the economic variable alone explained 49% of the variation in life expectancy among developing countries. But in 1970–1975 the most important indicator was percentage of the adult population literate, which explained 78% of the variation by itself. In addition, the model showed that sanitation variables began to appear as significant correlates of life expectancy in the later period, playing a larger role than income per capita (31).

Gwatkin (36a) and Ruzicka & Hansluwka (68a), noting a deceleration in the pace of mortality decline in the 1970s, suggested that the underlying dependence of health upon economic development was reasserting itself.

Hill (40), reviewing the data from the 1950s to the 1970s, agreed that there had been some slowdown in the pace of mortality decline in the Americas, possibly some in sub-Saharan Africa, but that in Asia there had been some acceleration in the rate of decline in child mortality. He noted that the time variable implied a trend toward lower mortality independent of income and education from the 1950s to the 1960s for the Americas and Africa, but no such trend for Asia from the 1950s to the 1960s or for any region from the 1960s to the 1970s. He concluded that "the effects of income and education improvements appear to have remained more or

less constant over time and to be similar across regions, whereas the effects of other factors appear virtually to have disappeared in the recent past" (40).

Similarly, Preston (64), who had found that only 30% of the mortality decline from the 1930s to the 1960s could be explained by aspects of social and economic development such as income, literacy and nutrition, found these to be the dominating variables explaining the slower decline in the decade from 1965–1969 to 1975–1979. He suggested that "this greater relative role does not result from faster improvements in social and economic conditions during the recent period or from an increasing responsiveness of mortality to social and economic variables. Rather, the exogenous factors appear to have operated with sharply reduced intensity in the more recent period" (64).

Pendleton & Yang (59) analyzed differences in the effects of socioeconomic factors and health services in countries in early and late stages of mortality transition. Countries were so classified depending on whether they had higher or lower than average life expectancies. It was concluded that in late transition nations, socioeconomic development—living standards, literacy, and diet—is necessary for lowering mortality levels. For nations that are still in the early stages of transition, economic development—living standards and diet—did not constitute relatively important factors in reducing mortality levels. Literacy and health services imported from more developed nations seemed to be the primary reasons for overall mortality reductions and an increase in life expectancy (59).

Hunter (43) came to a somewhat different conclusion. She found that for nations at the earliest stage of health development, as measured by a group of health status variables, health resources played a small role in the equations describing health status. For such nations, the underdevelopment of economic, health, and educational infrastructure allowed international intervention (aid, investment, and export-import activity) to play a large role in health status determination. At middle health development levels, health and educational infrastructures were more important, but still secondary to economic indicators. At higher levels of health development, education, women's status, and political structure were especially important health status determinants (43).

DIRECTIONS OF CAUSALITY

Causality might run from literacy to health, from health to literacy, or each may have been influenced by some third factor. Multivariate analyses have shown that literacy, especially maternal literacy, in its association with health, is not a proxy for income or residence.

Grossman (33) in his study of middle-aged men concluded that the causal

relationship ran from schooling to health, as past health and third variables were held constant.

Fuchs (22, 26) has challenged this conclusion, suggesting that both health and schooling might be influenced by variations in individual's time preferences. Individuals with low time preferences (greater willingness to sacrifice today for a future gain) would invest in many years of schooling and also invest in health-enhancing activities.

For the Third World, the time preference variation among individuals does not explain the enormous increase in both school enrollments and life expectancy that took place after World War II. In countries whose GNP per capita was below the median, the rise in children of primary school age enrolled was from 37% in 1950 to 72% in 1970 (51).

O'Hara (55) argued that child health and child education are jointly determined by parents, and that the links from health to education are likely to be important. Healthier children appear to learn more and more quickly and stay in school longer (85).

Ram & Schultz (66) saw a causal linkage running from the unprecedented increase in life expectancy in India between 1951 and 1971 to the large increase in educational investments by families and governments in India.

Epstein (20) cautioned against seeing literacy as a panacea. She suggested that health and education are joint products of the prevailing social structure and saw no causal linkage from education to health in the Third World cultures she has studied. She believed the formal education and health services of these areas have been ineffective, and suggested that the teaching of good health practices through mass media offers more hope.

Behm (7) emphasized that "both the changes in mortality and education are occurring in Third World countries within a historic transition from pre-capitalistic modes of production to relatively advanced, dependent, capitalist development." He noted the importance of considering the contextual, historic conditions that, to a certain extent, are determining both parents' education and child mortality, and the association between them.

