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## The convergence of vulnerable characteristics and health insurance in the US

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### Abstract

This study defines vulnerability as a multi-dimensional construct, reflected in the convergence of predisposing, enabling, and need attributes of risk. Using race, income, and self-perceived health status as indicators and based on eight rounds of the US 1996 panel of the Medical Expenditure Panel Survey, the study examined how the interactions of these vulnerable characteristics affect insurance coverage, a critical measure of health care access. The results of the study demonstrate insurance coverage does vary with the extent of vulnerability. While race and income significantly influence insurance coverage, respectively, there was relatively little disparity in insurance due to health status. Between race and income, income was a more significant predictor of lack of insurance coverage since low-income people regardless of race and health were significantly more likely to be uninsured or partially insured. However, it is important to note that minorities were disproportionately over-represented in the low-income or bad health groups so that any adverse association between income, bad health, and insurance status would affect minorities significantly more than whites. Among those with insurance, the most vulnerable group, the minority-low-income-bad health group or those with all the three vulnerability indicators, were most likely to be publicly insured. A policy implication is to target limited resources on insurance coverage for the more vulnerable groups, those with a convergence or cluster of predisposing, enabling, and need attributes of risk. © 2001 Elsevier Science Ltd. All rights reserved.

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Despite extensive research on vulnerable populations and national efforts at reducing disparity in health and health care between them and the general public, there is no explicit consensus as to what constitutes vulnerability. The Webster dictionary defines “vulnerable” as “capable of being physically wounded” or “open to attack or damage”. In a broad sense, vulnerability denotes susceptibility to poor health. From an epidemiological perspective, everyone is potentially vulnerable over an extended period of time. Yet, researchers and policymakers obviously do not have everyone in mind when they address vulnerable populations. Rather, research and policy regarding vulnerable populations

typically focus on distinct sub-populations, for example, racial or ethnic minorities, the uninsured, children, the poor, the chronically ill and disabled, the mentally ill, persons with acquired immunodeficiency syndrome (AIDS), alcohol or substance abusers, and homeless individuals (Aday, 1993a). For example, In *Healthy People 2000*, a US national prevention strategy for significantly improving the health of the American people, vulnerable populations were identified as those with low income, disabilities, and minority groups (US Department of Health & Human Services, 1991). The US federal government recently launched an initiative to eliminate racial and ethnic disparities in health, specifically, infant mortality, cancer screening and management, cardiovascular disease, diabetes, AIDS, and immunizations (US Department of Health & Human Services, 1998, 1999). A closer examination reveals that these sub-populations typically experience

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a convergence or interaction of multiple vulnerable characteristics. For example, racial or ethnic minorities are disproportionately distributed at the lower end of the socioeconomic ladder and experience worse health outcomes than white Americans (Council on Ethical & Judicial Affairs, 1990; Council on Scientific Affairs, 1991; Kramarow et al., 1999). The uninsured are more likely to be unemployed or work in small companies that do not offer health insurance than the insured and they experience greater barriers accessing health care (Monheit & Vistnes, 1997; Newacheck, Stoddard, Hughes, & Pearl, 1998; US Congress Office of Technology Assessment, 1992).

This paper provides a conceptual definition of vulnerability and applies this model to the examination of vulnerability and health insurance status, a follow-up on an earlier limited analysis of socio-demographic characteristics and insurance status published as a paper on data and trend (Shi, 2000). Since health insurance plays a significant role in ensuring access to, and continuity of, health care (Newacheck et al., 1998; Anonymous, 1997; Kogan et al., 1995; Muller, Patil, & Boilesen, 1998; US Congress Office of Technology Assessment, 1992; Angel & Angel, 1996; Schoen, Lyons, Rowland, Davis, & Puleo, 1997; Sox, Swartz, Burstin, & Brennan, 1998), and quality care contributes to improved health outcome (Safran et al., 1998; Starfield, 1992, 1998), ensuring insurance coverage for vulnerable populations is critical in improving their general health status. As demographic shifts and socioeconomic trends in the US will result in vulnerable populations becoming the majority within the twenty-first century, fundamental improvement of the nation's health cannot be accomplished without corresponding improvement in the health of vulnerable populations.

## Conceptual framework

### *Defining vulnerability*

From a health perspective, vulnerability refers to the likelihood of experiencing poor health and is determined by a convergence of predisposing, enabling, and need characteristics at both individual and ecological levels. Poor health can be manifested physically, psychologically, and/or socially. Since poor health along one dimension is likely to be compounded by poor health along others, the health needs are greater for those with problems along multiple dimensions than those with problems along a single dimension.

