Inequalities and Primary Care

PRIMARY CARE, INCOME INEQUALITY, AND SELF-RATED HEALTH IN THE UNITED STATES: A MIXED-LEVEL ANALYSIS

Leiyu Shi and Barbara Starfield

Using the 1996 Community Tracking Study household survey, the authors examined whether income inequality and primary care, measured at the state level, predict individual morbidity as measured by self-rated health status, while adjusting for potentially confounding individual variables. Their results indicate that distributions of income and primary care within states are significantly associated with individuals' self-rated health; that there is a gradient effect of income inequality on self-rated health; and that individuals living in states with a higher ratio of primary care physician to population are more likely to report good health than those living in states with a lower such ratio. From a policy perspective, improvement in individuals' health is likely to require a multi-pronged approach that addresses individual socioeconomic determinants of health, social and economic policies that affect income distribution, and a strengthening of the primary care aspects of health services.

A growing body of literature demonstrates the association of primary care and health outcomes at the individual and ecological levels (1–14). Among the individual-level studies, the Rand Health Insurance Study demonstrated the benefit of access to primary care services, including improved vision, more complete immunizations, better blood pressure control, enhanced dental status, and lower estimated mortality in comparison with individuals having financial barriers to access in the form of cost sharing (15–17). Starfield (18) demonstrated the importance of entry-level access to primary care to better outcomes for 16 common types of conditions in children and youths. Shea and colleagues (19), using a case-control approach, demonstrated the impact of having a primary care physician. Men appearing at an emergency room in a large metropolitan area were characterized as having either complications of hypertension or another

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condition while incidentally having uncomplicated hypertension. The men with complications of hypertension were much less likely to have a source of primary care than those whose hypertension was an incidental finding. The presence or absence of a source of primary care was the most notable and significant difference between the two groups—even more important than insurance coverage. Using nationally representative survey data, Franks and Fiscella (20) showed, after controlling for differences in demographic characteristics, health insurance status, health perceptions, reported diagnoses, and smoking status, that adult respondents who reported a primary care physician rather than a specialist as their regular source of care had lower subsequent mortality and lower annual health care costs.

There has also been increasing evidence associating primary care with improved health outcomes at the ecological level. One ecological study encompassing 11 western industrialized countries characterized the strength of the primary care infrastructures (9, 21). It scored five characteristics of the health system considered conducive to a strong primary care infrastructure, including primary care physician/population ratios (PC/population), and six characteristics of people's experiences in receiving care generally considered to reflect strong primary care. Countries with weak primary care infrastructures had higher costs and poorer outcomes. Other evidence comes from ecological studies of the relationship between PC/population ratios and various types of health outcomes in the United States. Both Shi (8, 10) and Farmer and colleagues (22) found better health outcomes in states with higher PC/population ratios, after controlling for sociodemographic measures (percent elderly, percent urban, percent minority, education, income, unemployment, pollution) and lifestyle factors (seatbelt use, obesity, and smoking). These studies operationalized *primary care* as physicians in family practice and general practice, general internal medicine, and general pediatrics. In the United States, primary care is principally the responsibility of physicians in these specialties (23). Parchman and Culler (24) demonstrated that geographic areas with more family and general physicians per population had lower hospitalization rates for conditions that should be preventable with good primary care; the same was not the case for general internists or general pediatricians. Moreover, there is evidence that primary care physicians are more likely to achieve cardinal primary care functions with known relationships to improved health outcomes (25, 26).

Even after controlling for the adverse impact of income inequality on health, recent studies at both the U.S. state and Metropolitan Statistical Area levels have demonstrated that the PC/population ratio remains significantly associated with improved health status, whether measured by life expectancy, age-adjusted mortality, or leading causes of death (27, 28). These ecological studies suggest that primary care attenuates, although does not eliminate, the severe adverse impact of income inequality on population health.