Palloni (56) noted that the extent of illiteracy in a society reflects not only the limitations of individuals "but, more importantly, the capacity of a system to organize and mobilize to fulfill social necessities, the degree of social and political maturity of the system above and beyond the amounts of wealth at its disposal and the degree of equality of its distribution."

MECHANISMS

It is reasonable that social and economic structures play a role not expressed in measures of literacy and income. The association of literacy and health is found in such a variety of conditions, however, that an understanding of the

mechanisms of this effect should stand high on a scientific research or policy analysis agenda.

Resources and Knowledge

Improvements in health can be considered the consequences of enhanced knowledge and resources. The possession of literacy increases the ability of a family or a community to acquire more knowledge and resources.

Education increases market productivity. The relationship between schooling and earnings is well documented. Sloan (73) has suggested that factors producing increased earnings include the impact of schooling on worker productivity, the increased propensity of the educated to seek and find work, better access to job market information, and larger amounts of on-the-job training that individuals with more education receive. The higher income resulting from increased market productivity should lead to increased expenditures on food, housing, and medical care, with improved health as a consequence (55).

On the other hand, participation in the labor force by mothers may, by reducing the time spent in child-rearing and domestic activities, reduce or reverse this effect. This may not happen if women have highly paid jobs that permit them to pay for child care, if the work takes place in the home, if an extended family shares child care activities, or if institutional child care services of high quality are available. The United Nations study of child mortality differentials showed that, after all other variables were entered into the model, women who did not work at all or who worked in family enterprises had the lowest child mortality in 10 of the 14 countries examined (79, p. 158).

Paternal literacy, which has small effect on child mortality in rural areas of most countries, is more important in cities, where education produces more income, and where income, in turn, may more effectively produce health because of availability of basic goods and services, food, clothing, medical care, housing, sanitation, and other health-related items (79).

The effect on health of family resources as influenced by literacy is the resultant of forces working in different directions. The increase of income helps, but the loss of maternal care time may be detrimental.

Although the ability to acquire knowledge of means of avoiding diseases and death is critical to the association between literacy and health, Preston (65) noted that ignorance about disease processes and appropriate remedies neutralized the potential advantages of higher literacy and greater economic resources of the upper class in the United States at the end of the nineteenth century. Caldwell (12) examined Australian data for the same period, and agreed that medical care had little to offer. But he observed that richer and

educated Australian families protected their health through household hygiene and removing children from school during outbreaks of disease.

In what ways are resources and knowledge gained by literacy converted into lower morbidity and mortality? It has been suggested that literacy leads to better use of health services and child care and feeding, more hygienic household practices and personal habits, and raises the demand for community health services. These actions may come about from increased knowledge, or, as Caldwell has hypothesized, because the status of literate mothers is raised, changing the structure of the family (11, 12).

Health Services Utilization

Literacy has been shown to be complementary to health services. Studies of Indian states have noted that literate mothers utilize modern health services more than do illiterate mothers and saw this as a way in which literacy led to lower infant and child mortality.

Jain (44), comparing differentials in infant mortality among states in rural India, concluded that adult female literacy affects infant mortality primarily through its association with better medical care at birth of the child (and perhaps during the prenatal period), and secondarily due to its association with preventive and curative medical care during the postneonatal period.

Nag (54), comparing the States of Kerala and West Bengal in India, noted that, although there is little difference between these states in the availability of medical facilities, the people in Kerala use medical facilities much more than in West Bengal, and that a major factor appears to be the higher literacy in Kerala, particularly among females, which likely increased awareness about the need and right to use public facilities (54).

In rural Karnataka, Caldwell et al (14) showed that some education was necessary for a person to feel any identification with modern as distinct from traditional curative measures and that with increased schooling parents were more likely to bring sick children to health services, to follow the suggested treatment properly, to persist sufficiently long with treatment, and to report back to the health service if a cure was not being effected (14).

An analysis of data from Nigerian villages, reported by Caldwell & Orubuloye (55a), suggested that the gain in life expectancy at birth was 20% when the sole intervention was easy access to adequate health services for illiterate mothers, 33% when it was education without health facilities, but 80% when it was both (12, p. 204). It was reported that an educated mother is more likely to be listened to by doctors and nurses, and she "can demand their attention even when their reluctance to do anything more would completely rebuff an illiterate" (11, p. 410).

