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Research Article

Factors responsible for mortality variation in the United States: A latent variable analysis

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Abstract

BACKGROUND
Factors including smoking, drinking, substance abuse, obesity, and health care have all been shown to affect health and longevity. The relative importance of each of these factors is disputed in the literature, and has been assessed through a number of methods.

OBJECTIVE
This paper uses a novel approach to identify factors responsible for interstate mortality variation. It identifies factors through their imprint on mortality patterns and can therefore identify factors that are difficult or impossible to measure directly, such as sensitive health behaviors.

METHODS
The analysis calculates age-standardized death rates by cause of death from 2000-2009 for white men and women separately. Only premature deaths between ages 20-64 are included. Latent variables responsible for mortality variation are then identified through a factor analysis conducted on a death-rate-by-state matrix. These unobserved latent variables are inferred from observed mortality data and interpreted based on their correlations with individual causes of death.

RESULTS
Smoking and obesity, substance abuse, and rural/urban residence are the three factors that make the largest contributions to state-level mortality variation among males. The same factors are at work for women but are less vividly revealed. The identification of factors is supported by a review of epidemiologic studies and strengthened by

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correlations with observable behavioral variables. Results are not sensitive to the choice of factor-analytic method used.

CONCLUSIONS
The majority of interstate variation in mortality among white working-age adults in the United States is associated with a combination of smoking and obesity, substance abuse and rural/urban residence.

1. Introduction

Understanding the underlying causes of variation in mortality is useful for health policy and intervention design. However, risk factors can be difficult to measure directly, as observed measures are often products of traits or circumstances that are unobserved, partially observed, or complex and multidimensional. An alternative is to infer the effects of risk factors indirectly using a latent variable approach. Because factors that influence mortality typically manifest themselves in several causes of death, associations among causes of death over time or space may provide important information about underlying causal factors. Without explicitly introducing a latent variable model, such reasoning has been used to infer the role of cigarette smoking (Peto et al. 1992; Preston et al. 2011) and the quality of the health care system in explaining variation in US mortality (Nolte and Mckee 2004).

In this paper we take advantage of variation in mortality by cause of death across US states to identify the underlying factors that are creating such variation. The emphasis is on behavioral factors that affect the risk of death. Previous studies have suggested that behavioral factors play a leading role in explaining US mortality (Mokdad et al. 2004; Mokdad et al. 2005; Murray et al. 2006; Danaei et al. 2009; 2010; Mehta and Preston 2012; Murray et al. 2013).

The primary approach to identifying the role of behavioral factors in interstate mortality variation is to apply relative risks derived from epidemiologic studies to the risk factor distribution of populations using the population attributable fraction (PAF) (Danaei et al. 2009; Danaei et al. 2010). In order to provide reliable results, such an approach requires accurate data on both relative risks and on risk factor distributions. Neither is measured with a high degree of accuracy or certainty and in some instances the data are altogether unavailable. For example, the fraction of deaths attributable to obesity in the US varies by a factor of 3-4 depending on which set of national estimates of relative risks is employed (Mehta and Chang 2009). Relative risks from smoking depend on the number of cigarettes consumed per day, inhalation, filtration, tar content,

and especially the duration and past intensity of the habit. These elements are not readily captured in a single variable. Data on other behaviors, such as use of illicit drugs and unsafe sex, are often unreliable because of their sensitive nature. Finally, the source of data for most regional analyses of health patterns in the US, the Behavioral Risk Factor Surveillance Survey (BRFSS), is subject to several important limitations related to validity and comparability of data, including reliance on self-reported data, exclusion of households without telephones, and high rates of non-response. The national response rates for BRFSS in 2011 were 53.0% for landlines and 27.9% for cell phones (Centers for Disease Control and Prevention 2013a).