No studies have as yet been conducted at both the ecological and individual levels (i.e., mixed-level) to examine whether the ecological measure of primary care is significantly associated with the individual-level measure of health, while controlling for confounding variables at the individual level. Although ecological studies are important in their own right—given that population-level characteristics and patterns of exposure cannot be viewed merely as the sum of effects on the individuals in that population (29–31)—the ecological effects are ultimately manifested on individuals. One mixed-level analysis used a state-level measure of income inequality and an individual-level measure of health from the combined 1993–94 survey of the behavioral risk factor surveillance system. Kennedy and coworkers (32) found, after controlling for personal characteristics and household income, that individuals living in states with the greatest inequalities in income were 30 percent more likely to report their health as fair or poor (rather than good to excellent) than individuals living in states with the smallest inequalities in income.

Our current study adopted the methodology used by Kennedy and colleagues, with both state-level and individual-level data obtained from the 1996 Community Tracking Study household survey. The purpose was to examine whether income inequality and primary care measured at the state level predict individual morbidity as measured by self-rated health status (rated as excellent, very good, good, fair, or poor), while adjusting for potentially confounding individual variables including sex, age, race/ethnicity, education, employment, wage, poverty, health insurance, physical health, and smoking. Self-rated health has strong predictive validity for mortality, morbidity, and mental health, independent of other physiological, behavioral, and psychosocial risk factors (32–35). Using a mixed-level model that includes both ecological (income distribution and PC/population ratio within a state) and individual variables enhances model specification and allows us to test for a contextual effect of income and primary care distribution on individual-level health.

METHODS

Data and Measures

We used state-level and individual-level data for 1996. The state-level data included income distribution and PC/population ratio.

Income distribution was measured by the Gini coefficient, a commonly used indicator of income inequality wherein higher values indicate greater inequality in income distribution (36, 37). It is derived from the Lorenz curve, a mechanism that graphically represents the cumulative share of the total income accruing to successive income intervals. Data used to calculate the Gini coefficient at the state level came from the 1996 Current Population Survey (38), which provides annual data on household income for 25 income intervals. Counts of the number of

households in each income interval, along with the total aggregate income and the median household income, were obtained for each state. The Gini coefficient was calculated using software developed by E. Welniak (39). As in the study by Kennedy and colleagues (32), states were divided into four categories based on the distribution of the Gini coefficient. *Category 1* represents states with the smallest inequality in income, those with coefficients less than one standard deviation (1 S.D.) below the 0.43 mean coefficient for the United States in 1996 (<0.40); *category 2*, states with coefficients between 1 S.D. below the mean and the mean (0.40–0.43); *category 3*, states with coefficients between the mean and 1 S.D. above the mean (0.43–0.46); and *category 4,* states with the greatest inequality in income (>0.46).

The measure of primary care, as in previous state-level analysis (27), was the PC/population ratio, defined as primary care physicians who were in active office-based patient care per 10,000 civilian population. The primary care specialties included family practice and general practice (combined), general internal medicine, and general pediatrics (1). Data were obtained from the American Medical Association Physicians Master File.

At the individual level, data were drawn from the 1996 Community Tracking Study (CTS) household survey, a major initiative of the Robert Wood Johnson Foundation. CTS is a national study of the rapidly changing health care market and the effects of these changes on people's care-seeking behavior and health. The study develops an information base designed to track and analyze change. CTS has three objectives: tracking changes in health systems, tracking changes in outcomes, and understanding the effect of health-system changes on outcomes.

For 1996, CTS collected data on 60 communities defined as counties or groups of counties based on Metropolitan Statistical Areas (MSA) (for metropolitan communities) and Bureau of Economic Analysis Economic Areas (for nonmetropolitan communities) (40). An area is defined as an MSA if it has a city with a population of at least 50,000 or an urbanized area of at least 50,000 population with a total metropolitan population of at least 100,000 (41). In addition to the county containing the central city, an MSA may include additional counties having close economic/social ties to the central county. The MSAs include entire counties, except for the six New England states, where towns/cities are the units of definition because of the absence of county governments. The 60 communities were randomly selected with probability in proportion to population to ensure representation of the U.S. population. Within each community, households were randomly selected through random-digit dialing, and a field sample represented household with no telephones or with intermittent telephone service. Information was obtained on all adults in the household and one randomly selected child within each family in the household. All families within a household were interviewed separately in English or (for respondents not fluent in English) in Spanish. Stratification by region and systematic sampling by state ensured the full

diversity of health delivery systems across the nation, as well as diversity with respect to historical evolution and community "culture," as reflected by differences across regions and states. More detailed discussions of the design and scope of CTS are available elsewhere (42–44).