In laying out the now well-known access to care framework (Aday, 1993b), Aday and Andersen described predisposing characteristics as those that describe the propensity of individuals to use services including basic demographic characteristics (e.g., age,

sex, and family size), social structure variables (e.g., race and ethnicity, education, employment status, and occupation), and beliefs (e.g., general beliefs and attitudes about the value of health services); enabling characteristics as the means individuals have available to them for the use of services including resources specific to individuals and families (e.g., income and insurance coverage) and attributes of the community or region in which an individual lives; and need characteristics as health status or illness, which is the most important cause of health services use. Not only do these characteristics converge and determine individuals' access to health care, as Aday and Andersen purported, they also ultimately influence individuals' risk of contracting illness or recovering from illness for those already sick. While characteristics of need directly demonstrate individuals' risk of becoming ill, predisposing characteristics indicate the propensity of becoming ill and enabling characteristics reflect resources available to overcome illness. Thus, individuals are most vulnerable if they experience a convergence of predisposing, enabling, and need attributes of risk at both the individual and ecological or community level. By including vulnerability traits at the ecological level, this definition underlies the notion that vulnerability does not represent a personal deficiency of special populations, but rather the interaction effects of multiple factors over many of which individuals have little or no control (Aday, 1999). It justifies the role of society as a whole to address the concerns of vulnerable populations including access to health insurance coverage.

### *What constitutes vulnerable populations*

Although everyone is potentially vulnerable over an extended period of time, due to the differential susceptibility to predisposing, enabling, and need attributes of risk, some groups of the population face greater risk than others. These groups, termed vulnerable populations, represent diverse groups of individuals who experience wide disparity in access to health services, outcomes of health care, and higher relative risk of poor physical, psychological, and/or social health than the population as a whole (Aday, 1994; Lurie, 1997; Shortell, Gillies, Anderson, Erickson, & Mitchell, 1996). Various terms have been used to describe these populations, including underserved populations (Blumenthal, Mort, & Edwards, 1995), medically underserved (Sundwell & Tavani, 1991; Wrigley, Andres, & Davidson, 1996), medically disadvantaged (Sundwell & Tavani, 1991), underprivileged (Traugott, 1996), poverty-stricken populations, distressed populations, and American underclasses (Demko & Jackson, 1995). Vulnerable groups have included high-risk mothers and children, people of color, the poor, non-English

speaking patients, the chronically ill and disabled, the mentally ill, persons with AIDS, alcohol or substance abusers, the suicide- or homicide-prone, abusing families, homeless individuals, and recent immigrants and refugees (Aday, 1993a).

### *Operationalizing vulnerability in research*

In research, vulnerability may be studied by using distinct population groups defined by one or more vulnerable attributes. Examples of vulnerable groups defined by one risk attribute include racial/ethnic minority (predisposing characteristic), uninsured (enabling characteristic), and chronically ill (need characteristic). Examples of vulnerable groups defined by two risk attributes include uninsured racial/ethnic minority (predisposing and enabling), children with chronic illness (predisposing and need), and low-income persons with AIDS (enabling and need). Examples of vulnerable groups defined by the convergence of predisposing, enabling, and need attributes of risk include low-income family children with poor health, or uninsured minority in poor health. Moreover, sample size permitting, it is possible to include more than one risk attribute within predisposing, enabling, or need factors. For example, one can study minority children in low-income and uninsured families (two predisposing and one enabling attributes). The conceptualization of vulnerable sub-populations should be guided by the study purpose and availability of sufficient sample size for both the vulnerable groups and the groups with whom they are compared. Fig. 1 summarizes measures of predisposing, enabling, and need attributes of vulnerability at both individual and ecological levels. The operationalization of vulnerability is based on the presumption that the interaction between individual and ecological factors contributes to a higher likelihood of poor health.

Operationalizing vulnerability as a combination of disparate factors is preferred to studying individual factors separately because vulnerability when defined as a convergence of risks can best capture reality. Indeed, individuals or population groups considered more vulnerable rarely experience only one particular risk. They are more likely afflicted with multiple risks.

Examining vulnerability as a multi-dimensional construct can also demonstrate gradient relationship between vulnerability status and outcomes of interest and thus improve our understanding of the patterns and factors related to the outcomes of interest. The findings are likely to be more precise and can provide better guidance to policy makers. For example, if we are able to demonstrate a gradient relationship between vulnerability status and insurance coverage, our understanding of the patterns and factors in being uninsured in the US is enhanced and policy makers can thus use limited

resources to target those groups that are most vulnerable.

