

8. West KP Jr, Khatri SK, Katz J, LeClerq SC, See LC, Pokhrel RP, Sommer A. Vitamin A and childhood morbidity in Nepal: impact on dysentery and diarrheal disease. *FASEB J*. 1992;6:A1787. Abstract.
9. Pelletier DL, Frongillo, Jr, EA, Habicht J-P. Epidemiologic evidence for a potentiating effect of malnutrition on child mortality. *Am J Public Health*. In press.

## Abdeljaber and Colleagues Respond

Drs. Stoltzfus and Habicht assume that, because certain markers of vitamin A status return to presupplementation levels within weeks, the health effects also have a short duration. That cannot be the case, especially in view of the major long-term reduction in mortality also found in the Aceh study (35%) and in others using somewhat different methodology.<sup>1</sup> Although we agree that it would have been ideal to measure morbidity closer to supplementation, this was not possible in the study as designed.

It is of note that other investigations have not found vitamin A effects on acute illness morbidity while detecting reductions in mortality.<sup>2,3</sup> Such an apparent paradox has several possible explanations. Severity of an acute illness can be reduced with no effect on actual frequency. As the authors suggest, a decrease in case fatality would be the numerical consequence. This is entirely in keeping with the observation that, while the incidence of acute respiratory infection is not very different in many parts of the world, mortality is only common in developing countries—again a difference in case fatality.<sup>4</sup>

In the recently completed Nepal Vitamin A Child Survival project, two types of information were collected on morbidity. This operations research study involved 64 000 children distributed between three vitamin-A-deficiency intervention programs and one control group.<sup>5</sup> To assess compliance with the intervention at 12 and at 24 months after baseline, the mothers were asked if any of the children had an acute respiratory illness or diarrhea in the preceding 7 days. No statistically significant differences were detected among groups at either observation. In contrast, when the mothers were asked whether they recalled a severe acute illness in the preceding year, those whose children received the interventions reported significantly fewer events than those whose children were in the control group. Admittedly, recall over such a long period is often faulty, but these observa-

tions again suggest that an effect on severity can exist without one on acute illness frequency. □

Mutee H. *Abdeljaber, MD, DrPH*  
Arnold S. *Monto, MD*  
Robert L. *Tilden, PhD*  
Anthony *Schorck, PhD*

The authors are with the Department of Epidemiology, School of Public Health, University of Michigan, Ann Arbor.

Requests for reprints should be sent to Arnold S. Monto, MD, School of Public Health, University of Michigan, 109 Observatory St, Ann Arbor, MI 48109.

## References

1. Sommer A, Tarwojto I, Djunaedi E, West K, Loeden R, Mele L. Impact of vitamin A supplementation on childhood mortality. *Lancet*. 1986;i:1169-1173.
2. Rahmthulla L, Underwood BA, Thulasiraj RD, Milton RC. Diarrhea, respiratory infections and growth are not affected by a weekly low-dose vitamin A supplement: a masked controlled field trial in children in southern India. *Am J Clin Nutr*. 1991;54:468-477.
3. Arthur P, Kirkwood B, Ross D, Morris S, Gyapong J, Tomkins A, Hutton A. Impact of vitamin A supplementation on childhood morbidity in northern Ghana. *Lancet*. 1992;339:361-362. Letter.
4. Monto AS. Acute respiratory infection in children of developing countries: the challenge of the 90's. *Rev Inf Dis*. 1989;2:498-505.
5. *Vitamin A Mortality and Morbidity Studies. Report of a Joint WHO/USAID/NEI Consultation*. Geneva, Switzerland: World Health Organization; 1992.

## Multidisciplinary Findings on Socioeconomic Status and Health

Socioeconomic status (SES) has been regarded as one entity for too long. Winkleby et al.<sup>1</sup> argue that education, occupation, and income—the three components of SES—should be assessed independently. Education may be associated with the reading of medical news articles in newspapers and magazines that, in turn, may lead to the adoption of healthy habits.<sup>2</sup> Occupations have varying risks of traumatic and environmental hazards. Income is associated with access to medical care. Moreover, different government programs (such as Head Start, the Occupational Safety and Health Administration, and welfare benefits) are designed to affect the three components separately.