In our study, individual-level measures included self-rated health status and sociodemographic characteristics related to health status. Self-rated health status served as the dependent, outcome variable and was coded 1 for respondents reporting excellent, very good, or good health (hereafter referred to as good/excellent health) and 0 for those reporting fair or poor health. Sociodemographic measures served as covariates and included information on sex, age, race/ethnicity, education, paid work (employment and type), hourly wage, family income (where poverty status is derived), health insurance, SF-12 physical health score,[1] and smoking, all of which are associated with health status (45, 46). The SF-12 physical health score was used for adults only, and a dummy category was therefore used for children in the logistic regression model to reduce the number of missing values.

Analysis

The analyses were weighted to represent the civilian non-institutionalized population of the continental United States. The SUDAAN software (47) was used to take into account the complex CTS design, including the clustering of the sample in the 60 communities, the inclusion of multiple families within a household, the sampling of multiple adults within families, and the random selection of one child (48).

To examine the association between primary care, income inequality, and self-rated health, we first looked at the bivariate association of these measures using Chi-square for categorical variables and *t*-test for continuous variables. Logistic regression was then performed to examine the relation between a state's income inequality and primary care and self-perceived health. A second logistic regression model examined the same relation while adjusting for the sociodemographic characteristics of individuals. We present both the odds ratios and their 95 percent confidence intervals (C.I.), along with a test of significance of the coefficients. An odds ratio greater than one indicates that in comparison with the reference group, the associated group raises the probability of reporting good or excellent health (or lowers the probability of reporting fair or poor health). An odds ratio less than one indicates that in comparison with the reference group, the associated group lowers the probability of reporting good or excellent health (or raises the probability of reporting fair or poor health).

[1] SF-12 is a short-form health survey with only 12 questions that yield summary physical and mental health outcome scores for the individual. It is one of the most widely used health surveys. SF-12 was adapted from the more lengthy SF-36 health survey and published in early 1995. More detailed information may be obtained from the survey's Website (http://www.sf-36.com/).

RESULTS

Table 1 summarizes the characteristics of the respondents and the bivariate relations with reported fair or poor health. The differences in sample sizes and the population they represent for different variables are due to differences in missing values. In the bivariate analyses, income inequality was significantly associated with reporting fair/poor health ($P < .05$). Among respondents living in states with the worst income distribution (category 4), 16 percent reported fair/poor health. In contrast, among those living in states with the best income distribution (category 1), 10 percent reported fair/poor health. About 13 percent reported fair/poor health in the other two categories of income distribution. Primary care was also significantly associated with reporting fair/poor health ($P < .01$). The mean PC/population ratio was 8.87 primary care physicians per 10,000 population for respondents reporting fair/poor health, but 9.06 per 10,000 population for those reporting good/excellent health.

Most sociodemographic characteristics were also significantly associated with self-rated health. Females, elders, racial/ethnic minorities, those with lower education level, the unemployed, the low-income, those with income below the poverty level, the uninsured, the less healthy (measured by the SF-12), and smokers were more likely to report fair/poor health than were males, younger people, whites, those with higher education level, the employed, the high-income, those with income above the poverty level, the insured, the more healthy, and nonsmokers, respectively ($P < .01$). The sociodemographic characteristics demonstrating the greatest disparity in reported health were education, employment, age, income under the poverty level, and race/ethnicity. Among those with less than 12 years of education, 36 percent reported fair/poor health; among those with more than 16 years of education, less than 7 percent reported fair/poor health. Also reporting fair/poor health were 27 percent of the unemployed, but less than 9 percent of the employed; 28 percent of the elderly (age 65 and over), but less than 5 percent of those under 18 and 13 percent of those age 18 to 64; 25 percent of those with below-poverty income, but less than 9 percent of those with above-poverty income; 22 percent of Hispanics, 17 percent of blacks, and 15 percent of native Americans, Asian/Pacific Islanders, and other minorities, but less than 11 percent of whites.

