United States General Accounting Office

GAO

Report to the Chairman, Committee on Labor and Human Resources, U.S. Senate

November 1996

PUBLIC HEALTH

A Health Status Indicator for Targeting Federal Aid to States

GAO 75 years 1921 - 1996

GAO/HEHS-97-13

GAO

United States
General Accounting Office
Washington, D.C. 20548

Health, Education, and
Human Services Division

B-274670

November 13, 1996

The Honorable Nancy Kassebaum
Chairman, Committee on Labor
and Human Resources
United States Senate

Dear Madam Chairman:

The public health system plays an essential role in improving the health of the American population. It promotes the prevention of communicable diseases and of exposure to toxic environmental pollutants and helps guard against harmful products and poor-quality health care. During fiscal year 1993, federal, state, and local governments spent an estimated $14 billion on activities such as preventive services, health surveillance, outreach, training, and planning.

The federal government fulfills its role in improving public health in a variety of ways. For example, it coordinates with the states to set and implement national health policy. It also sponsors and administers programs for developing health resources and preventing and controlling diseases and alcohol and drug abuse. In fiscal year 1993, the federal government financed an estimated $3 billion, or about 20 percent, of the $14 billion spent on core public health functions by all levels of government.

As part of the federal effort, the Centers for Disease Control and Prevention (CDC) funds a variety of grant programs to state and local governments for such projects as immunization, human immunodeficiency virus (HIV) prevention, preventive health activities, and lead poisoning prevention. In fiscal year 1995, CDC distributed nearly $2 billion to the states for public health services.

On January 4, 1995, you introduced the Public Health Enhancement Act of 1995 (S. 142).[1] Under your proposal, 12 of the federal public health grants that are administered by CDC would have been consolidated into one integrated health system block grant (see app. I for a list of these programs). The goal of your proposal was to increase the efficiency and flexibility with which the public health system attends to state and regional health problems.

[1]S. 142 did not become law.

To help ensure that this block grant reflected this goal, you asked us to identify measures of the health status of states' populations that could be used to target federal funds. More specifically, you asked whether premature mortality rates[2] and number of people in poverty would be appropriate measures of—and proxies for—health status and whether other measures might also be used.

Using state-level data, we examined the relationship of premature mortality, people in poverty, and other measures to information on states' health status from two sources and assessed the appropriateness of including these proxies in an allocation formula for a federal public health block grant. The two sources we used were the Healthy People 2000 indicators, which consist of 18 indicators compiled by CDC, and a composite health status index developed by the ReliaStar Corporation.

To determine if cross-state differences in health status could be largely explained—and, therefore, represented in a funding formula—by one or just a few proxies, we undertook a statistical analysis to identify those variables that best accounted for cross-state differences in the Healthy People 2000 indicators and the ReliaStar index. First, we used principal component analysis to reduce the total variation associated with the Healthy People 2000 indicators to a smaller number of more general components. Next, we conducted correlation and regression analyses to determine the extent to which individual Healthy People 2000 indicators, premature mortality, and other selected variables could serve as proxies for the entire set of Healthy People 2000 indicators. Similarly, we examined the correlations of these indicators with the ReliaStar index to determine if they corroborated the results from our analysis of the Healthy People 2000 indicators (see apps. II and III for more detail). We conducted our work from December 1995 through August 1996 in accordance with generally accepted government auditing standards.

Results in Brief

We found that premature mortality is the best single proxy for reflecting differences in the health status of states' populations as measured by both the Healthy People 2000 indicators and the ReliaStar index. Premature mortality accounted for 36 percent of the variation in the Healthy People 2000 indicators and 75 percent of the variation in the ReliaStar index. Our analysis showed that using premature mortality to distribute federal

[2]We used years of potential life lost (YPLL) as our measure of premature mortality. YPLL is defined as the number of years between the age at death, for those who die before age 65, and age 65. While YPLL is typically calculated over an age range from birth to 65 years of age, it is also calculated using other age ranges, such as birth to age 75.

funding for core public health functions would systematically target federal assistance to states on the basis of their populations' rates of mortality, disease incidence, and risk for mortality and morbidity.

A number of other variables, including the proportion of states' populations that are poor or minorities, were also found to be correlated with health status differences as measured by the Healthy People 2000 indicators and the ReliaStar index. However, including these variables along with premature mortality did not significantly enhance our ability to differentiate the health status of state populations. Moreover, improving the targeting of funds beyond that obtained using premature mortality alone would require using several additional variables, which would add to the complexity of the allocation formula.