## **Methods**

### *Data*

Data for this study came from the household component (HC) of the 1996 panel of the medical expenditure panel survey (MEPS), a nationally representative survey of the US civilian non-institutionalized population cosponsored by the agency for healthcare research and quality (AHRQ) and the National Center for Health Statistics (NCHS). Since several of the policy-relevant vulnerable population sub-groups were oversampled including Hispanics and blacks, those with functional problems, and individuals with family income less than 200% of the poverty line, this data set affords an excellent opportunity to examine the insurance status of vulnerable populations. A more detailed discussion of the complex design of MEPS has been published elsewhere (Cohen, 1997a,b). The current analysis used all those who completed eight rounds of the survey. This recently released longitudinal dataset allows us to study family income and health insurance for the whole of 1996.

### *Measures*

Dependent variable: insurance status. We used the questions on health insurance from Round eight to determine individuals' insurance status for the whole year (based on 12 monthly responses for each insurance category). The final coding of insurance consisted of five categories: (1) Publicly insured — those with public insurance for each of the 12 months of 1996, (2) Privately insured — those with private insurance for each of the 12 months of 1996, (3) Privately and publicly insured or dual insurance — those with public or private insurance for each of the 12 months of 1996 AND for some or all of these months the individuals have both public and private insurance coverage, (4) Partially insured — those with either public or private insurance for at least one month but less than 12 months in 1996, and (5) Uninsured — those without any insurance coverage for each of the 12 months of 1996. Research indicates that compared to the continuously insured, those insured but with a recent time uninsured were at high risk of going without needed care (Schoen & DesRochs, 2000).

In the US, public insurance primarily refers to Medicaid (a means tested individual welfare program sponsored jointly by Federal and State government whose eligibility primarily depends on family and individual income and children), Medicare (an entitlement social

### ***Individual Level***

#### Predisposing

- Demographic variables: age and sex.
- Social structure variables: race and ethnicity, education, employment status, and occupation.
- Cultural variables: health belief, attitude, and behaviors (smoking, drinking alcohol, poor diet, drug abuse).

#### Enabling

- Assets and resources that contribute to one's ability to be economically self-sufficient: income and insurance.
- Mediating factors that include access to health care and quality of health care. Health care is broadly defined as services rendered at the individual level conducive to individual health including preventive, medical (i.e., primary, secondary, tertiary), and human services.

#### Need

- Self-perceived or evaluated health: self-perceived physical and mental health status; diagnosed illness.
- Quality of life: need assistance in Activity of Daily Living (ADL) such as dressing and eating, need assistance in Instrumental Activity of Daily Living (IADL) such as managing money and shopping for personal items, social limitations, cognitive limitation, and limitation in work, housework, or school.
- Sub-populations: vulnerable to physical health – high-risk mothers and infants, chronically ill and disabled individuals, persons with AIDS; vulnerable to mental health – mentally ill and disabled, alcohol or substance abusers, suicide- or homicide-prone; vulnerable to social health - abusing families, homeless people, immigrants and refugees.

### ***Ecological: system, social, and environmental level***

#### Predisposing

- Residence (MSA<sup>†</sup> vs. non-MSA, rural vs. urban), crimes, stress, social inequality, income inequality, wealth inequality, industrialization.

#### Enabling

- Social assets (social capital) refer to characteristics of one's social network that provide emotional and instrumental support, such as family structure, friendship ties, neighborhood connections, and religious organizations. coverage), and attributes of the community or region in which an individual lives.
- Health care delivery system: availability, accessibility, and utilization of preventive, medical, public health, and human services care.

#### Need

- Community health indicators including mortality, morbidity, and quality of life measures.

<sup>†</sup> Metropolitan Statistical Areas (MSA). An area is defined as an MSA if there is a city with a population of at least 50,000 or if there is an urbanized area of at least 50,000 population with a total metropolitan population of at least 100,000.

Fig. 1. Measures of predisposing, enabling, and need attributes of vulnerability at individual and ecological levels.

welfare program sponsored by Federal government whose eligibility primarily depends on age currently set at 65), and CHAMPUS (civilian health and medical program of the uniformed services, a generous health insurance package for the dependents of personnel in uniformed services and military retirees). Private insurance includes either managed care (HMO) or fee-for-service. Since MEPS did not have detailed monthly information on the managed care status of the insurance plan, we could not further examine HMO versus non-HMO among the privately insured. Detailed discussion of US insurance schemes has been published elsewhere (Shi & Singh, 1998).