Table 2 presents the multivariate odds ratios for the effects of income inequality and primary care on self-rated health. Both income inequality and primary care were significantly associated with self-rated health. The odds ratios of the Gini coefficient for income inequality show a gradient relation between income distribution and self-rated health. Compared with respondents living in states with the worst income distribution (category 4), those living in states with the best income distribution (category 1) were 1.87 times more likely to report good/excellent health ($P < .01$). Those in categories 2 and 3 were 1.44 and 1.38 times more likely to report good health ($P < .01$). The odds ratio of the

PC/population ratio indicates that every additional primary care physician per 10,000 population was associated with a 5 percent increase in the odds of reporting good/excellent health.

The effects of income inequality and primary care were attenuated somewhat, although remained significant, after including the sociodemographic covariates in the analysis (Table 2). There remains an increased odds of 33 percent of reporting good/excellent health for those living in states with the best income distribution (category 1) compared with those living in states with the worst income distribution (category 4). An additional primary care physician per 10,000 population was associated with a 2 percent increase in the odds of reporting good/excellent health. The sociodemographic covariates significantly associated with reporting good/excellent health were white race/ethnicity (relative to minority), higher education (relative to lower education), income above poverty level (relative to income below poverty level), privately insured (relative to uninsured or publicly insured), and nonsmoking. Sex, employment status, and employment type were no longer significant after adjusting for other sociodemographic characteristics.

DISCUSSION

The findings of this study corroborate those of other studies using different variables at the state and Metropolitan Statistical Area levels: both income inequality and primary care were significantly associated with the health indicator (27, 28). The distributions of income and primary care in states are significantly associated with individuals' self-rated health, after adjusting for confounding individual variables. We found, after controlling for individual covariates, that those living in states with less income inequality are 1.2 to 1.3 times more likely to report good/excellent health than those living in states with greater income inequality. The adjusted odds ratios of the Gini coefficient of income inequality are comparable to, although slightly higher than, those obtained by Kennedy and colleagues (32): 1.16 to 1.33 versus 1.11 to 1.25. The higher Gini coefficient in our study reflects a worsening income distribution at the state level in 1996 compared with 1990–92 (the years of the data used in the study by Kennedy and colleagues). Both studies found a gradient effect of income inequality on self-rated health: those living in states with a lower level of income inequality are more likely to report good/excellent health than those living in states with a higher level of income inequality. The gradient effect was less pronounced in the complete model, although those living in states with the highest level of income inequality are more likely to report fair/poor health than are those living in states with lower levels of income inequality. The similar results from the two studies, using different data sets and covering different years, indicate the robustness of the finding.

Table 1

Characteristics of respondents and percentage reporting fair or poor health, the 1997 Community Tracking Study household survey

Characteristics	Sample size	Population (%)	Percent reporting fair/poor health	*P* value
GINI COEFFICIENT				
<0.4038[a]	2,940	19,178,945 (7.28)	10.35	
0.4038–0.4313	23,373	107,628,740 (40.85)	12.76	
0.4314–0.4590	25,477	105,513,475 (40.04)	12.96	
>0.4590[b]	7,095	31,167,974 (11.83)	15.65	0.04*
PC/POP RATIO[c]				
Fair/poor health	6,967	34,267,832 (11.83)	8.87 (2.60)	
Good/excellent health	53,288	229,221,301 (88.17)	9.06 (2.36)	0.00**
SEX				
Male	27,503	128,334,858 (48.71)	11.61	
Female	31,382	135,154,275 (51.29)	14.33	0.00**
AGE				
17	10,647	68,350,446 (25.94)	4.70	
18–64	41,228	160,118,923 (60.77)	13.28	
65	7,010	35,019,765 (13.29)	27.94	0.00**
RACE/ETHNICITY				
Black	6,649	32,835,281 (12.46)	17.10	
Native/Asian/Pacific/other	3,480	15,255,266 (5.79)	14.88	
Hispanic	5,236	29,437,019 (11.17)	21.82	
White	43,224	184,607,615 (70.06)	10.69	0.00**
EDUCATION (years)				
>16	5,043	13,858,198 (7.10)	6.74	
13–16	19,780	77,961,639 (39.94)	9.20	
12	17,467	68,033,947 (34.86)	15.03	
0–11	5,955	35,327,934 (18.10)	36.04	0.00**
PAID WORK				
No	17,160	76,390,426 (39.15)	27.30	
Yes	31,078	118,748,262 (60.85)	8.59	0.00**

Table 1

(Cont'd.)