The present study takes an entirely different approach. It treats behavioral factors as latent variables that are identifiable through covariation of causes of death across populations. The operation of a particular risk factor is expected to appear in the form of high correlations across states within the cluster of causes of death for which its relative risks are greatest. Unlike prior studies, the present study is not limited to the subset of risk factors that can be reliably measured; thus it has the potential to uncover previously overlooked patterns of risk in populations. Also, because this approach is independent of the attributable-risk approach, it provides a valuable independent assessment of the contribution of behavioral risk factors to mortality variation.

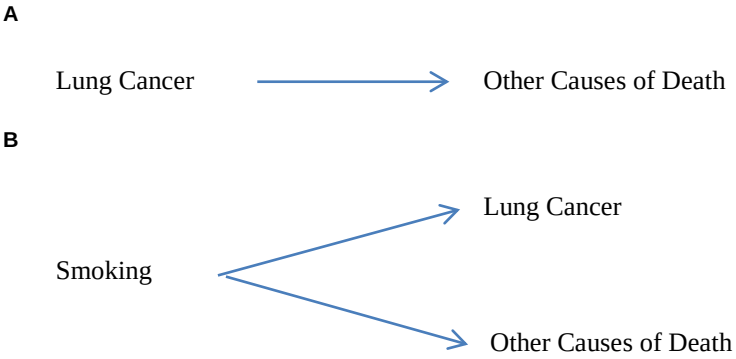
2. Background and approach

Through straightforward decompositional methods, inter-population differences in death rates or life expectancy can be readily assigned to various causes of death (Preston et al. 2001). Beyond their contributions to such accounting exercises, death rates from a particular cause have also been used as indicators of broader determinants of mortality. One set of applications of this approach has used particular causes of death (variously termed “sentinel”, “tracer” or “amenable” causes) as indicators of the performance of a medical system (Polednak 2000; Nolte and McKee 2008).

A second set of applications has used lung cancer as an indicator of smoking prevalence and intensity (Peto et al. 1992; Preston et al. 2010; Fenelon and Preston 2012). Statistical relations were established between lung cancer mortality and mortality from other causes of death across OECD countries (Preston et al. 2011) and across states of the United States (Fenelon and Preston 2012). The statistical model used in these applications was negative binomial regression in which death rates from other causes of death were regressed on death rates from lung cancer and a set of indicator variables. The causal model assumed in this approach is shown in Figure 1A. But if mortality from both lung cancer and other causes of death are functions of smoking, then smoking should be treated as a latent variable, as shown in Figure 1B.

Furthermore, there is no reason to expect that smoking is the only factor at work in fashioning population mortality patterns: the role of smoking should be inferred in a multivariate context.

Figure 1: Directed acyclic graphs portraying the (A) incorrect causal model; (B) correct causal model



Notes: In Preston et al. 2011, lung cancer was treated as a marker of smoking and used to predict the effects of smoking on other causes of death. The causal model inherent to this approach is portrayed in (A). This model is incorrect because lung cancer and other causes of death are not causally related. In the present analysis smoking is treated as a latent variable and its effects are inferred from the correlation structure among causes of death with which smoking is associated. The causal model inherent in this approach is portrayed in (B). This model correctly characterizes the relationship between the variables.

In the present analysis we assume that behavioral factors are latent variables whose effects manifest themselves in a variety of causes of death. We will employ a list of mutually exclusive causes of death, without prejudging which causes of death, or behavioral risk factors, are to be featured.

The influence of a particular risk factor will be inferred from the significance of variation in causes of death with which that factor is most closely associated. We look, in particular, for causes of death associated with four behavioral risk factors: smoking, obesity, alcohol abuse, and illicit drug use. Obesity is not technically a behavioral risk factor but we refer to it as such because it closely related to behaviors of dietary intake and physical activity. We also consider a non-behavioral factor, the quality of the health care system. In some instances operation of a factor can be identified through explicit terms contained in the International List of Diseases, Injuries, and Causes of Death, e.g., alcohol poisoning. In these cases the behavioral factor (alcohol) has been assigned by the attending physician or coroner. More commonly, we rely on epidemiologic

studies, and meta-analyses thereof, to identify the causes of death that demonstrate the highest relative risks for a particular risk factor.