Background

Health status is a multidimensional concept encompassing such elements as the presence of disease, quality of life, and risk of death. The Healthy People 2000 program, administered by the Department of Health and Human Services, is a national strategy for improving the health of the American people in the decade preceding the year 2000. As part of this strategy, CDC established 18 indicators with which to assess different dimensions of states' health status. The indicators address health status outcomes, such as mortality and disease incidence, and potential health risk factors, such as low-weight births and childhood poverty. (See app. II for more detail.)

In addition to Healthy People 2000, the ReliaStar Financial Corporation annually publishes a composite health status index. In contrast to the Healthy People 2000 indicators, the ReliaStar index presents a single summary indicator of health status. When the index was first developed, a panel of public health experts reached consensus on 17 indicators to use to reflect a variety of health status outcomes and risks, including lifestyle, disease, and mortality. The panel then agreed on how to weight each of the individual indicators to create an overall summary indicator. (See app. III for more detail.)

The Healthy People 2000 indicators and ReliaStar index include a number of the same health indicators, but there are several that are unique to each. For example, both use infant mortality and motor vehicle deaths, but only the Healthy People 2000 indicators include low-weight births, births to adolescents, childhood poverty, and air quality. In contrast, the ReliaStar index includes the prevalence of smoking, access to primary care, and

state support for public health care, but the Healthy People 2000 indicators do not.

Premature Mortality Best Reflected Cross-State Differences in Health Status

Our analysis indicated that premature mortality better explained the cross-state variation in the Healthy People 2000 indicators than any other measure that we examined: Independently, premature mortality accounted for 36 percent of the cross-state variation. Once differences in premature mortality were accounted for, the efficacy of using other indicators became questionable. In some cases, adding a particular indicator could modestly increase the amount of variation in the Healthy People 2000 indicators that was accounted for, but doing so might not be appropriate. Adding states' suicide rates as an indicator, for example, would increase the explained variation by about 9 percentage points, but the subjectivity involved in identifying suicide as a cause of death would limit its value as a variable in the funding formula. That is, the potential influence on funding levels of using the suicide rate indicator could affect how reliably states reported it as a cause of death.

In other cases, including additional indicators contributed little to explaining the variation in health status presented by the Healthy People 2000 indicators. For example, including the percentage of a state's population that lived in a rural area increased the amount of variation that was accounted for by only 5 percentage points. Further, indicators such as deaths due to work-related injuries, cardiovascular deaths, the percentage of a state's population living in an area with poor air quality, teen births, and motor vehicle deaths each increased the percentage of explained variation by 3 percentage points or less.

We also examined the relationship between the ReliaStar index and premature mortality and other selected indicators. We found that premature mortality was the best single indicator for explaining cross-state variation associated with this index: It accounted for 75 percent of the cross-state variation in the ReliaStar index. Adding motor vehicle deaths increased the proportion of explained variation by only 7 percentage points, to 82 percent. Adding the proportion of people in poverty as a third indicator increased the share of explained variation to 85 percent.

Conclusions

Premature mortality is an appropriate health status indicator for allocating federal funding for the core public health functions administered by the

states. If using a single indicator in an allocation formula is considered desirable to reduce its complexity and the burden of administering it, premature mortality is the best indicator to choose.

Using premature mortality along with states' suicide rates would better reflect cross-state differences in states. However, determining suicide as a cause of death is somewhat subjective, and including it as a variable in a funding formula could affect the reliability of data reported on suicide rates.

Because this report does not directly affect agency operations, we did not obtain comments from CDC or any other agency of the Department of Health and Human Services. We did, however, submit our report for review by outside experts and included their technical suggestions, where appropriate.

We are sending copies of this report to appropriate congressional committees and subcommittees, the Secretary of Health and Human Services, and the Director of the Centers for Disease Control and Prevention.

This report was prepared under the direction of Jerry Fastrup, Assistant Director, Health Financing and Systems Issues. If you have any questions about this report, please contact me on (202) 512-7119 or Jerry Fastrup on (202) 512-7211. Other individuals who made contributions to this report include Mark Vinkenes and Michael O'Dell, both Senior Social Science Analysts.