An analysis of the relationship between life expectancy and water supply and sanitation investments in developing countries by Shuval et al (71)

suggested that the health impacts of these programs were positively associated with the proportion of the adult populations that were literate.

Palloni (57) has noted that "In many societies seemingly beneficial vertical interventions have had little impact because the population to which they are targeted does not fully participate or cooperate (failures in malaria surveillance; refusal to proceed with oral rehydration; indifference to massive vaccination campaigns). Redistributive programs affecting educational levels, however, may lead to more successful application of those vertical programs."

These studies imply that it is not the availability of health facilities alone that determines health as much as their utilization, and it is by encouraging their use that literacy plays a critical role. This distinction may account for not only some of the power of literacy, but also the lack of significance of the availability of health facilities in some analyses.

Other studies have suggested that health services may also act as substitutes for widespread literacy. Rosenzweig & Schultz's (68) analysis of household records from the 1973 Colombian Population Census suggested that "urban public health activities are *substitutes* for the health care knowledge and the management capacity that an educated mother brings to her family."

Behm (8), in presenting relationships between years of mother's education and child mortality in Latin America, noted that not only is the national level low in Cuba, but that differences on account of education are much lower in Cuba than in the other Latin American countries studied. It is possible that Cuba's policy of devoting a large portion of its budget to health services and to provide these widely may have been a factor in the relatively small effect of literacy on child health in that country. China may be another example of this substitution effect (12a).

Health Practices and Habits

Although it has been suggested that literacy enhances the ability and the desire to protect the children's health, exercise healthy habits and avoid unhealthy ones, empirical evidence in developing countries is sparse.

Wolfe & Behrman (86) reported in their study of nutrition in Managua that "more educated women are more efficient in household production of nutrition. . . . For example, more educated women are generally better informed about the nutritional contents of foods, the importance of nutrition, and nutritional options from market purchases or from home production."

Tekce & Shorter's (75) study of squatter settlements in Amman looked at five practices: use of a mid-wife or physician as birth attendant, use of soap for hand washing, immunizations, sickness care, and diet and feeding practices. Literate women were significantly higher on each, and their children had lower mortality rates. An exception was that whereas breast-feeding was moderately long for both literate and illiterate women, the shortening of

breast-feeding associated with literacy exerted an upward pressure on fertility by shortening birth intervals, a negative factor for child health (75).

Fertility Behavior

The conclusions of Cantrelle et al's (15) analysis of the determinants of mortality in Senegal since 1960 were different from those of other research. The educational level attained by wives had little effect on infant or child mortality, when age, residence, and literacy of the husband were controlled. They concluded that "the effect of the level of education of the mother on mortality essentially operates through an increase in age at maternity and perhaps through marriage stability rather than a change in behavior" (15).

The link between fertility behavior and health is assumed to lie in the positive relationship of infant and maternal mortality to birth intervals and parity (76).

Most studies have found a negative relationship between indicators of education attainment level and fertility. This has been attributed to improved access to information, including family planning, a more egalitarian relationship between husband and wife in determining the number and spacing of children, changes in paternal aspirations for their children in regard to higher education and occupation, and increased average age at marriage (77).

Cochrane's (16) review of studies of relationships between education and fertility concluded that education may increase or decrease individual fertility. The decrease is greater for the education of women in urban than rural areas, but education is more likely to increase fertility in countries with the lowest level of female literacy.

A possible explanation of this last was offered by Bongaarts et al (9) in their analysis of fertility determinants in sub-Saharan Africa, where educated, urban women, although they tend to marry later, generally abstain sexually for shorter periods after delivery and tend to replace breast-feeding earlier or altogether with alternative milk or solid foods.

Family Structure

Caldwell (11) has been a pioneer in the identification of maternal education as a major factor in determining child mortality. In his study of Nigerian data, he suggested that the most important explanation for this phenomenon may be that "the education of women greatly changes the traditional balance of familial relationships, with profound effects on child care" (11).

Caldwell & McDonald's (13) analysis of World Fertility Surveys did not detect any differences in the impacts of maternal and paternal education by cultural region that reflected different family structures and female roles, nor did it find the kinds of difference between the impacts of education that might arise from different types of schooling or different levels of educational development. They reasoned, therefore, that schooling of parents has similar

impacts on child mortality in most of the Third World. They suggested that the major impact of schooling is the new family system it brings about (13):

“... a system where parents, or even mothers, can make immediate decisions about child care. More importantly, it is a system in which children (and women) are awarded higher priorities in terms of care and consumption than in the traditional system. Children's complaints are more likely to be heard and sick children are less likely to work. Perhaps the most important factor is that food, especially animal protein, is likely to be shared more evenly.