Characteristics	Sample size	Population (%)	Percent reporting fair/poor health	*P* value
EMPLOYMENT TYPE				
Federal government	937	3,623,932 (3.05)	7.43	
State government	2,167	7,401,664 (6.23)	8.23	
Local government	1,993	7,260,475 (6.11)	8.10	
Self-employment	4,129	15,800,607 (13.31)	8.91	
Private	21,852	84,661,585 (71.30)	8.65	0.71
HOURLY WAGE				
$0.1–4.99	1,726	7,668,986 (6.47)	14.85	
$5.00–9.99	10,087	41,567,342 (35.05)	11.55	
$10.00–14.99	7,998	30,564,525 (25.78)	6.73	
$ 15.00	11,226	38,778,822 (32.70)	5.64	0.00**
POVERTY LEVEL				
Below	6,985	40,871,807 (15.51)	24.93	
Above	51,900	222,617,326 (84.49)	10.82	0.00**
HEALTH INSURANCE				
Insured	51,735	227,526,934 (86.35)	12.46	
Uninsured	7,150	35,962,199 (13.65)	16.45	0.00**
SF-12 PHYSICAL HEALTH SCORE				
53.49 (median value)	24,188	102,494,461 (52.51)	29.27	
<53.49 (median value)	24,058	92,690,522 (47.79)	1.14	0.00**
SMOKE EVER				
No	24,671	98,580,738 (50.69)	13.68	
Yes	23,426	95,905,062 (49.31)	18.17	0.00**

[a]States with the smallest inequalities in income.
[b]States with the greatest inequalities in income.
[c]Means and standard deviations are reported; the significance is based on *t*-test.
*$P < .05$; **$P < .01$

Table 2

Odds ratios (95% confidence intervals) for respondents reporting good, very good, or excellent health

Characteristics	Odds ratio adjusted for primary care (95% C.I.)	Odds ratio adjusted for primary care and sociodemographics (95% C.I.)
GINI COEFFICIENT		
<0.4038[a]	1.87 (1.53–2.28)**	1.33 (1.17–1.52)**
0.4038–0.4313	1.44 (1.21–1.71)**	1.16 (1.03–1.31)**
0.4314–0.4590	1.38 (1.17–1.63)**	1.27 (1.12–1.43)**
>0.4590[b]	1.00	1.00
PC/POP RATIO[c]	1.05 (1.03–1.07)**	1.02 (1.01–1.04)**
SEX		
Male		1.02 (0.95–1.09)
Female		1.00
AGE		
17		1.00 (1.00–1.00)
18–64		0.63 (0.57–0.70)**
65		1.00
RACE/ETHNICITY		
Black		0.82 (0.75–0.90)**
Native/Asian/Pacific/other		0.82 (0.69–0.99)*
Hispanic		0.41 (0.36–0.46)**
White		1.00
EDUCATION (years)		
>16		2.64 (2.33–3.00)**
13–16		2.25 (2.02–2.49)**
12		1.81 (1.64–2.00)**
0–11		1.00
PAID WORK		
No		0.47 (0.10–2.21)
Yes		1.00
EMPLOYMENT TYPE		
Federal government		1.19 (0.84–1.68)
State government		0.96 (0.76–1.22)
Local government		0.91 (0.75–1.11)
Self-employment		1.01 (0.85–1.19)
Private		1.00

Table 2

(Cont'd.)