Table 1 presents, in alphabetical order, the set of causes of death that we expect to be most closely associated with the five risk factors that we consider. Amenable causes represent deaths that are considered avoidable through medical services. References to the studies that support such identifications are included.

Table 1: Risk factors and associated causes of death

Smoking	Obesity	Alcohol Use	Drug Use	Amenable Causes
Aneurysm	Breast cancer	Alcohol poisoning	Accidental poisonings	Breast cancer
Bladder cancer	Cerebrovascular disease	Breast cancer	Cardiomyopathy	Cervical cancer
Cerebrovascular disease	Colorectal cancer	Esophageal cancer	Cerebrovascular disease	Colorectal cancer
COPD	Corpus Uteri cancer	Interpersonal violence	Hepatitis	Diabetes mellitus
Esophageal cancer	Diabetes mellitus	Larynx cancer	HIV/AIDS	Respiratory diseases
Ischemic heart disease	Esophageal cancer	Liver cancer	Hypertensive Heart Disease	Skin cancer
Larynx cancer	Ischemic heart disease	Liver cirrhosis	Liver cirrhosis	
Lung Cancer	Kidney cancer	Oral cancer	Liver Cancer	
Oral Cancer	Kidney disease	Self-inflicted harm	Self-Inflicted harm	
Respiratory diseases	Liver cirrhosis	Transport injuries		

Abbreviations: COPD, Chronic Obstructive Pulmonary Disease.

Notes: Causes of death are compiled from the following sources. Smoking: Pirie et al. 2012, Ezzati et al. 2005a, Ezzati et al. 2005b, Oza et al. 2011; Obesity: Whitlock et al. 2009, Renehan et al. 2008. Alcohol Use: Lim et al. 2013, Corrao et al. 2004, Taylor et al. 2010. Drug Use: Single et al. 1999, Van Den Berg et al. 2007, Wijetunga et al. 2003. Amenable Causes: Nolte and McKee 2004, 2008, Polednak 2000.

3. Data and methods

We use factor analysis to identify latent variables underlying mortality variation between US states during the period 2000–2009. Factor analysis describes observed,

correlated variables by means of a smaller number of latent, unobserved variables or 'factors'. These factors are ordered by the amount of variance they explain. Each factor identified has a factor loading for each of the observed variables (i.e., mortality rates for a particular cause of death). The loading is the correlation between that factor and a particular cause of death, and the sum of their correlations across k factors is how much variation in that cause of death can be explained by k factors. Each factor also produces a factor score for each observation (i.e., state), indicating the relative intensity of the operation of that factor in the state.

In mathematical terms, cause-specific death rates (C_1, $C_2 \ldots C_p$) are treated as functions of underlying factors (F_1, $F_2 \ldots F_m$). Each cause of death is linearly related to the chosen number of factors as shown:

$$C_j = B_{j1}F_1 + B_{j2}F_2 + \ldots + B_{jm}F_m + e_j \quad (1)$$

where C_j represents the j^{th} of p causes of death obtained from n independent subjects (states). B_{jm} represent the factor loadings relating cause of death j to the m^{th} factor F, and e_j represents the variance unique to cause of death C_j (Brown 2006).

We examine mortality by cause of death for white persons aged 20-64. Deaths within this age range are conventionally considered 'premature'. Those dying are less likely to suffer from multiple pathologic processes that can make cause of death assignments more uncertain at older ages. As demonstrated in the electronic supplementary material, results are very similar when the age range is expanded. Attention is confined to the white population in order to minimize the role of sources of variation associated with race.