Sincerely yours,

William J. Scanlon
Director, Health Financing
and Systems Issues

Contents

Letter 1

Appendix I CDC Programs That Would Have Been Consolidated Under S. 142 8

Appendix II Healthy People 2000 Indicators 9
Background 9
States Differed in Terms of Mortality, Disease Incidence, and Risk 10
Statistical Analysis 12

Appendix III ReliaStar State Health Status Index 19
Development and Composition of the ReliaStar Index 19
Comparison of the ReliaStar Index and Healthy People 2000 Indicators 24
Stepwise Regression 25

Tables
Table II.1: Healthy People 2000 Indicators 11
Table II.2: Principal Components 13
Table II.3: Weight on Each Healthy People 2000 Indicator Associated With Each Principal Component 14
Table II.4: Component 1 Stepwise Regressions 16
Table II.5: Component 2 Stepwise Regressions 17
Table II.6: Proportion of the Cross-State Variation in the Healthy People 2000 Indicators Associated With Various Proxies 18
Table III.1: Measures and Weights of ReliaStar State Health Rankings 20
Table III.2: ReliaStar Health Status Index Scores, 1995 21
Table III.3: Measures Included in the ReliaStar Index and Healthy People 2000 Indicators 25
Table III.4: Predictors of the ReliaStar Health Status Index 26

Figure
Figure III.1: ReliaStar Health Status Index Scores 23

Abbreviations

AIDS	acquired immunodeficiency syndrome
CDC	Centers for Disease Control and Prevention
HIV	human immunodeficiency virus
YPLL	years of potential life lost

CDC Programs That Would Have Been Consolidated Under S. 142

Programs	Total fiscal year 1995 award amounts (in millions)
Immunization grant program	$355
Preventive health services programs for human immunodeficiency virus[a]	227
Preventive health and health services block grant	154
Preventive health services programs for tuberculosis	108
Breast and cervical cancer	84
Prevention and control of sexually transmitted disease	82
Lead poisoning prevention	26
Cancer registries	14
Preventive health services programs for diabetes	11
Preventive health services programs for disabilities	8
Preventive health services programs for tobacco use	5
Infertility and sexually transmitted disease prevention	[b]

[a]Human immunodeficiency virus = HIV.

[b]Included in the funding amount for prevention and control of sexually transmitted disease.

Healthy People 2000 Indicators

As part of Healthy People 2000, the Centers for Disease Control and Prevention (CDC) monitors the health status of state populations using 18 health status indicators. On the basis of a statistical analysis of these indicators and selected variables, we concluded that premature mortality is the best single proxy to reflect differences in health status as measured by the Healthy People 2000 indicators. Moreover, we concluded that once premature mortality is accounted for, no other single measure appears to appreciably improve the differentiation of states' health status. Instead, several measures would have to be used to differentiate health status among states, and this would make a grant allocation formula more complex and difficult to use. This appendix presents the statistical analyses that support these conclusions.

Background

Healthy People 2000 is a national strategy for improving the health of the American people in the decade preceding the year 2000. The strategy, which was unveiled in September 1990 by the Secretary of the Department of Health and Human Services, has three broad goals:

- to increase the span of healthy life for Americans,
- to reduce health disparities among Americans, and
- to provide access to preventive services to all Americans.

These goals are supported by 300 objectives that address 22 priority areas. For example, one objective is to reduce the prevalence of cigarette smoking to no more than 15 percent of the population aged 20 and older. Another objective is to increase basic immunization levels to at least 90 percent among children under age 2. For each priority area, a U.S. Public Health Service agency was designated both to develop an implementation plan and to coordinate activities directed toward attaining the objectives under that area.

CDC was delegated responsibility for the priority area concerning health surveillance and the development of supporting data systems. As part of this responsibility, CDC developed a set of 18 health status indicators that are used to track the general health status of state populations.

The indicators were chosen to facilitate national, state, and local efforts in tracking the Healthy People 2000 objectives and to help communities assess the general health status of their populations. A committee consisting of federal, state, and local health officials and representatives from academic institutions selected the 18 indicators by consensus.

States Differed in Terms of Mortality, Disease Incidence, and Risk

Each of the Healthy People 2000 indicators is based on data that are produced by the federal government. We have classified the 18 indicators into three groups: mortality, disease incidence, and indicators of health risk (see table II.1).