An exception to Caldwell's suggestion that it is largely the schooling of women leading to modern or Western family values that affects child mortality is Cantrelle et al's study (15). In Senegal they found that “for the husband, it appears that the degree of literacy (the simple fact of knowing how to read, whether in French or Arabic, whether learned in school or not) has a very appreciable impact on mortality, whereas the net effect of having been to a modern school does not (15).

Although Palloni (56, pp. 642-43) agreed that the factors stressed by Caldwell may be operative, he argued that “the proportion of illiterate in a population is less of an indication of the reaction of mothers with inadequate knowledge to treat and feed a sick child or to challenge the authority of elders than a reflection of the degree of social and political maturity of a system.”

Community Level Variables

O'Hara (55) suggested that a better educated community will want and be able to afford better public health, water, and sanitation facilities. Meegama (50) argued that this occurred in Sri Lanka, where universal adult franchise led to heavy investments in education and to a rise in literacy. “The resulting rise in aspirations had the effect of improving health awareness and thereby increasing investments in health at the household and public level” (50).

Case studies of Kerala and Costa Rica also reported that considerable credit for the success of their health programs goes to an educated electorate that made the government health-conscious (28, 54).

Noting that, although Latin American data showed declines in child mortality with increases in maternal education, the levels of mortality at each level of education varied among countries, Ware suggested that “education has an impact not only through the characteristics of the individual mother but also through the educational level of society as a whole” (85a).

CONCLUSIONS

A strong and consistent association of literacy with mortality has been demonstrated to be significant independent of culture or level of economic development and where either nations or individuals were the units of analysis. There

is evidence that practices likely to promote and protect health, such as child care and feeding practices, utilization of modern health services, and fertility behavior, are associated with literacy.

Caldwell has suggested that the major reason for the behavior changes is that literacy leads to the adoption of modern attitudes (12). But the question remains as to whether increases in the prevalence of literacy in developing societies is a cause of modernization or, as Palloni has suggested, it is a reflection of a society's increasing sophistication and modernization (56). Behm (8) and Epstein (20) have argued that health and education are the common result of the social and economic context.

Each of these hypotheses is likely to be operating in a pattern of circular causation with cumulative effects, to borrow a phrase from Myrdal (53). Literacy affects health, and health affects educational attainment. Both are influenced by the social and economic context of a society. But developing countries are not static. They are in transition toward modernization. The relationships among variables change as nations move through mortality transitions or stages of health development. The prevalence of literacy stimulates and facilitates modernization, and modernization increases the demand for literacy and the capacity of a society to meet that demand.

Antonovsky (2) and Sagan (69) have seen the capacity to cope with stress as the key to health. Antonovsky's "salutogenic model" suggests that one's position on a sense of coherence continuum determines one's place on a health-disease continuum (2). Sagan concluded that "those who are competent and have confidence in themselves and their ability to control their own lives will experience better health outcomes than those who do not" (69). Literacy is a powerful tool for coping. It is a critical factor interacting with others in a complex way in promoting the health of populations.

Literature Cited

1. Antonovsky, A. 1967. Social class, life expectancy and overall mortality. *Milbank Mem. Fund Q.* 45:31-73
2. Antonovsky, A. 1979. *Health, Stress, and Coping*. San Francisco: Josey-Bass
3. Arriaga, E. E. 1979. Infant and child mortality in selected Asian countries. See Ref. 89, pp. 98-118
4. Arriaga, E., Davis, K. 1969. The pattern of mortality change in Latin America. *Demography* 6:223-42
5. Auster, R., Leveson, I., Sarachek, D. 1969. The production of health, an exploratory study. *J. Human Resources* 4:411-36
6. Bairagi, R. 1980. Is income the only constraint on child nutrition in Bangladesh? *Bull. WHO* 58:767-72
7. Behm, H. 1982. Empirical findings on the association between education and child health status: Discussion. See Ref. 32, pp. 269-73
8. Behm, H. 1979. Socioeconomic determinants of mortality in Latin America. See Ref. 89, pp. 139-65
9. Bongaarts, J., Frank, O., Lesthaeghe 1984. The proximate determinants of fertility in sub-Saharan Africa. *Popul. Dev. Rev.* 10:511-37
10. Briscoe, J. 1978. The role of water supply in improving health in poor countries (with special reference to Bangladesh). *Am. J. Clin. Nutr.* 31:2100-13
11. Caldwell, J. 1979. Education as a factor in mortality decline: An examination of