*Independent variable: vulnerability.* Based on the conceptualization of vulnerability discussed earlier in this paper, we identified measures within MEPS that denote predisposing, enabling, and need attributes of risk. We combined three of these variables into a new vulnerability measure that reflects the convergence of predisposing, enabling, and need attributes of risk. These were race (predisposing dimension), income (enabling dimension), and self-perceived health status (need dimension), and are among the most, although not the only, significant indicators of vulnerability. Self-rated health has strong predictive validity for mortality, morbidity, and mental health, independent of other

physiological, behavioral, and psychosocial risk factors (Idler & Kasl, 1995; Farmer & Ferraro, 1997; Idler & Benyamini, 1997; Kennedy, Kawachi, Glass, & Prothrow-Stith, 1998). It is possible to create a measure incorporating other vulnerable attributes (e.g., the more objective chronic illness measure for health status, the behavioral risks such as smoking, alcohol, and drug abuse for predisposing factor). However, the trade-off is that the resulting sample size for some sub groups would be too small for comparative analysis (e.g., chronic illness is likely to be more concentrated among the elderly population). To avoid small sub group sample size, we further re-coded these variables into dichotomous categories so that our final vulnerability measure was limited to eight categories: (1) the minority-low-income-bad health group (the most vulnerable group with vulnerable attributes in all three dimensions), (2) minority-low-income-good health group, (3) minority-high-income-good health group, (4) white-low-income-bad health group (these are also highly vulnerable groups with vulnerable attributes in two of the three dimensions), (5) minority-high-income-good health group, (6) white-low-income-good health group, (7) white-high-income-bad health group (these groups are less vulnerable with only one of the three vulnerable attributes measured), and (8) white-high-income-good health group (this is the least vulnerable group with none of the three vulnerable attributes measured). Minority included all non-white racial and ethnic groups including blacks, Hispanics, Asians, American Indians, and others.

Low income was based on the variable family income as a percentage of poverty within MEPS (POVCAT). This variable was constructed from data collected in the Round 3 Income Section. Family income comprised annual earnings from wages, salaries, bonuses, tips, commissions; business and farm gains and losses; unemployment and workman's compensation; interest and dividends; alimony, child support, and other private cash transfers; private pensions, IRA withdrawals, social security, and veterans payments; supplemental security income and cash welfare payments from public assistance, aid to families with dependent children, and aid to dependent children; gains and losses from estates, trusts, partnerships, S corporations, rent, and royalties; and a small amount of "other" income. Family income excluded tax refunds and capital gains. Person-level income totals were then summed over family members to yield the family-level total. POVCAT was constructed by dividing family income by the applicable poverty line (based on family size and composition), with the resulting percentages grouped into five categories: negative or poor, near poor, low income, middle income, and high income. For the purpose of this study, we grouped "negative or poor, near poor, low income" as "low income" and "middle income, high income" as

"high income". Due to confidentiality concerns, MEPS did not release family income as well as the components of person level income. Due to the definitions used by this study and missing values especially when multiple variables were combined to derive the vulnerability measure, the final sample was significantly reduced and correspondingly the population to which it represented.

Independent variable: covariates. Additional measures of vulnerability were included as covariates. These included age, sex, education, employment (individual predisposing), metropolitan statistical area (MSA) residence, region (ecological predisposing), perceived mental health status, and activities of daily living or ADL (individual need). The limitation of MEPS precluded the use of more individual or ecological vulnerability attributes as listed in Fig. 1. Other variables with too many missing values were also excluded.

### *Analysis*

The software SUDAAN was used for the data analysis due to the multi-stage, stratified cluster sampling of the MEPS. All analyses accounted for both the design effect and the sampling weights. Since many of the individual measures of vulnerability were correlated, logistic regressions were used to examine the independent effects of these individual characteristics on insurance status.

We did not include observations with missing values on our dependent (i.e., insurance status) and vulnerability measures. Observations with missing values on other measures (i.e., covariates) were still included in multivariate analyses. We created dummy categories for the missing values so that analyses could be performed with a larger sample size. None of the dummy categories affected the final outcome of the models.

Estimates presented in the text and tables were weighted to reflect national population totals. Unless otherwise stated, only differences that were significant at the level of 0.05 or higher (in a two-tailed test) are discussed here.

### **Results**

Table 1 displays the sample and population distributions of insurance coverage by vulnerability measured as the convergence of race, income, and self-perceived health status. Note, due to the exclusion of those with Medicare (an entitlement program for those over 65) and missing values as a result of coding, the sample of 19,116 individuals can be generalized to over 236 million or over 87% of US population. First of all, it is important to note that minorities were more likely to be classified as low-income or bad health than whites.