Table II.1: Healthy People 2000 Indicators

	National average rate	Minimum/ maximum state rate
Mortality indicators (per 100,000 population)[a]		
Total mortality	504.5	392.0-608.0
Cardiovascular deaths	180.4	137.2-237.1
Lung cancer deaths	39.3	17.1-53.6
Breast cancer deaths	21.9	16.4-27.5
Motor vehicle deaths	15.8	8.7-31.6
Suicides	11.1	5.9-22.9
Homicides	10.5	0-19.6
Infant mortality	8.5	5.6-11.9
Work injury-related deaths	3.2	0-15.5
Disease incidence indicators (per 100,000 population)[b]		
Acquired immunodeficiency syndrome[c]	31.2	1.4-79.0
Syphilis	10.4	0-67.5
Tuberculosis	9.8	0-21.7
Measles	0.1	0-5.2
Risk factors[d]		
Poor air quality, as measured by the proportion of people living in counties exceeding U.S. Environmental Protection Agency standards for air quality during the previous year	23.5%	0-96.9
Prenatal care, as measured by the percentage of mothers delivering live infants who did not receive prenatal care during the first trimester	22.3%	11.5-38.3
Childhood poverty, as measured by the proportion of children less than 15 years of age living in families at or below the poverty level	20.8%	9.5-39.4
Low birth weight, as measured by the percentage of live-born infants weighing less than 2500 grams at birth	7.1%	4.9-9.9
Births to adolescents (females aged 10 to 17 years) as a percentage of total live births	4.9%	1.9-9.4

[a]All mortality indicators are based on 1992 data except for work-related death and infant mortality rates. Work-related death rates are based on 1993 data. Infant mortality rates are based on 1992 data except for people of Asian, Native American, and Hispanic origin. Infant mortality rates for these groups are based on an average of 1989 to 1991 data. Also, the infant mortality rate is determined by the rate (per 1,000 live births) of death among infants less than 1 year of age.

[b]All disease incidence indicators are based on 1993 data.

[c]Acquired immunodeficiency syndrome = AIDS.

[d]All risk indicators are based on 1993 data.

As shown in table II.1, individual states differed from the national average on each of the indicators. In some cases, these differences were substantial. While the national average total mortality rate was 505 per 100,000 people, this rate ranged from 392 in Hawaii to 608 in Mississippi. States differed most with respect to deaths due to work-related injuries. For this indicator, the highest rate was nearly 400 percent higher than the national average. States differed the least in terms of total mortality and deaths resulting from breast cancer. The highest rates differed from the national averages on these indicators by about 20 percent and 26 percent, respectively.

When considering the variation across all of the 18 indicators, states differed most with respect to the disease incidence indicators and least with respect to the indicators of mortality and risk. Among the former indicators, the maximum rates differed from the national averages by a range of about 120 to 5,100 percent. In contrast, for the mortality and risk factors, the maximum rates differed from the national averages by a range of about 20 to nearly 400 percent.

Statistical Analysis

Using all of the Healthy People 2000 indicators to reflect states' health status would result in a complex formula with 18 discrete need indicators. A less complex formula is possible, however, by reflecting the cross-state variation in the 18 Healthy People 2000 indicators with a smaller subset of proxies.

To identify such proxies, we followed a two-step process. First, we performed a principal component analysis to reduce the Healthy People 2000 indicators to a smaller number of components.[3] We then used correlation and regression analyses to determine how well premature mortality, poverty, the individual indicators, and other selected measures or combinations of these variables accounted for the cross-state variation contained in the Healthy People 2000 indicators, and their suitability as proxies for health status in an allocation formula.

Principal Component Analysis

Principal component analysis is a statistical technique that creates new "synthetic" variables, called principal components, to reflect as much of the total variation within a group of variables as possible but with a smaller set of components. Principal components are created sequentially,

[3]For the measles indicator, the mean was quite small and the standard deviation quite large. Consequently, we omitted this indicator from our analysis. Hence, our principal component analysis involved 17 of the original 18 Healthy People 2000 indicators.

so that the first component reflects as much of the variation in the original group of variables as possible. Succeeding components are each created to reflect the largest possible shares of the remaining variation. The total number of principal components equals the total number of original variables and, taken together, all of the principal components explain all of the variation in these variables. By using this technique, it is often possible to reflect a substantial proportion of the variation of a large number of variables with only two or three principal components. In a principal component analysis, all variables are treated as equally important. For example, a high rate of mortality is treated as being as important as a high incidence of measles.

Four Principal Components Account for Three-Quarters of the Variation in the Healthy People 2000 Indicators

The principal component analysis of the Healthy People 2000 indicators produced four components that accounted for over 75 percent of the variation in the original set of indicators (see table II.2). The first component accounted for 42 percent of the total variation, with each remaining component adding successively less to the explained variation. Components produced beyond the fourth one contributed about 5 percent or less to the explained variation; therefore, we eliminated them from the remaining analysis.