We obtained counts of deaths by age, state, and cause of death from the National Center of Health Statistics (NCHS) (2010). State identifiers for deaths in years 2007-2009, not available in the public-use mortality file, were obtained through a special request to the NCHS. State level mid-year population estimates are taken from the National Center for Health Statistics bridged-race population estimates (National Center for Health Statistics 2012b). Hawaii is dropped from the analysis because of its very small number of deaths. We calculate the death rates by age, state, and cause of death over the decade 2000–2009. By pooling ten years of data we are able to calculate reliable rates for a larger set of causes of death. We then age-standardize the death rates using the age distribution of the US population in 2000 as the standard (Anderson and Rosenberg 1998). We perform separate analyses for men and women.

We use cause-of-death groupings from the recently published Global Burden of Disease compendia (GBD), which were developed for public health applications from the International Classification of Diseases versions 9 and 10 (Naghavi et al. 2010). We have made several modifications to the GBD list that are described in the electronic

supplementary material. Most of these adjustments disaggregate individual causes of death with epidemiological significance from larger groups of causes (e.g., alcoholic liver cirrhosis is separated from the cirrhosis of the liver category). Causes of death with fewer than 5,000 deaths for either sex during the decade for the US as a whole are eliminated from the analysis.

Analysts using factor analysis face several methodological choices. For our basic analysis we use the procedures that are most conventional: factors are assumed to be uncorrelated with one another, factor scores for each state or state-year are estimated using the regression-based approach, scree plots are used to determine the number of factors selected, and varimax rotation is used after determining the number of factors to retain. As demonstrated in the electronic supplementary material, results are not sensitive to these choices.

This is not the first effort to use factor analysis or its close relative, principal components analysis, in a study of mortality variation (see United Nations (1982) and Gavrilova et al. (2002) for earlier examples). However, to the best of our knowledge it is the first effort to use spatial variation in mortality by cause of death to identify latent variables responsible for mortality variation.

4. Results

We chose to include three factors for each sex, because plots of the proportion of variance explained by the successive addition of factors to the analysis (scree plots) show a rapid fall-off after three for males. For females the drop off is not as abrupt, but we retained three factors to remain consistent across sexes. In the electronic supplementary material we show that factor loadings for the first three factors are not sensitive to the choice of the number of factors retained. The scree plots and eigenvalues of the factor analysis also appear in the electronic supplementary material. The first factor explains 34% of the total variance in causes of death for males and 33% of the total variance for females. The cumulative variance explained by three factors is 61% and 56% for males and females, respectively.

Table 2 presents the factor loadings for males. The table contains only factor loadings that are greater than 0.60 ($p<.00001$). These factor loadings are simply the correlation coefficients between the columns (factors) and rows (causes of death). We chose a relatively high cutoff of 0.60 in our interpretation of factors, but all loadings are reported in the appendix. We have given names to the factors based upon our expectations of the causes of death with which a factor is most closely identified. We label the first factor “Smoking/Obesity”. The cause of death with which the first factor is most highly correlated is lung cancer ($r = 0.947$). In fact, this is the highest

correlation of any cause of death with any factor for either sex. This result is a clear indication of the importance of smoking to explaining interstate variation in mortality.

Table 2: Male factor loadings

Smoking/Obesity		Substance Abuse		Rural/Urban	
Cause of Death	**Factor Loading**	**Cause of Death**	**Factor Loading**	**Cause of Death**	**Factor Loading**
Lung, Trachea, and Bronchus Cancer	0.947	Liver Cancer	0.844	Self-Inflicted Injuries	0.849
Colorectal Cancer	0.884	Interpersonal Violence	0.834	Transport Injures	0.794
Ischemic Heart Disease	0.880	Hepatitis	0.804	Exposure to Mechanical Forces	0.770
Oral Cancer	0.837	Non-Alcoholic Liver Cirrhosis	0.771	Other Accidents	0.753
Larynx Cancer	0.820	HIV/AIDS	0.758	Accidental Drowning	0.611
Cerebrovascular Disease	0.757	Accidental Poisoning	0.706		
Chronic Obstructive Pulmonary Disease	0.749	Other Digestive Diseases	0.670		
Exposure to Smoke or Heat	0.744	Hypertensive Heart Disease	0.643		
Pancreatic Cancer	0.729	Alcoholic Liver Cirrhosis	0.640		
Non-Hodgkins Lymphoma	0.717				
Leukemia	0.706				
Respiratory Disease	0.690				
Diabetes Mellitus	0.635				

Notes: Death registration data is taken from the NCHS and includes white men ages 20-64 and years 2000-2009. Factor analysis is run on a state by age-standardized cause of death matrix that generates three factors. Factor loadings represent the correlations between causes of death and these factors. All correlations over 0.6 ($p<.00001$) are reported in this table.