Characteristics	Odds ratio adjusted for primary care (95% C.I.)	Odds ratio adjusted for primary care and sociodemographics (95% C.I.)
HOURLY WAGE		
$0.1–4.99		0.93 (0.75–1.15)
$5.00–9.99		0.84 (0.75–0.95)**
$10.00–14.99		1.05 (0.92–1.20)
$ 15.00		1.00
POVERTY LEVEL		
Below		0.78 (0.71–0.86)**
Above		1.00
HEALTH INSURANCE		
Public		0.64 (0.56–0.73)**
Private		1.43 (1.28–1.59)**
Uninsured		1.00
SF-12 PHYSICAL HEALTH SCORE		
53.49 (median value)		0.04 (0.03–0.04)**
<53.49 (median value)		1.00
SMOKE EVER		
No		1.30 (1.22–1.39)**
Yes		1.00

[a]States with the smallest inequalities in income.
[b]States with the greatest inequalities in income.
*$P < .05$; **$P < .01$ for differences from reference group (odds ratio = 1.00).

This is the first study to establish a contextual effect of primary care on individuals' self-rated health. Previous ecological studies have demonstrated a consistent impact of primary care on population health indicators (8, 10, 27, 28), but none has examined whether the ecological measure of primary care exerts an independent effect on an individual measure of health. Our study demonstrates that individuals living in states with a higher PC/population ratio are more likely to report good/excellent health than those living in states with a lower PC/population ratio, even after adjusting for socioeconomic determinants of health status. This mixed-level analysis indicates that the association between primary care and

health is not likely to be the product of the ecological fallacy. The finding of a significant association between primary care and self-rated health contributes to the mounting evidence that specific aspects of health services have an independent effect in improving population health (1, 49, 50)–in particular, the beneficial effects of primary care. That socioeconomic status measures attenuate, although do not eliminate, the effect of both income inequality and primary care on self-rated health suggests that socioeconomic characteristics remain critical in influencing individuals' health. From a policy perspective, improvement in individuals' health is likely to require a multi-pronged approach that addresses individual socioeconomic determinants of health, social and economic policies that affect income distribution, and a strengthening of the primary care aspects of health services.

The current study contributes to the literature on relative social position and health. Although a variety of mechanisms have been postulated to account for the processes through which income inequality might affect health (51), there is no convergence on the mechanisms by which the effect occurs. Psychosocial theories give overriding influence to the psychological effects of income disparities on groups and individuals in the population. According to these theories, phenomena such as alienation are the main path of the ill effect on health (8–10). Social capital explanations hold that social relationships influence health either directly or through other phenomena. One postulated explanation is that more egalitarian areas are more socially cohesive, leading to less psychosocial stress and better health status. For example, Kawachi and coworkers have demonstrated that where income differences are smaller, people are more trusting of one another and more likely to participate in communal activities, and this social cohesiveness is linked to lower overall mortality (52) and better self-rated health (53). Research also indicates the importance of political context and government policies in determining inequalities in a society and the level of health of its population (54). The structure of local government is important in establishing how representative and responsive authorities are to the needs and demands of all constituencies (55). These attitudes and structures will affect whether and how government acts through public policies to moderate social inequalities and, in particular, invest in education, welfare, public health, and environmental protection—all of which affect health outcomes.

Virtually all the published studies on the relationship between income inequality and health either explicitly or implicitly assume that adequacy of health services is not the mechanism by which income inequality affects health; even those who propose an important role for the policy context have not included health policy in their conceptualization. The results of this study suggest that primary care may serve as one pathway that mediates the adverse impact of income inequality. Granted, the measurement of primary care in this study remains crude for it does not capture the unequal distribution or concentration of primary care physicians across a state or reflect the adequacy of primary care practice by

primary care physicians. Further progress on the relationship between income inequality and health will be made by careful consideration of how income distribution might influence the health of individuals and populations through a variety of pathways including the provision of primary care as measured by its cardinal attributes, namely, first contact, longitudinality, comprehensiveness, and coordination.