Table II.2: Principal Components

Component	Percentage of variation	Cumulative percentage	Percentage of explained variation
1	42.1	42.1	55
2	17.4	59.5	23
3	10.7	70.2	14
4	6.3	76.5	8

Each principal component is calculated as a weighted sum of the original 17 indicators. A better understanding of the components can be obtained by examining the weights.[4] Indicators with large weights have a greater influence on a principal component and indicators with small weights have less influence. The weight on each of the indicators is shown in table II.3. Weights above 0.60 appear in bold type.

[4]These weights are generally referred to as loading factors in a principal component analysis.

Table II.3: Weight on Each Healthy People 2000 Indicator Associated With Each Principal Component

	Component			
Healthy People 2000 Indicator	**1 (42%)**	**2 (17%)**	**3 (11%)**	**4 (6%)**
Mortality indicators				
Total mortality	**.9264**	–.0553	–.1459	.2557
Cardiovascular deaths	**.8802**	–.1506	–.3086	.0626
Lung cancer deaths	**.6476**	–.2370	–.3921	.3749
Breast cancer deaths	.0447	–.5010	–.4876	.2801
Motor vehicle deaths	.5644	**.7379**	–.0742	.1008
Suicides	–.0116	**.7414**	.3660	.4271
Homicides	**.8646**	–.0970	.3097	–.0020
Infant mortality	**.7819**	.0662	–.3049	–.1345
Work injury-related deaths	.0182	**.6458**	–.0688	–.0482
Disease incidence indicators				
AIDS	.2441	–.7371	.4661	–.0459
Syphilis	**.8241**	.0194	–.1338	–.1413
Tuberculosis	.5072	–.4229	.5359	–.2064
Risk factors				
Poor air quality	–.0779	–.3571	.4027	**.6837**
Prenatal care	.5331	.3660	.5341	.0038
Childhood poverty	**.7737**	–.0606	.0288	–.1107
Low birth weight	**.8538**	–.1136	.0940	–.1468
Births to adolescents	**.8969**	.3067	.0773	.0034

Interpretation of the Principal Components

The first component appears to be most strongly related to both mortality and risk factors. Total mortality has a weight of 0.93, and deaths as a result of cardiovascular disease, homicide, and infant mortality also have high weights. Three of the five risk factors (childhood poverty, low birth weight, and teen births) also contribute heavily to the first component.

The second component is most strongly related to suicide, motor vehicle deaths, and work injury-related deaths. The component is negatively related to the incidence of AIDS. No single indicator or set of indicators is highly related to the third component. The fourth component is most strongly associated with areas with poor air quality (weight = 0.68).

Stepwise Regression

We used correlation and regression analyses to see if premature mortality, poverty, and other selected variables could serve as proxies for the principal components. Through correlation analysis, we identified as

potential proxies any of the variables that had a correlation coefficient of at least 0.60 with a component.[5] We then used stepwise regression to determine the extent to which variation in each of the principal components could be explained by these variables.

The stepwise regression procedure allowed us to determine which statistical models most simply explained each of the components. This technique selects the variable that is most strongly related to the dependent variable and then includes only those additional variables that increase the explanatory power of the model. Moreover, a variable with a relationship to the dependent variable that is likely to have occurred by chance is omitted from the equation.[6]

Component 1

As mentioned before, the first component accounted for the largest proportion of variation in the Healthy People 2000 indicators—42 percent. The component was correlated at 0.60 or more with nine of the Healthy People 2000 indicators and two of the other selected measures—premature mortality and poverty. The correlations exceeded 0.80 for eight of these variables.

Since premature mortality had the highest correlation with the first principal component, the stepwise regression technique selected it as the first variable to be included in the model. Premature mortality alone explained 86 percent of the variation in this component (see adjusted R^2 in table II.4). Adding cardiovascular-related deaths contributed an additional 7 percentage points to the explained variation, increasing the R^2 to 93 percent. Teen births contributed an additional 4 percentage points to the explained variation, while homicide and low birth weight added 1 percentage point each.

[5]The measures included premature mortality, minority population, poverty population, population under age 18, population over age 60, population between ages 16 and 24, and rural population.

[6]Variables were excluded from a regression equation when their relationship to the dependent variable had more than 5 chances in 100 to have occurred randomly.