Despite their claim to primacy, Winkleby et al. were not the first to assess the relative importance of education, occupation, and income. A number of economists

have addressed this issue. Auster, Leveson, and Sarachek,<sup>3</sup> Fuchs,<sup>4</sup> Grossman,<sup>5</sup> and Newhouse and Friedlander<sup>6</sup> were perhaps the first to emphasize that education was more important than income in its association with health. However, Duleep<sup>7</sup> maintains that income is more important than education. Kemna<sup>8</sup> and I<sup>9,10</sup> have addressed controversies surrounding occupation and health associations that have been adjusted for education and income. Recently, cardiovascular disease, arthritis, and obesity researchers have been urged to consider the three SES components separately.<sup>11-14</sup>

Most economists would agree with Winkleby et al. that education is probably more important to health status than either occupation or income. But, before education is assigned a causal role, Fuchs' argument<sup>15</sup> concerning the ability to delay gratification needs to be addressed. Fuchs suggests that it is not the high level of education per se that confers the health benefit; rather, it is an unobserved variable such as the ability to delay gratification. Those with this ability will adopt health habits now that will improve their health in the future. These people will also invest in many years of schooling in anticipation of high wages. If Fuchs is right, the idea that investments in education will improve health is sophistry. Winkleby et al. dismiss Fuchs' argument with one sentence. Again, economists have attempted to address directly Fuchs' criticisms of the education–health association.<sup>16-19</sup> To date, all of these studies have found statistically and clinically significant education–health associations after accounting for the bias introduced by such traditionally unobserved variables as the ability to delay gratification.

It is reassuring to note that prior research by economists support two of Winkleby et al.'s conclusions: (1) Education, occupation, and income have separate influences on health; and (2) education is probably the most important of the three but must be assessed in light of Fuchs' argument about the ability to delay gratification. □

J. Paul Leigh, PhD

Requests for reprints should be sent to J. Paul Leigh, PhD, Stanford University School of Medicine, Division of Immunology and Rheumatology, 1000 Welch Rd, Suite 203, Palo Alto, CA 94304-1885.

## References

1. Winkleby MA, Jatulis DE, Frank E, Fortmann SP. Socioeconomic status and

- health: how education, income, and occupation contribute to risk factors for cardiovascular disease. *Am J Public Health*. 1992;82:816-820.
2. Feldman JJ. The dissemination of health information: case studies in adult learning. Chicago, Ill: Aldine; 1966.
  3. Auster R, Leveson I, Saracheck D. The production of health: an exploratory study. *J Hum Resour*. 1969;4:411-436.
  4. Fuchs VR. Some economic aspects of mortality in developed countries. In: Perlman M, ed. *The Economics of Health and Medical Care*. London: MacMillan; 1974.
  5. Grossman M. The correlation between health and schooling. In: Terleckyj NE, ed. *Household Production and Consumption*. New York: Columbia Press for the National Bureau of Economic Research; 1975. Vol. 40, Studies on Income and Wealth, Conference on Research on Income and Wealth.
  6. Newhouse JP, Friedlander LJ. The relationship between medical resources and measures of health: some additional evidence. *J Hum Resour*. 1980;15:201-217.
  7. Duleep HO. Measuring the effect of income on adult mortality using longitudinal administrative record data. *J Hum Resour*. 1986;21:238-251.
  8. Kemna HJMI. Working conditions and the relationship between schooling and health. *J Health Econ*. 1987;6:189-210.
  9. Leigh JP. Direct and indirect effects of education on health. *Soc Sci Med*. 1983;17:227-234.
  10. Leigh JP. An empirical analysis of self-reported, work-limiting disability. *Med Care*. 1985;23:310-319.
  11. Leigh JP. Occupation and coronary disease: schooling as a confounder. *JAMA*. 1988;259:157-158. Letter.
  12. Leigh JP, Fries JF. Education level and rheumatoid arthritis: evidence from five data centers. *J Rheumatol*. 1991;18:24-34.
  13. Leigh JP, Fries JF. Occupation, income, and education as independent covariates of arthritis in four national probability samples. *Arthritis Rheum*. 1991;34:984-995.
  14. Leigh JP, Fries JF, Hubert HB. Gender and race differences in the correlation between body mass and education. *J Epidemiol Community Health*. 1992;46:191-196.
  15. Fuchs VR. Time preference and health: an exploratory study. In: Fuchs VR, ed. *Economic Aspects of Health*. Chicago: University of Chicago Press; 1982.
  16. Behrman JR, Wolfe BL. Does schooling make women better nourished and healthier? *J Hum Resour*. 1989;24:644-663.
  17. Leigh JP. Schooling and use of seat belts. *South Econ J*. 1990;57:195-207.
  18. Berger MC, Leigh JP. Schooling, self-selection, and health. *J Hum Resour*. 1989;24:433-455.
  19. Kenkel DS. Health behavior, health knowledge and schooling. *J Polit Econ*. 1991;99:287-305.