- Nigerian data. *Popul. Studies* 33(3): 395-413
12. Caldwell, J. C. 1986. Routes to low mortality in poor countries. *Popul. Dev. Rev.* 12:171-220
 - 12a. Caldwell, J. C., Caldwell, P. 1985. Education and literacy as factors in health. See Ref. 38, p. 185
 13. Caldwell, J., McDonald, P. 1982. Influence of maternal education on infant and child mortality: Levels and causes. See Ref. 32, pp. 251-67
 14. Caldwell, J. C., Reddy, P. H., Caldwell, P. 1983. The social component of mortality decline: An investigation in South India employing alternative methodologies. *Popul. Studies* 37:185-205
 15. Cantrelle, P., Diop, I. L., Garenne, M., Gueye, M., Sadio, A., et al. 1986. The profile of mortality and its determinants in Senegal, 1960-1980. In *Determinants of Mortality Change and Differentials Developing Countries*, p. 104. New York: United Nations
 16. Cochrane, S. H. 1979. *Fertility and Education: What Do We Really Know?* Baltimore: Johns Hopkins Univ. Press
 17. Cochrane, S. H., Leslie, J., O'Hara, D. J. 1982. Parental education and child health: Intracountry evidence. See Ref. 32, pp. 213-50
 18. Davis, K. 1956. The amazing decline of mortality in underdeveloped countries. *Am. Econ. Rev.* 46:305-18
 19. Edwards, L. N., Grossman, M. 1981. Children's health and the family. In *Advances in Health Economics and Health Services Research*, ed. R. M. Schufiler, pp. 35-84. Greenwich, Conn: JAI Press
 20. Epstein, T. S. 1982. The social context of education and health. *Health Policy Educ.* 3:71-90
 21. Deleted in proof
 22. Farrell, P., Fuchs, V. R. 1982. Schooling and health: The cigarette connection. *J. Health Econ.* 1:217-30
 23. Feachem, R., Burns, E., Cairncross, S., Cronin, A., Cross, P., et al. 1978. *Water, Health and Development*, p. 182. London: Tri-Med
 24. Flegg, A. T. 1982. Inequality of income, illiteracy and medical care as determinants of infant mortality in underdeveloped countries. *Popul. Studies* 36:441-58
 25. Frederickson, H. 1966. Determinant and consequences of mortality and fertility trends. *Public Health Rep.* 81:715-27
 26. Fuchs, V. R. 1982. Time preference and health: An exploratory study. In *Economic Aspects of Health*, ed. V. Fuchs, pp. 93-120. Chicago: Univ. Chicago Press
 27. Gollday, F. 1980. *Health Problems and Policies in the Developing Countries*. Washington, DC: World Bank Staff Working Paper No. 412
 28. Gonzalez-Vega, C. 1985. Health improvements in Costa Rica: The socioeconomic background. See Ref. 38, pp. 147-58
 29. Deleted in proof
 30. Graff, H. J. 1987. *The Labyrinths of Literacy: Reflections on Literacy Past and Present*, pp. 57-59. London: Falmer
 31. Grosse, R. N. 1980. Interrelation between health and population: Observations derived from field experiences. *Soc. Sci. Med.* 14C:99-120
 32. Grosse, R. N., Friedl, J., eds. 1982. *Literacy, Education and Health Development. Special Issues, Health Policy Educ.* 2:211-384, 3:1-123
 33. Grossman, M. 1975. The correlation between health and schooling. In *Household Production and Consumption*, ed. N. E. Terleckyj, pp. 147-210. New York: Columbia Univ. Press
 34. Grossman, M. 1982. Government and health outcomes. *Am. Econ. Rev.* 72(2):191-95
 35. Deleted in proof
 36. Gwatkin, D. 1979. Food policy, nutrition, planning and survival: The cases of Kerala and Sri Lanka. *Food Policy* 4:245-58
 - 36a. Gwatkin, D. R. 1980. Indications of change in developing country mortality trends: The end of an era? *Popul. Dev. Rev.* 6:615-44
 37. Deleted in proof
 38. Halstead, S. B., Walsh, J. A., Warren, K. S., eds. 1985. *Good Health at Low Cost*. New York: Rockefeller Found.
 39. Hashmi, S. S. 1979. Socioeconomic determination of mortality levels in Asia and the Pacific. See Ref. 89, pp. 119-36
 40. Hill, K. 1985. The pace of mortality decline since 1950. In *Quantitative Studies of Mortality Decline in the Developing World*. Washington, DC: World Bank Staff Working Paper No. 683, p. 94
 41. Hobcraft, J. N., McDonald, J. W., Rutstein, S. O. 1984. Socioeconomic factors in infant and child mortality: A cross-national comparison. *Popul. Studies*, 38:189-223
 42. Hunter, C. St. J., Harman, D. 1979. *Adult Illiteracy in the United States*, pp. 7-21. New York: McGraw-Hill
 43. Hunter, S. S. 1987. *Health status: An anthropological model of its determi-*