Table 1  
Vulnerability and health insurance coverage — 1996 US civilian noninstitutionalized population under 65

Vulnerability	Sample (Population)	Insurance coverage				
		Public insurance	Private insurance	Private & public insurance	Partial insurance	Uninsured
Minority-low income-bad health	271 (3,203,741)	46.50% (45.66%)	7.75% (8.02%)	4.43% (4.87%)	19.93% (19.44%)	21.40% (22.00%)
Minority-low income-good health	1,617 (18,621,820)	32.65% (28.50%)	19.05% (20.15%)	5.44% (5.36%)	21.77% (22.72%)	21.09% (23.28%)
Minority-high income-bad health	143 (1,737,083)	13.29% (13.67%)	50.35% (51.43%)	9.79% (8.37%)	15.39% (15.92%)	11.19% (10.65%)
Minority-high income-good health	1,649 (20,635,131)	4.37% (4.01%)	69.50% (68.72%)	3.34% (3.08%)	11.89% (12.16%)	10.92% (12.03%)
White-low income-bad health	742 (7,173,831)	35.58% (33.98%)	15.09% (16.89%)	5.66% (7.95%)	16.04% (14.77%)	27.63% (26.40%)
White-low income-good health	4,767 (47,837,440)	19.89% (16.92%)	27.96% (32.37%)	3.36% (4.27%)	20.85% (21.05%)	27.94% (25.39%)
White-high income-bad health	556 (6,904,166)	6.48% (5.02%)	63.67% (66.00%)	7.01% (7.57%)	9.53% (9.95%)	13.31% (11.47%)
White-high income-good health	9,371 (130,497,467)	2.57% (2.36%)	76.95% (78.14%)	2.45% (2.59%)	8.99% (9.05%)	9.04% (7.86%)
Total	19,116 (236,610,680)	11.69% (9.21%)	55.23% (60.14%)	3.35% (3.57%)	13.77% (13.21%)	15.97% (13.86%)

While 36% of the whites were of low income and 8% bad health, 51% of minorities were of low income and 11% bad health.<sup>1</sup>

Nationally, about 16% of the under 65 population were uninsured in 1996. Another 14% were partially insured that year. Just about 12% had public insurance, and only over 3% had both public and private coverage.

Low income was most associated with uninsurance and partial insurance. Among the low income, whites were more likely to be uninsured than minorities (27.63–27.94% for low-income whites versus 21.09–21.40% for low-income minorities). The probability of low-income whites becoming uninsured was 0.0804 (see Table 2, Panel 3, column uninsured: 0.0107+0.0697) and the corresponding probability for low-income minorities

was 0.0208 (see Table 2, Panel 3, column uninsured: 0.0030+0.0178). This could be due to the fact that a greater proportion of low-income minorities than whites were publicly insured (32.65–46.50% versus 19.89–35.58%) or partially insured (19.93–21.77% versus 16.04–14.77%). While public insurance, by design, was associated with low income and bad health, low-income whites, particularly those in good health, seemed to stay away from it.

Whites were more likely to be privately insured than minorities (15.09–27.96% for low-income whites versus 7.75–19.05% for low-income minorities; 63.67–76.95% for high-income whites versus 50.35–69.50% for high-income minorities). The corresponding probability of private insurance was 0.4712 for whites (see Table 2, Panel 3, column private: 0.0059+0.0697+0.0185+0.3772) but 0.0810 for minorities (see Table 2, Panel 3, column private: 0.0011+0.0161+0.0038+0.0600).

Low income was more significantly associated with lack of insurance than bad health. The probability of being uninsured was 0.0184 due to bad health (see Table 2, Panel 3, column uninsured: 0.0030+0.0008+0.0107+0.0039) but 0.1012 due to low income

<sup>1</sup>Minority low income: low-income minority/total minority = (271 + 1617)/(271 + 1617 + 143 + 1649) = 0.5130. White low income: low-income white/total white = (742 + 4767)/(742 + 4767 + 556 + 9371) = 0.3569. Minority bad health: bad health minority/total minority = (271 + 143)/(271 + 1617 + 143 + 1649) = 0.1125. White bad health: bad health white/total white = (742 + 556)/(742 + 4767 + 556 + 9371) = 0.0841.

Table 2  
Deriving the probability of insurance status

Panel 1. Probability of race, income, and health status							
Race	Income	Health	Sample	Race	Income	Health	Probability
Minority	Low	Bad	271	0.193	0.513	0.144	0.014
Minority	Low	Good	1617	0.193	0.513	0.856	0.085
Minority	High	Bad	143	0.193	0.487	0.080	0.007
Minority	High	Good	1649	0.193	0.487	0.920	0.086
White	Low	Bad	742	0.807	0.357	0.135	0.039
White	Low	Good	4767	0.807	0.357	0.865	0.249
White	High	Bad	556	0.807	0.643	0.056	0.029
White	High	Good	9371	0.807	0.643	0.944	0.490
			19116				1

  