Most of the other causes of death that are heavily loaded on Factor 1 are also closely associated with smoking: COPD, oral cancers, ischemic heart disease, and cerebrovascular disease. Such a pattern accords with our expectations about patterns of variation by cause of death that should be observed if smoking were an important contributor to interstate variation in mortality. In fact, 7 of the 10 causes of death identified in Table 1 to be most strongly associated with smoking have loadings on Factor 1 above 0.60. The 3 remaining causes of death identified for smoking in Table 1 have moderately high loadings: esophagus cancer (0.594), aneurysm (0.567), and bladder cancer (0.457). Also appearing on the list of heavily loaded causes of death is exposure to smoke and heat, often a consequence of careless smoking (United States Fire Administration 2013).

One cause of death with only mildly elevated risks for smokers also appears on the list of causes with high loadings on Factor 1: diabetes mellitus. That is one of the most important causes of death through which obesity operates. Colorectal cancers are also closely associated with obesity (Table 1) and appear in the list of heavily loaded causes on Factor 1. Cerebrovascular disease and ischemic heart disease appear on the lists of diseases closely associated with both smoking and obesity. In other words, Factor 1 includes representations of both smoking and obesity as causal factors in mortality variation, and their influences are not readily disentangled. This issue is addressed in more detail below.

Figure 2 shows the map of factor scores for Factor 1 among males. Clearly, this factor is heavily concentrated in the Appalachian region down through the Deep South. The lowest factor scores are concentrated in the West, especially Utah and Colorado. This pattern is highly correlated with death rates from lung cancer, but it is also highly correlated with death rates from all causes combined ($r = .72$). This latter correlation is not a necessary result of using factor analysis because the correlations between causes of death do not reflect the relative magnitude of death rates from various causes, only their patterns of variation across multiple causes.

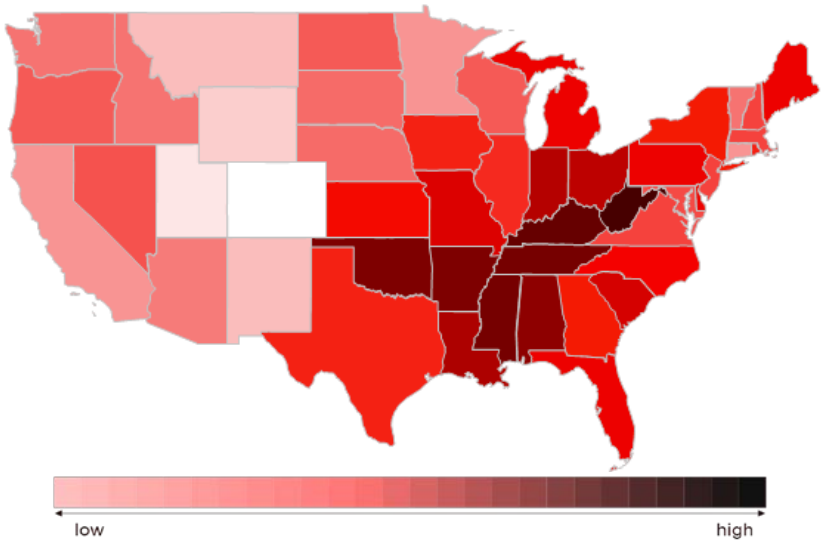
We have labeled Factor 2 for males “Substance Abuse”, an ascription that appears particularly clear-cut. Hepatitis and HIV/AIDS are associated with drug abuse and unsanitary use of needles, and accidental poisonings consist almost exclusively of drug overdoses. Liver cirrhosis and liver cancer are associated with hepatitis and substance abuse. Six of the nine causes of death hypothesized to be most closely associated with drug abuse in Table 1 have factor loadings above 0.60 in Table 2. Alcohol abuse appears to play a role in Factor 2 as well. Liver cancer, alcoholic liver cirrhosis, and interpersonal violence are closely associated with alcohol abuse (Table 1) and appear on the list of causes of death most heavily loaded on Factor 2. “Other digestive diseases” are also heavily loaded on male Factor 2. This category includes pancreatitis and liver disease, which are often an outcome of alcohol abuse (Rehm 2011). The appearance of