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REFERENCES

1. Starfield, B. *Balancing Health Needs, Services, and Technology.* Oxford University Press, New York, 1998.
2. Institute of Medicine. *Defining Primary Care: An Interim Report.* National Academy Press, Washington, D.C., 1994.
3. Shi, L. Balancing primary versus specialty care. *J. R. Soc. Med.* 88: 428–432, 1995.
4. Politzer, R. M., et al. Primary care physician supply and the medically underserved. *JAMA* 266: 104–109, 1991.
5. Starfield, B. *Primary Care: Concept, Evaluation, and Policy.* Oxford University Press, New York, 1992.
6. Bindman, A. B., et al. Primary care and receipt of preventive services. *J. Gen. Intern. Med.* 11: 269–276, 1996.
7. Roos, N. Who should do the surgery? Tonsillectomy and adenoidectomy in one Canadian province. *Inquiry,* 16: 73–83, 1979.
8. Shi, L. The relation between primary care and life chances. *J. Health Care Poor Underserved* 3: 321–335, 1992.
9. Starfield, B. Primary care: Is it essential? *Lancet* 344: 1129–1133, 1994.
10. Shi, L. Primary care, specialty care, and life chances. *Int. J. Health Serv.* 24: 431–458, 1994.
11. Greenfield, S., et al. Outcomes of patients with hypertension and non-insulin-dependent diabetes mellitus treated by different systems and specialities: Results from the Medical Outcomes Study. *JAMA* 274: 1436, 1995.
12. Green, L. A. Science and the future of primary care. *J. Fam. Pract.* 42: 119, 1996.
13. Grumbach, K. Separating fad from fact: Family medicine, primary care, and the role of health services research. *J. Fam. Pract.* 43: 30, 1996.
14. Donaldson, M. S., and Vanselow, N. A. The nature of primary care. *J. Fam. Pract.* 42: 113, 1996.
15. Lohr, K. N., et al. Use of medical care in the Rand Health Insurance Experiment: Diagnosis and service specific analyses in a randomized controlled trial. *Med. Care* 24: S1–S87, 1986.
16. Goldberg, G. A., and Newhouse, J. P. Effects of cost sharing on physiological health, health practices, and worry. *Health Serv. Res.* 22: 279–306, 1987.

17. Newhouse, J. P., and the Health Insurance Group. *Free for All? Lessons from the Rand Health Insurance Experiment.* Harvard University Press, Cambridge, 1993.
18. Starfield, B. *Effectiveness of Medical Care: Validating Clinical Wisdom.* Johns Hopkins University Press, Baltimore, 1985.
19. Shea, S., et al. Predisposing factors for severe, uncontrolled hypertension in an inner-city minority population. *N. Engl. J. Med.* 327: 776–781, 1992.
20. Franks, P., and Fiscella, K. Primary care physicians and specialists as personal physicians: Health care expenditures and mortality experience. *J. Fam. Pract.* 47: 105–109, 1998.
21. Starfield B. Primary care and health. *JAMA* 266: 2268–2271, 1991.
22. Farmer, F. L., Stokes, C. S., and Fisher, R. H. Poverty, primary care and age-specific mortality. *J. Rural Health* 7: 153–169, 1991.
23. U.S. Department of Commerce and the Census Bureau. *Statistical Abstracts of the United States.* U.S. Government Printing Office, Washington, D.C., 1988–1992.
24. Parchman, M., and Culler, S. Primary care physicians and avoidable hospitalization. *J. Fam. Pract.* 39: 123–128, 1994.
25. Weiner, J., and Starfield, B. Measurement of the primary care roles of office-based physicians. *Am. J. Public Health* 73: 666–671, 1983.
26. Rosenblatt, R., et al. The generalist role of specialty physicians: Is there a hidden system of primary care? *JAMA* 279: 1364–1370, 1998.
27. Shi, L., et al. Income inequality, primary care, and health indicators. *J. Fam. Pract.* 48: 275–284, 1999.
28. Shi, L., and Starfield, B. Primary care, income inequality, and racial mortality in U.S. metropolitan areas. Paper submitted for publication.
29. Susser, M., and Susser, E. Choosing a future for epidemiology. I: Eras and paradigms. *Am. J. Public Health* 86: 668–673, 1996.
30. Susser, M., and Susser, E. Choosing a future for epidemiology. II: From black box to Chinese boxes and eco-epidemiology. *Am. J. Public Health* 86: 674–677, 1996.
31. Koopman, J. S., and Lynch, J. W. Individual causal models and population system models in epidemiology. *Am. J. Public Health* 89: 1170–1174, 1999.
32. Kennedy, B. P., et al. Income distribution, socioeconomic status, and self-rated health in the United States: Multilevel analysis. *BMJ* 317: 917–921, 1998.
33. Idler, E. L., and Benyamini, Y. Self-rated health and mortality: A review of twenty-seven community studies. *J. Health Soc. Behav.* 38: 21–37, 1997.
34. Idler, E. L., and Kasl, S. Self-ratings of health: Do they also predict change in functional ability? *J. Gerontol. B Psychol. Sci. Soc. Sci.* 50B: S344–353, 1995.
35. Farmer, M. M., and Ferraro, K. F. Distress and perceived health: Mechanisms of health decline. *J. Health Soc. Behav.* 39: 298–311, 1997.
36. Kaplan, G. A., et al. Income inequality and mortality in the United States. *BMJ* 312: 999–1003, 1996.
37. Lynch, J. W., et al. Income inequality and mortality in metropolitan areas of the United States. *Am. J. Public Health* 88: 1074–1080, 1998.
38. U.S. Census Bureau. Website: http://www.census.gov
39. Welniak, E. Unpublished. U.S. Census Bureau, 1988.
40. Cunningham, P. J. Pressures on safety net access: The level of managed care penetration and uninsurance rate in a community. *Health Serv. Res.* 34: 255–270, 1999.