Panel 2. Insurance status distribution									
Race	Income	Health	Sample	Public	Private	Private & Public	Partial	Uninsured	Total
Minority	Low	Bad	271	0.465	0.078	0.044	0.199	0.214	1.000
Minority	Low	Good	1617	0.327	0.191	0.054	0.218	0.211	1.000
Minority	High	Bad	143	0.133	0.504	0.098	0.154	0.112	1.000
Minority	High	Good	1649	0.044	0.695	0.033	0.119	0.109	1.000
White	Low	Bad	742	0.356	0.151	0.057	0.160	0.276	1.000
White	Low	Good	4767	0.199	0.280	0.034	0.209	0.279	1.000
White	High	Bad	556	0.065	0.637	0.070	0.095	0.133	1.000
White	High	Good	9371	0.026	0.770	0.025	0.090	0.090	1.000

  

Panel 3. Probability of combined vulnerability and insurance status								
Race	Income	Health	Public	Private	Private & public	Partial	Uninsured	Total
Minority	Low	Bad	0.0066	0.0011	0.0006	0.0028	0.0030	0.0142
Minority	Low	Good	0.0276	0.0161	0.0046	0.0184	0.0178	0.0846
Minority	High	Bad	0.0010	0.0038	0.0007	0.0012	0.0008	0.0075
Minority	High	Good	0.0038	0.0600	0.0029	0.0103	0.0094	0.0863
White	Low	Bad	0.0138	0.0059	0.0022	0.0062	0.0107	0.0388
White	Low	Good	0.0496	0.0697	0.0084	0.0520	0.0697	0.2494
White	High	Bad	0.0019	0.0185	0.0020	0.0028	0.0039	0.0291
White	High	Good	0.0126	0.3772	0.0120	0.0441	0.0443	0.4902
			0.1169	0.5523	0.0335	0.1377	0.1597	1.0000

(see Table 2, Panel 3, column uninsured:  $0.0030 + 0.0178 + 0.0107 + 0.0697$ ). The probability of being partially insured was 0.0130 due to bad health (see Table 2, Panel 3, column partial:  $0.0028 + 0.0012 + 0.0062 + 0.0028$ ) but 0.0794 due to low income (see Table 2, Panel 3, column partial:  $0.0028 + 0.0184 + 0.0062 + 0.0520$ ).

Table 3 presents results of logistic regression models associating the measure of vulnerability with insurance coverage while controlling for other covariates. These results indicate the likelihood of whether an individual with certain combination of vulnerable attributes will be insured. Three models were presented comparing insurance with uninsured or partially insured (model 1), partially insured only (model 2), and uninsured only (model 3). The odds ratios and their 95% confidence intervals (C.I.) were presented along with test of

significance of the coefficients. Individuals with Medicare or CHAMPUS were also included since the analysis focused on predictors of availability of insurance rather than type of insurance as presented in Table 1.

Controlling for other socio-demographic characteristics, the vulnerability measure remained highly significant. Compared with the least vulnerable group, the white-high-income-good-health group, those with vulnerable attributes were significantly more likely to be uninsured or partially insured (model 1). While the combination of minority and low-income status was the best predictor of no insurance, income was a more significant predictor of insurance coverage than race. Regardless of race, individuals with low income were significantly less likely to have insurance than those with high income. However, the odds of being uninsured were not significantly different between the minority-high-

Table 3

Logistic regressions of vulnerability, sociodemographic characteristics, and insurance status — 1996 U.S. Civillian noninstitutionalized population at all ages