substance abuse as a major factor in explaining mortality variation is an important finding, as previous studies have found it difficult to measure substance abuse and to understand its contribution to mortality variation. This appears to be the first instance in which a geographic pattern of mortality from various causes of death associated with substance abuse has been identified.

Figure 2 shows a map of factor scores for male Factor 2. The highest scores occur in states along the southern perimeter from Florida to California, with the highest scores in New Mexico and Nevada. Lowest values are observed in the upper Midwest, especially in North and South Dakota. Unlike other factors, we have a limited understanding of the expected geographic variation in substance abuse, and therefore are more speculative in our interpretation of the factor scores. One hypothesis is that the geographic pattern could reflect a greater relative ease of drug trafficking along the southern border.

Figure 2: Male factor score maps

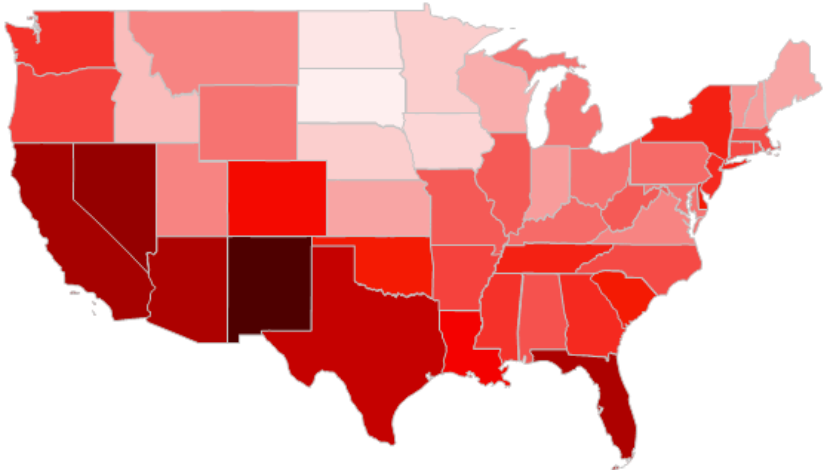
Smoking/obesity factor scores



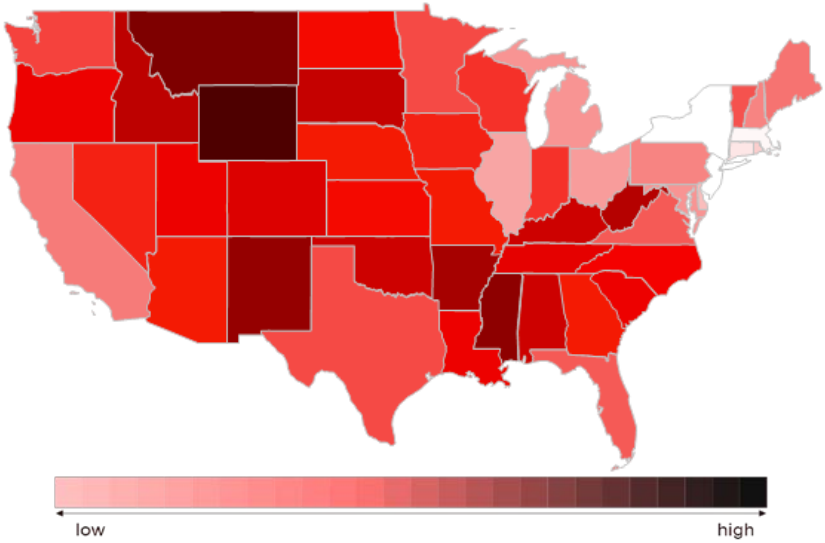
Notes: Factor scores reflect the relative standing of a state on a factor. Darker states have higher factor scores, meaning they have higher death rates for causes of death with high factor loadings for that factor. Hawaii is not included in the analysis. Alaska is not shown in the figure.