## Winkleby and Colleagues Respond

It is apparent from the literature cited by Dr. Leigh that the powerful link between socioeconomic status (SES) and

health has generated research from multiple disciplines. We reviewed the references cited by Dr. Leigh and agree that all share some similarities with our topic. However, we did not find any replication of our research that quantifies the independent associations between the three main dimensions of SES (education, income, and occupation) and a set of risk factors for disease.

Dr. Leigh observes that many economists who have examined associations between schooling and indicators of health over the last several decades have emphasized that "education is more important than income in its association with health." Furthermore, he points out that economists have stressed that only when all three dimensions of SES are simultaneously accounted for can unbiased estimated associations be obtained.

The multidisciplinary finding that education is more strongly associated with health than are income or occupation has generated diverse hypotheses regarding the mechanisms through which education may positively influence health. We agree that it may not be years of education per se that confer a health advantage. It is the challenge of future researchers to assess the role of education by evaluating Fuchs' hypothesis that education is a proxy for ability to delay gratification, our hypothesis that education protects against disease (by facilitating an individual's acquisition of positive social, psychological, and economic skills), and other hypotheses. □

Marilyn Winkleby, PhD  
Darius E. Jatulis, MS  
Erica Frank, MD, MPH

Requests for reprints should be sent to Marilyn Winkleby, PhD, Stanford Center for Research in Disease Prevention, 1000 Welch Rd, Palo Alto, CA 94304-1885.

## Computerized Multiple Cause-of-Death Information Available from NCHS

We were pleased to see the discussion by Cottrell et al.<sup>1</sup> regarding the utility of multiple cause-of-death information as a surveillance tool for occupation-related deaths. However, we would like to point out an error. The authors state that due to the "lack of access to computerized multiple cause-of-death files . . ." the use of these data is limited.<sup>P119</sup> In fact, the National Center for Health Statistics (NCHS) of the Centers for Disease Control annually prepares publicly available computer-

ized multiple cause-of-death tapes for the United States and the states, separately identified.<sup>2</sup> The tapes can be obtained from the National Technical Information Service. Furthermore, since 1985, the usual occupation and industry of the decedent has been included on these tapes for an increasing number of states, although not for the District of Columbia.

Using the publicly available 1987 multiple cause-of-death tape, I identified for the District of Columbia one death due to asbestosis (ICD-9 501) and four deaths due to mesothelioma (ICD-9 163.9). This is the same number identified for 1987 by Cottrell et al.<sup>1</sup> and reflects, presumably, the same individuals. Therefore, the NCHS tapes provide information similar to that determined by manual review. (Of these individuals, only two would have been identified if the underlying cause of death had been used.)

Using national statistics, I discussed some time ago the importance of and problems associated with using multiple cause-of-death information for occupational health epidemiology.<sup>3</sup> Furthermore, national statistics are regularly reported for the diseases noted in the article by Cottrell et al.<sup>1</sup> in the annual publication *Health United States*. In *Health United States, 1990*<sup>4</sup> data on sentinel occupation-related deaths among men aged 25 years or older are presented for 1980 through 1986, excluding 1981 and 1982, for which years only half of the multiple cause-of-death information was processed by NCHS because of budget constraints. For these years, only 83% of malignant neoplasms of the peritoneum and pleura deaths (an approximation to mesothelioma neoplasms), 36% of coal workers' pneumoconiosis deaths, 25% of asbestosis deaths, and 44% of silicosis deaths were identified through the underlying cause of death. These figures are not substantially different from the 15/48 (31%) of occupation-related deaths that were identified by Cottrell et al.<sup>1</sup> through the underlying cause of death. Therefore, the national experience is similar to the District of Columbia experience. □

Diane K. Wagener, PhD  
Diane M. Makuc, DrPH  
Harry Rosenberg, PhD

The authors are with the National Center for Health Statistics.

Request for reprints should be sent to Diane K. Wagener, PhD, Office of Analysis and Epidemiology, National Center for Health Statistics, 6525 Belcrest Rd, Hyattsville, MD 20782.