41. Office of Resource and Planning, Bureau of Health Professions. *User Documentation for the Area Resource File (ARF).* February 1998 Release. Health Resources and Services Administration, Department of Health and Human Services, 1998.
42. Kemper, P., et al. The design of the Community Tracking Study. *Inquiry* 33: 195–206, 1996.
43. Metcalf, C. E., et al. *Site Definition and Sample Design for the Community Tracking Study.* Technical Publication No. 1. Center for Studying Health System Change, Washington, D.C., 1996.
44. Robert Wood Johnson Foundation. Website: http://www.rwjf.org/nation/jnation.htm
45. Sen, A. Mortality as an indicator of economic success or failure. *Econ. J.* 108: 1–25, 1998.
46. Evans, R. G., Barer, M. L., and Marmor, T. R. *Why Are Some People Healthy and Others Not? The Determinants of Health of Populations.* Aldine de Gruyter, New York, 1994.
47. SUDAAN [software]. Research Triangle Institute, Research Triangle Park, N.C.
48. Shah, B. V., Barnwell, G., and Bieler, F. S. *SUDAAN User's Manual, Release 7.0.* Research Triangle Institute, Research Triangle Park, N.C.
49. Lantz, P. M., et al. Socioeconomic factors, health behaviors, and mortality: Results from a nationally representative prospective study of US adults. *JAMA* 279(21): 1703–1708, 1998.
50. Bunker, J. Frazier, H., and Mosteller, F. Improving health: Measuring the effects of medical care. *Milbank Q.* 72: 225–228, 1994.
51. Starfield, B., and Shi., L. Determinants of health: Testing of a conceptual model. In *Socioeconomic Status and Health in Industrial Nations: Social, Psychological, and Biological Pathways,* edited by N. E. Adler et al., pp. 344–346. New York Academy of Sciences, New York, 1999.
52. Kawachi, I., et al. Social capital, income inequality, and mortality. *Am. J. Public Health* 87: 1491–1498, 1997.
53. Kawachi, I., Kennedy, B. P., and Glass, R. Social capital and self-rated health: A contextual analysis. *Am. J. Public Health* 89: 1187-1193, 1999.
54. Dye, T. R. *Politics in States and Communities,* Ed. 7. Prentice-Hall, Englewood Cliffs, N.J., 1991.
55. Banfield, E. C. *The Unheavenly City: The Nature and Future of Our Urban Crisis.* Free Press, Glencoe, Ill., 1961.

Direct reprint requests to:

Dr. Leiyu Shi
Department of Health Policy and Management
The Johns Hopkins School of Hygiene and Public Health
Hampton House, Room 409
624 North Broadway
Baltimore, MD 21205-1996