Independent Variables	1 = Insured 0 = Uninsured or partially insured	1 = Insured 0 = Partially insured	1 = Insured 0 = Uninsured
	Odds Ratio (95% C.I.) Model 1	Odds Ratio (95% C.I.) Model 2	Odds Ratio (95% C.I.) Model 3
Intercept	81.34 <sup>c</sup> (33.51, 197.44)	150.00 <sup>c</sup> (49.94, 450.53)	202.16 <sup>c</sup> (56.63, 721.68)
Vulnerability			
Minority-low income-bad health	0.35 <sup>c</sup> (0.25, 0.48)	0.35 <sup>c</sup> (0.22, 0.55)	0.33 <sup>c</sup> (0.22, 0.50)
Minority-low income-good health	0.25 <sup>c</sup> (0.20, 0.30)	0.27 <sup>c</sup> (0.21, 0.35)	0.23 <sup>c</sup> (0.17, 0.29)
Minority-high income-bad health	0.71 (0.44, 1.16)	0.59 (0.32, 1.08)	0.84 (0.44, 1.59)
Minority-high income-good health	0.65 <sup>c</sup> (0.52, 0.81)	0.70 <sup>c</sup> (0.54, 0.91)	0.59 <sup>c</sup> (0.45, 0.77)
White-low income-bad health	0.36 <sup>c</sup> (0.28, 0.46)	0.47 <sup>c</sup> (0.33, 0.65)	0.28 <sup>c</sup> (0.21, 0.37)
White-low income-good health	0.25 <sup>c</sup> (0.21, 0.29)	0.28 <sup>c</sup> (0.23, 0.34)	0.21 <sup>c</sup> (0.17, 0.25)
White-high income-bad health	0.85 (0.63, 1.16)	0.92 (0.61, 1.38)	0.76 (0.53, 1.09)
White-high income-good health	Reference group		
Age			
< 17	0.06 <sup>c</sup> (0.04, 0.09)	0.09 <sup>c</sup> (0.05, 0.14)	0.04 <sup>c</sup> (0.02, 0.08)
18–64	0.02 <sup>c</sup> (0.02, 0.03)	0.04 <sup>c</sup> (0.03, 0.06)	0.01 <sup>c</sup> (0.01, 0.02)
65 +	Reference group		
Sex			
Male	0.82 <sup>c</sup> (0.76, 0.88)	0.96 (0.87, 1.06)	0.69 <sup>c</sup> (0.63, 0.76)
Female	Reference group		
Highest degree			
College	2.65 <sup>c</sup> (2.25, 3.12)	1.81 <sup>c</sup> (1.42, 2.30)	3.70 <sup>c</sup> (3.02, 4.52)
GED/high school	1.62 <sup>c</sup> (1.43, 1.83)	1.28 <sup>b</sup> (1.08, 1.53)	1.92 <sup>c</sup> (1.65, 2.24)
None	Reference group		
Employment status			
Employed	1.36 (0.72, 2.59)	0.96 (0.43, 2.15)	2.44 <sup>a</sup> (1.10, 5.41)
Unemployed	Reference group		
MSA			
Yes	1.07 (0.90, 1.27)	0.96 (0.79, 1.16)	1.16 (0.94, 1.44)
No	Reference group		
Region			
Northwest	1.35 <sup>c</sup> (1.13, 1.62)	1.27 <sup>a</sup> (1.03, 1.57)	1.48 <sup>c</sup> (1.17, 1.87)
Midwest	1.52 <sup>c</sup> (1.28, 1.80)	1.41 <sup>b</sup> (1.15, 1.72)	1.66 <sup>c</sup> (1.33, 2.07)
West	1.11 (0.93, 1.33)	1.19 (0.96, 1.48)	1.06 (0.87, 1.30)
South	Reference group		
Perceived mental health status			
Excellent	0.82 (0.49, 1.36)	0.85 (0.41, 1.76)	0.69 (0.39, 1.21)
Very good	0.77 (0.45, 1.29)	0.81 (0.39, 1.69)	0.64 (0.36, 1.13)
Good	0.79 (0.47, 1.33)	0.90 (0.43, 1.86)	0.63 (0.35, 1.12)
Fair	0.88 (0.51, 1.53)	0.86 (0.40, 1.85)	0.84 (0.47, 1.52)
Poor	Reference group		
Need ADL help/supervision			
Yes	2.73 <sup>c</sup> (1.61, 4.63)	2.33 <sup>a</sup> (1.18, 4.58)	3.16 <sup>b</sup> (1.56, 6.40)
No	Reference group		

<sup>a</sup>  $p < 0.05$ ,  
<sup>b</sup>  $p < 0.01$ ,  
<sup>c</sup>  $p < 0.001$ .

income-bad health group and the white-high-income-good-health group.

Consistent with the results of bivariate analyses, low-income groups were most likely to be uninsured or

partially insured (75% less likely to be insured for minority-low-income-good health and white-low-income-good health groups, 65% less likely to be insured for minority-low-income-bad health group, and 64% for

white-low-income-bad health groups, respectively). Among high-income groups, only minority-high-income-good health group was significantly less likely to have insurance than their white counterparts. Separate analyses with the uninsured (model 2) and partially insured (model 3) yield comparable results. Minority-low-income-good health group was mostly likely to be partially insured (73% less likely) followed by white-low-income-good health (72% less likely), minority-low-income-bad health (65% less likely), white-low-income-bad health (53% less likely), and minority-high-income-good health (30% less likely). White-low-income-good-health group was most likely to be uninsured (79% less likely) followed by minority-low-income-good-health (77% less likely), white-low-income-bad health (72% less likely), minority-low-income-bad health (67% less likely), and minority-high-income-good-health (41% less likely).