Table II.4: Component 1 Stepwise Regressions

	Model 1	Model 2	Model 3	Model 4	Model 5
Adjusted R^2	0.86	0.93	0.97	0.98	0.99
Intercept	–5.40	–6.66	–5.90	–5.35	–5.53
(t-value)	(–17.04)	(–22.85)	(–30.35)	(–26.21)	(–30.26)
Premature mortality	5.70	3.77	2.31	1.40	1.23
(t-value)	(17.29)	(10.29)	(8.46)	(4.57)	(4.60)
Cardiovascular deaths		3.16	2.67	2.76	2.57
(t-value)		(6.85)	(9.43)	(11.57)	(12.12)
Births to adolescents			1.14	1.06	0.98
(t-value)			(9.12)	(9.97)	(10.46)
Homicides				0.41	0.33
(t-value)				(4.52)	(4.09)
Low birth weight					0.68
(t-value)					(4.00)

Component 2

The second principal component accounted for 17 percent of the total variation in the Healthy People 2000 indicators. Only three Healthy People 2000 indicators had correlations at 0.60 or more (see table II.3); only one of the other selected measures—population less than 18 years of age—had a correlation of 0.60 or more. The second component is most strongly related to specific kinds of mortality, for example, accidental death and suicide.

Suicide alone explained 54 percent of the variation in the second component (see table II.5). Work injury-related deaths increased the explained variation by 17 percentage points, and motor vehicle deaths added another 7 percentage points, raising the explained variation to 78 percent. Finally, population less than 18 years of age added 2 percentage points.

Table II.5: Component 2 Stepwise Regressions

	Model 1	Model 2	Model 3	Model 4
Adjusted R^2	0.54	0.71	0.78	0.80
Intercept	–2.89	–2.97	–3.38	–5.35
(t-value)	(–7.42)	(–9.60)	(–11.75)	(–5.88)
Suicides	2.64	2.10	1.62	1.38
(t-value)	(7.65)	(7.21)	(5.80)	(4.80)
Work injury-related deaths		0.57	0.41	0.28
(t-value)		(5.43)	(4.07)	(2.56)
Motor vehicle deaths			1.03	1.06
(t-value)			(4.02)	(4.33)
Population less than 18 years of age				2.31
(t-value)				(2.27)

Component 3

The third component accounted for about 11 percent of the total variation in the Healthy People 2000 indicators. This component was moderately correlated with only one measure—rural population—which explained about 43 percent of its variation.[7]

Component 4

Finally, the fourth component accounted for the smallest percentage of the total variation in the Healthy People 2000 indicators—about 6 percent. This component was moderately correlated with just one of the Healthy People 2000 indicators, the proportion of people living in counties exceeding U.S. Environmental Protection Agency air quality standards, which explained about 46 percent of the variation in the fourth component.

Premature Mortality Is the Best Single Proxy of Health Status That We Tested

We combined the results of the principal component and regression analysis to determine how much total variation each potential proxy accounted for in the 17 Healthy People 2000 indicators. Premature mortality accounted for 36 percent of the total variation since, by itself, it accounted for 86 percent of the variation in the first component, which itself represented 42 percent of the total variation in the set of indicators. The results for the other proxies are summarized in table II.6.

[7]Because of the negative sign associated with rural population, by implication, the factor is positively correlated with urban population.

Table II.6: Proportion of the Cross-State Variation in the Healthy People 2000 Indicators Associated With Various Proxies

Variable	Explained percentage of variation
Premature mortality	36
Suicides	9
Rural population	5
Work injury-related deaths	3
Cardiovascular deaths	3
Poor air quality	3
Births to adolescents	2
Motor vehicle deaths	1
Homicides	[a]
Low birth weight	[a]
Population less than 18 years of age	[a]

[a]Less than 1 percent.

ReliaStar State Health Status Index

The Northwestern National Life Insurance Company, a subsidiary of the ReliaStar Financial Corporation, has published state rankings of health status since 1989 that are based on a methodology they developed for this purpose. We found that premature mortality alone can explain 75 percent of the cross-state variation in the ReliaStar index. As with Healthy People 2000, once premature mortality is accounted for, none of the other variables that we used adds appreciably to the explanation of the variation in the ReliaStar index. Further, no other measure that we tested was shown to be a reasonable single proxy for both the Healthy People 2000 indicators and the ReliaStar index. This appendix presents our analysis of the ReliaStar index.

Development and Composition of the ReliaStar Index

The ReliaStar state health status index is an overall measure by state of the general health of the population in the United States. The index was first published in October 1989 and has been published annually ever since. Except for one major refinement in 1990, the methodology used to produce the index has generally remained the same. Therefore, versions of the index since 1990 are essentially comparable and can be used to note shifts in measured health status from year to year.

The ReliaStar index is currently based on an overall score produced from 17 health status measures that are grouped into five categories: lifestyle, access to care, occupational safety and disability, disease, and mortality (see table III.1). Each measure is assigned a weight on the basis of a consensus judgment of health experts that determines the measure's percentage of the overall score. An overall score is constructed by summing the measures after multiplying each one by its weight. We have converted the score to an index number so that a score of 1.0 indicates the national average.