Figure 2: (Continued)

Substance abuse factor scores



Rural/urban factor scores



Notes: Factor scores reflect the relative standing of a state on a factor. Darker states have higher factor scores, meaning they have higher death rates for causes of death with high factor loadings for that factor. Hawaii is not included in the analysis. Alaska is not shown in the figure.

Factor 3 for males is a vivid pattern associated with injuries. The five causes of death that correlate the highest with this factor are all some form of injury, including self-inflicted injuries, transport injuries, exposure to mechanical forces, other accidents, and drowning (Table 2). The death rate from falls is the next most highly correlated with Factor 3 at 0.586. While deaths from drowning and falls are not numerous, their geographic distribution is quite similar to that of several more important sources of fatal injury.

Figure 2 presents the map of factor scores for male Factor 3. Montana and Wyoming lead the way in injury mortality, with other states in the Mountain time zone also exhibiting high scores. States with large urban populations like New York, Massachusetts, New Jersey, Illinois, and California have the lowest scores on this factor. Below, we demonstrate more formally the connection between rurality and Factor 3, a connection that supports our designation of this factor as a rural/urban factor. That mortality from injuries is higher in rural areas has been clearly demonstrated (Myers et al. 2013). A high rate of mass transit use may help keep mortality from transport injuries low in urban states, while lower population density in rural states may increase driving exposure. An individual's greater proximity to trauma centers in urban areas may also contribute (Myers et al. 2013). Another factor may be increased exposure to occupational hazards in rural areas. That suicide is also heavily loaded on this factor is intriguing, since transport injuries, falls, and drownings represent additional ways of ending one's life. Residents of rural areas have traditionally had higher suicide rates than urban residents (McCarthy et al. 2012; Singh and Siapush 2002). Furthermore, the map may reflect injury prevention laws, since mountain states tend to have the fewest injury prevention laws and northeastern states the most (Levi et al. 2012).

Table 3 presents the factor loadings for women. Factor 1 is labeled "substance abuse" because three of the five highest loadings are associated with substance abuse, including the clearest marker, accidental poisoning. The other two causes most heavily loaded on female Factor 1 are other digestive diseases and interpersonal violence, also plausibly linked to substance abuse. The first two factors for men and women are the same two factors, but reversed in order. Like male factor 2, female Factor 1 contains high loadings for liver cirrhosis, liver cancer, accidental poisoning, hepatitis, and other digestive diseases. Suicide and transport injuries are also plausibly associated with substance abuse and appear in the list of the causes most highly correlated with Factor 1. Cerebrovascular disease has the second highest loading, and is an important condition through which substance abuse operates (Kaku and Lowenstein 1990). But there are a total of 15 causes of death loaded at 0.60 or better with female Factor 1, including causes closely associated with smoking (COPD, respiratory diseases) and obesity (diabetes mellitus). As a result, this factor is not as coherently identified with

substance abuse as is Factor 2 for males. Nevertheless, female Factor 1 scores and male Factor 2 scores are correlated at a modest 0.60, indicating that they are tapping into somewhat the same sources.