Other significant correlates of insurance were age, sex, education, region, and need for ADL help/supervision. Younger people were less likely to be insured than the elderly, male less than female, but those with education, particularly college degrees, were more likely to be insured than those with no education. Those living in the Northwest and Midwest were more likely to be insured than those living in the South. Those needing ADL help/supervision were more likely to be insured than those who did not.

## Discussion

This study defines vulnerability as a multi-dimensional construct, reflected in the convergence of predisposing, enabling, and need attributes of risk. This broad definition of vulnerability presumes that vulnerable populations are those that experience risks in clusters and that those susceptible to multiple risks (e.g., being of racial/ethnic minority, children, and poor) are likely to be more vulnerable than those susceptible to single risk (e.g., high-income minority or children of high socioeconomic status). Using race, income, and self-perceived health status as indicators, the study examined how the interactions of these characteristics affect insurance coverage, a critical measure of health care access. The US is unique among developed nations in having no universal system of access to health insurance. Analysis of this system is mainly of interest outside the US as a warning of what happens when one departs from systems that aim at social protection.

The results of the study demonstrate that insurance coverage does vary with the extent of vulnerability experienced. While race and income significantly influence insurance coverage, respectively, there was relatively little disparity in insurance due to health status. Between race and income, income was a more significant

predictor of lack of insurance coverage since low-income people regardless of race and health were significantly more likely to be uninsured or partially insured, whereas the same could not be said for the minority-high-income-bad-health group and the white-high-income-good-health group. These results suggest that public programs such as Medicaid have greatly reduced the disparity in insurance coverage due to race and health status, just as the government-mandated Medicare program has brought insurance coverage for the elderly.

While low-income whites were more likely to be uninsured than low-income minorities, it is important to note that minorities were disproportionately over-represented in the low-income or bad health groups so that any adverse association between income, bad health, and insurance status would affect minorities significantly greater than whites. The fulfillment of the healthy people 2010 goal of eliminating racial disparities in health would require concerted efforts on raising the socioeconomic status of racial and ethnic minorities in addition to improving their access to care.

Among those with insurance, the most vulnerable group, the minority-low-income-bad-health group or those with all three vulnerability indicators, were most likely to be publicly insured, whereas the least vulnerable group, the white-high-income-good-health group or those with none of the three vulnerability indicators, were least likely to be publicly insured (46.50% of the sample and 45.66% of the population for the most vulnerable group vs. 2.57% of the sample and 2.36% of the population for the least vulnerable group) but most likely to be privately insured (7.75% of the sample and 8.02% of the population for the most vulnerable group vs. 76.95% of the sample and 78.14% of the population for the least vulnerable group). That low-income whites seem to stay away from Medicaid suggests a possible two-tiered system associating the private program with better quality and reputation than the public program.

Taken together, these results have several implications for policy and research. To achieve maximum benefits, policy makers should spend limited resources on insurance coverage for the more vulnerable, for example, those with a convergence or cluster of predisposing, enabling, and need attributes of risk. These were individuals with the greatest need for insurance but less able to obtain it. From the perspective of this study, these are individuals who have low income and are racial/ethnic minorities. Significant progress at reducing disparities in care and quality across racial and ethnic groups (as called upon in *healthy people 2010*) is unlikely to be fulfilled without significantly improving access to care for the most vulnerable groups. Future research could study other combinations of vulnerability traits and examine their impact on health care access and quality. Only by highlighting the disparities between vulnerable and non- or less-vulnerable populations can

we target those who need help the most. Studies that treat socio-demographic correlates of vulnerability indiscriminately or independently are unlikely to identify the more vulnerable groups and the ensuing recommendations are likely to be less specific or useful.

The study had several limitations. First, as indicated before, the limitation of MEPS prevented us from studying a broad array of vulnerable characteristics particularly at the ecological level. Since ecological determinants of vulnerability such as social and economic contexts are critical, and effective approaches to mitigating vulnerability must broaden the design of health policy to address them (Aday, 1999), the lack of ecological indicators rendered the analyses incomplete. Even at the individual level, the MEPS sample frame excludes several of the most vulnerable segments of the US population, including the homeless, migrant workers, and persons in criminal institutions. Neither did MEPS contain measures of behavioral risks such as smoking, alcohol consumption, and drug abuse, all of which likely to contribute to vulnerability.

Second, the vulnerability framework laid out in this paper remains incomplete and further refinement is needed not only to include additional predisposing, enabling, and need attributes of risk at both individual and ecological levels, but also to assess their relative conceptual and practical significance in affecting health care, quality of care, and health status (or health improvement for those already sick). Research should also seek to determine the extent access to quality medical care and public health can mediate the adverse impact of vulnerability.

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