Table III.1: Measures and Weights of ReliaStar State Health Rankings

Measure	Weight (in percent)	Mean	Minimum/ maximum state values
Lifestyle			
Prevalence of smoking—the percentage of the population over age 18 that smokes tobacco products regularly	10.0	22.2%	14.3-29.3%
Motor vehicle deaths—the annual number of deaths per 100 million miles driven	5.0	1.8	0.9-3.0
Violent crime—the annual number of murders, rapes, robberies, and aggravated assaults per 100,000 people	5.0	746.0	82.0-1,206.0
Risk for heart disease—a measure of three criteria: obesity, hypertension, and sedentary lifestyle	5.0	[a]	[a]
High school graduation—the percentage of ninth graders who graduate within 4 years	5.0	71.1%	56.3-89.1%
Access to care			
Unemployment—the average percentage of the civilian, noninstitutional labor force that is unemployed during the year	5.0	6.1%	2.9-8.6%
Adequacy of prenatal care—the percentage of pregnant women who had at least one prenatal visit with a health professional within the first trimester of pregnancy and at least 9 visits within the 36 weeks of gestation	5.0	70.2%	49.1-84.1%
Lack of access to primary care—the percentage of population areas that are underserved by primary medicine practitioners residing in designated Health Manpower Shortage Areas	5.0	10.6%	2.5-27.4%
Support for public health care—the percentage of a state's expenditures for public welfare, health care, and related services divided by the percentage of the state's population with an annual income below $15,000	5.0	Index = 1.44	0.69-2.69
Occupational safety and disability			
Occupational fatalities—the incidence per 100,000 workers of fatalities over a 5-year period	2.5	7.1	1.3-43.4
Work disability status—the percentage of a state's population that says a disability prevents them from working	2.5	4.2%	2.3-8.4%
Disease			
Heart disease—a 3-year average death rate per 100,000 due to heart disease that is age- and race-adjusted	7.5	151.0	116.0-188.0
Cancer cases—the number of projected cases per 100,000 for the current year	7.5	485.0	200.0-648.0
Infectious disease—a 3-year average per 100,000 that includes the occurrence of AIDS, tuberculosis, and hepatitis (all types)	5.0	53.4	10.8-103.1
Mortality			
Total mortality—a 3-year average rate per 100,000 that is age- and race-adjusted	10.0	521.0	430.0-590.0

(continued)

Measure	Weight (in percent)	Mean	Minimum/ maximum state values
Infant mortality—a 3-year average rate per 1,000 births that is race-adjusted	7.5	8.5	5.4-9.7
Premature death—the loss of years of productive life per 100,000 due to death before age 65	7.5	5,348.0	3,552.0-7,388.0

[a]Data not readily available.

State Variability Across Measures

Table III.1 shows that, as with the Healthy People 2000 indicators, the individual states can differ significantly from the national average on the ReliaStar measures. For example, the incidence of occupational fatalities in Alaska was about five times the national average. Also like the Healthy People 2000 indicators, however, the states tended to be more similar in terms of the mortality measures. For example, the highest rate of total mortality was only about 13 percent higher than the national average.

Distribution of the ReliaStar Index

Each state's index score, as determined by the ReliaStar methodology, is reported in table III.2. The national average is represented by an index score of 1.00. Poorer health status is represented by higher index scores and better health status by lower ones. For 1995, the health status index was lowest in the states of Minnesota, New Hampshire, and Utah. Conversely, the health status index was highest in the states of Louisiana, Mississippi, and South Carolina.

Table III.2: ReliaStar Health Status Index Scores, 1995

State	ReliaStar index
Alabama	1.11
Alaska	1.12
Arizona	0.99
Arkansas	1.14
California	0.99
Colorado	0.91
Connecticut	0.85
Delaware	1.01
Florida	1.10
Georgia	1.04
Hawaii	0.85
Idaho	0.98

(continued)

State	ReliaStar index
Illinois	1.00
Indiana	0.97
Iowa	0.89
Kansas	0.91
Kentucky	1.10
Louisiana	**1.23**
Maine	0.90
Maryland	0.92
Massachusetts	0.88
Michigan	1.00
Minnesota	**0.83**
Mississippi	**1.24**
Missouri	1.04
Montana	0.96
Nebraska	0.90
Nevada	1.14
New Hampshire	**0.81**
New Jersey	0.92
New Mexico	1.12
New York	1.10
North Carolina	1.02
North Dakota	0.92
Ohio	0.96
Oklahoma	1.06
Oregon	0.97
Pennsylvania	0.95
Rhode Island	0.93
South Carolina	**1.19**
South Dakota	0.94
Tennessee	1.10
Texas	1.03
Utah	**0.83**
Vermont	0.86
Virginia	0.91
Washington	0.92
West Virginia	1.16
Wisconsin	0.89
Wyoming	1.03

Note: States in bold type have the three highest and three lowest ReliaStar rankings.