- nants. Ph.D. thesis, State Univ. New York, Albany
44. Jain, A. K. 1984. *Determinants of Regional Variations in Infant Mortality in Rural India*. New York: Population Council
 45. Deleted in proof
 46. Kitagawa, E. M., Hauser, P. M. 1973. *Differential Mortality in the United States: A Study in Socioeconomic Epidemiology*. Cambridge: Harvard Univ. Press
 - 46a. Kusukawa, A. 1966. Social and economic factors in mortality in developing countries. *Proc. World Popul. Conf. Belgrade 1965*, 2:337-41. New York: United Nations
 47. Deleted in proof
 48. Logan, W. P. D. 1954. Social class variations in mortality. *Public Health Rep.* 69:1217-23
 49. MacMahon, B., Kevlar, M. G., Feldman, J. J. 1972. *Infant Mortality Rates: Socioeconomic Factors*. Washington: Natl. Cent. Health Stat.
 50. Meegama, S. A. 1986. The mortality transition in Sri Lanka. In *Determinants of Mortality Change and Differentials Developing Countries*, pp. 5-32. New York: United Nations
 51. Meyer, J. W., Ramirez, F. O., Rubinson, R., Boli-Bennet, J. 1979. The world educational revolution, 1950-70. In *National Development and the World System: Educational, Economic, and Political Change 1950-70*, ed. J. W. Meyer, M. T. Hannan, pp. 37-55. Chicago: Univ. Chicago Press
 52. Mosley, W. H. 1983. Will primary health care reduce infant and child mortality? A critique of some current strategies with special reference to Africa and Asia. *Int. Conf. Popul. Paris*
 53. Myrdal, G. 1968. *Asian Drama*, p. 1871. New York: Pantheon
 54. Nag, M. 1985. The impact of social and economic development on mortality: Comparative study of Kerala and West Bengal. See Ref. 38, pp. 57-78
 55. O'Hara, D. J. 1980. Toward a model of the effects of education on health. In *The Effects of Education on Health*. Washington, DC: World Bank Staff Working Paper No. 405
 - 55a. Orubuloye, I. O., Caldwell, J. C. 1975. The impact of public health service on mortality differentials in a rural area of Nigeria. *Popul. Studies*, 29:259-72
 56. Palloni, A. 1981. Mortality in Latin America: Emerging patterns. *Popul. Dev. Rev.* 7:623-49
 57. Palloni, A. 1985. An epidemiological demographic analysis of factors in the mortality decline of 'slow decline' developing countries. In *Int. Popul. Conf. Florence 1985*, 2:329-51. Liege: Union Sci. Study of Popul.
 58. Pattison, R. 1982. *On Literacy*, pp. 3-28. New York: Oxford Univ. Press
 59. Pendelton, B. F., Yang, S.-O. W. 1985. Socioeconomic and health effects on mortality declines in developing countries. *Soc. Sci. Med.* 30:453-60
 60. Deleted in proof
 61. Preston, S. H. 1976. *Mortality Patterns in National Populations*, pp. 81-82. New York: Academic
 62. Preston, S. H. 1978. Mortality, morbidity, and development. *Semin. Popul. Dev. EDCWA Reg.*
 63. Preston, S. H. 1980. Causes and consequences of mortality declines in less developed countries during the twentieth century. In *Population and Economic Change in Less Developed Countries*, ed. R. A. Esterlin, p. 306. Chicago: Univ. Chicago Press
 64. Preston, S. H. 1985. Mortality and development revisited. In *Quantitative Studies of Mortality Decline in the Developing World*, pp. 97-122. Washington, DC: World Bank
 65. Preston, S. H. 1985. Resources, knowledge and child mortality: A comparison of the U.S. in the late nineteenth century and developing countries today. In *Int. Popul. Conf. Florence 1985*, pp. 373-86. Liege: Int. Union Sci. Study Popul.
 66. Ram, R., Schultz, T. W. 1979. Life span, health, savings, and productivity. *Econ. Dev. Cult. Change* 27:399-421
 - 66a. Robinson, W. C. 1967. Recent mortality trends in Pakistan. In *Studies in the Demography of Pakistan*, ed. W. C. Robinson, p. 38. Karachi: Pakistan Inst. Dev. Econ.
 67. Rodgers, G. B. 1979. Income and inequality as determinants of mortality: An international cross-section analysis. *Popul. Studies* 33:343-51
 68. Rosenzweig, M. R., Schultz, T. P. 1982. Child mortality and fertility in Colombia: Individual and community effects. See Ref. 32, p. 345
 - 68a. Ruzicka, L. T., Hansluwka, H. 1982. Mortality in South and East Asia: Technology confronts poverty. *Popul. Dev. Rev.* 8:567-88
 69. Sagan, L. A. 1987. *The Health of Nations*. New York: Basic
 70. Seklani, M. 1979. L'évolution de la mortalité dans les pays arabes depuis le milieu du XXème siècle. See Ref. 89, pp. 240-64
 - 70a. Shiffman, M. A., Schneider, R.,