Figure III.1 shows that the health status index is typically lower (better health status) in the New England states and in the Midwestern states like Iowa, Minnesota, and Wisconsin. Conversely, the health status index tends to be higher (poorer health status) in the southern states, for example, Alabama, Louisiana, Mississippi, and South Carolina.

Figure III.1: ReliaStar Health Status Index Scores

Comparison of the ReliaStar Index and Healthy People 2000 Indicators

To facilitate a comparison of the Healthy People 2000 indicators with the ReliaStar index, table III.3 displays the health status measures found in each set according to whether they reflect mortality, disease incidence, health risk, or some other factor.

Table III.3: Measures Included in the ReliaStar Index and Healthy People 2000 Indicators

Measure	ReliaStar	Healthy People 2000
Mortality (deaths per 100,000 population)		
Total mortality	X	X
Cardiovascular deaths	X	X
Lung cancer deaths		X
Breast cancer deaths		X
Motor vehicle deaths	X	X
Suicides		X
Homicides		X
Infant mortality	X	X
Work injury-related deaths	X	X
Premature deaths (premature mortality)	X	
Disease incidence		
AIDS		X
Syphilis		X
Tuberculosis		X
Measles		X
Cancer cases	X	
Other infectious diseases	X	
Risk factors		
Poor air quality		X
Prenatal care	X	X
Childhood poverty		X
Low birth weight		X
Births to adolescents		X
Smoking	X	
Violent crime	X	
Risk for heart disease	X	
Other		
Work disability status	X	
High school graduation	X	
Unemployment	X	
Access to primary care	X	
State support of public health care	X	

Stepwise Regression

To determine how well premature mortality could serve as a proxy for the ReliaStar health status index, we fitted a regression model with these two

variables. We also used stepwise regression to test if any additional measures would improve our ability to account for variation in the ReliaStar index. For the stepwise regression, we used those Healthy People 2000 indicators and selected measures that were correlated at 0.60 or more with the ReliaStar index.

The results of the regression analysis are summarized in table III.4. Model 1 demonstrates that premature mortality alone can account for three-quarters of the cross-state variation in health status as measured by the ReliaStar index. Including motor vehicle deaths increases the proportion of explained variation to 82 percent, and adding poverty to the equation increases this proportion to 85 percent.

Table III.4: Predictors of the ReliaStar Health Status Index

	Model 1	Model 2	Model 3
Adjusted R^2	0.75	0.82	0.85
Intercept	0.44	0.44	0.46
(t-value)	(9.66)	(11.37)	(12.62)
Premature mortality	0.58	0.46	0.37
(t-value)	(12.12)	(9.62)	(6.91)
Motor vehicle deaths		0.11	0.08
(t-value)		(4.57)	(3.33)
Poverty			0.10
(t-value)			(2.98)

Ordering Information

The first copy of each GAO report and testimony is free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. VISA and MasterCard credit cards are accepted, also. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

Orders by mail:

U.S. General Accounting Office
P.O. Box 6015
Gaithersburg, MD 20884-6015

or visit:

Room 1100
700 4th St. NW (corner of 4th and G Sts. NW)
U.S. General Accounting Office
Washington, DC

Orders may also be placed by calling (202) 512-6000 or by using fax number (301) 258-4066, or TDD (301) 413-0006.

Each day, GAO issues a list of newly available reports and testimony. To receive facsimile copies of the daily list or any list from the past 30 days, please call (202) 512-6000 using a touchtone phone. A recorded menu will provide information on how to obtain these lists.

For information on how to access GAO reports on the INTERNET, send an e-mail message with "info" in the body to:

info@www.gao.gov

or visit GAO's World Wide Web Home Page at:

http://www.gao.gov

PRINTED ON RECYCLED PAPER

United States
General Accounting Office
Washington, D.C. 20548-0001

Bulk Rate
Postage & Fees Paid
GAO
Permit No. G100

Official Business
Penalty for Private Use $300

Address Correction Requested