- Faigenblum, J. M., Helms, R., Turner, A. 1978. Field studies on water sanitation and health education in relation to health status in Central America. *Progr. Water Technol.* 11:143-50
71. Shuval, H. I., Tilden, R. L., Perry, B. H., Grosse, R. N. 1981. Effect of investments in water supply and sanitation on health status: A threshold-saturation theory. *Bull. WHO* 59:243-48
 72. Deleted in proof
 73. Sloan, F. 1971. *Survival of Progeny in Developing Countries: Evidence from Costa Rica, Mexico, East Pakistan and Puerto Rico*. Santa Monica: Rand
 74. Stolnitz, G. J. 1975. International mortality trends: Some main factors and implications. In *The Population Debate: Dimensions and Perspectives*, 1:220-36. New York: United Nations
 75. Tekce, B., Shorter, F. C. 1984. Determinants of child mortality: A study of squatter settlements in Jordan. *Popul. Dev. Rev.* 10:257-80 (Suppl.)
 76. Trussell, J., Pebley, A. R. 1984. The potential impact of changes in fertility on infant, child and maternal mortality. *Studies Family Plann.* 15:267-80
 77. United Nations. 1983. *World Population Trends, Population and Development Interrelations and Population Policies, 1983 Monitoring Report*, 2:60. New York: United Nations
 78. United Nations. 1953. *The Determinants and Consequences of Population Trends*, p. 60. New York: United Nations
 79. United Nations. 1985. *Socioeconomic Differentials in Child Mortality in Developing Countries*, pp. 286-91. New York: United Nations
 80. Deleted in proof
 81. Deleted in proof
 82. United Nations. 1969. *1967 Report on the World Social Situation*, p. 32. New York: United Nations
 83. Deleted in proof
 84. United Nations Economic Commission for Africa. 1979. Mortality differences and their correlates in Africa. See Ref. 89, pp. 208-35
 85. Wadsworth, M. E. J. 1986. Serious illness in childhood and its association with later-life achievement. In *Class and Health*, ed. R. G. Wilkinson, pp. 50-74. London: Tavistock
 - 85a. Ware, H. 1984. Effects of maternal education, women's roles, and child care on child mortality. *Popul. Dev. Rev.* 10:191-214 (Suppl.)
 86. Wolfe, B., Behrman, J. 1983. Is income overrated in determining adequate nutrition? *Econ. Dev. Cult. Change* 31:525-50
 87. Deleted in proof
 88. World Health Organization. 1969. *Community Water Supply*, p. 6. Tech. Rep. Ser. No. 420. Geneva: WHO
 89. World Health Organization/United Nations. 1979. *Proc. Meet. on Socioecon. Determinants Consequences Mortal., Mexico City, 19-25 June 1979*. Geneva/ New York: WHO/UN