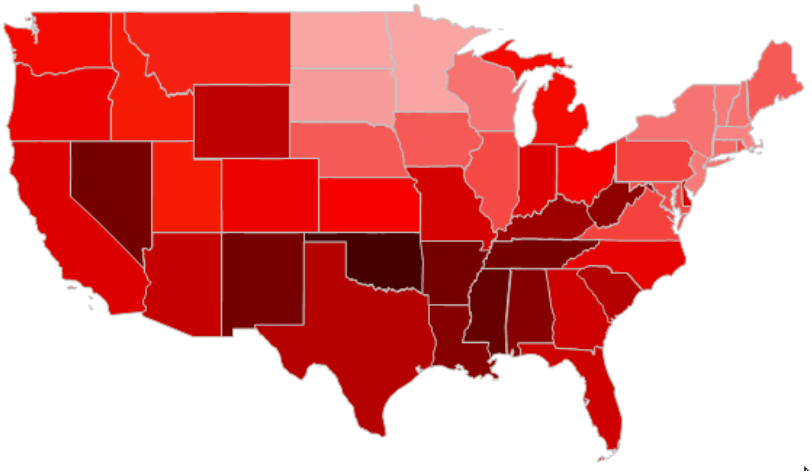
Table 3: Female factor loadings

Substance Abuse		Smoking/Obesity		Rural/Urban	
Cause of Death	**Factor Loading**	**Cause of Death**	**Factor Loading**	**Cause of Death**	**Factor Loading**
Interpersonal Violence	0.879	Colorectal Cancer	0.743	HIV/AIDS	0.728
Cerebrovascular Disease	0.876	Breast Cancer	0.740		
Other Digestive Diseases	0.869	Lung, Trachea, and Bronchus Cancer	0.725		
Non-Alcoholic Liver Cirrhosis	0.837	Non-Hodgkins Lymphoma	0.651		
Accidental Poisoning	0.778	Ischaemic Heart Disease	0.618		
Chronic Obstructive Pulmonary Disease	0.769				
Transport Injures	0.761				
Respiratory Diseases	0.751				
Cervical Uteri Cancer	0.749				
Ischaemic Heart Disease	0.726				
Self-inflicted Injuries	0.718				
Diabetes Mellitus	0.690				
Hepatitis	0.663				
Liver Cancer	0.654				
Other Accidents	0.613				

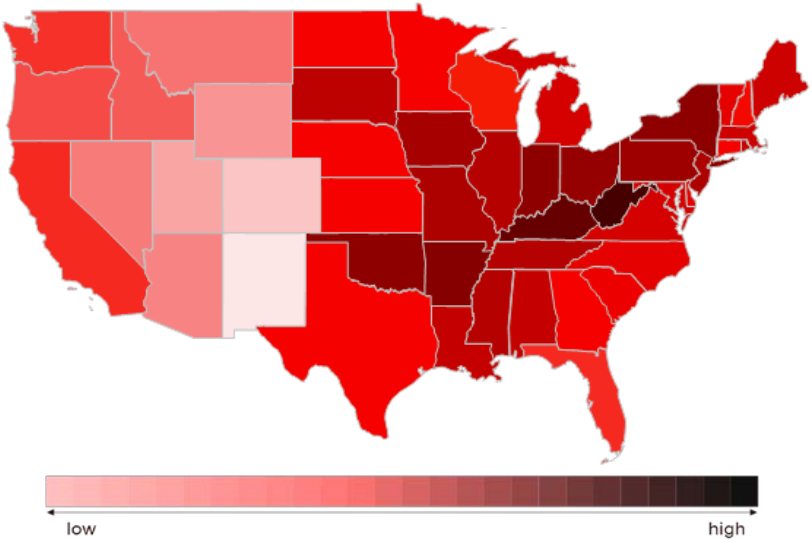
Notes: Death registration data is taken from the NCHS and includes white women ages 20-64 and years 2000-2009. Factor analysis is run on a state by age-standardized cause of death matrix that generates three factors. Factor loadings represent the correlations between causes of death and these factors. All correlations over 0.6 ($p<.00001$) are reported in this table.

Figure 3: Female factor score maps

Substance abuse factor scores



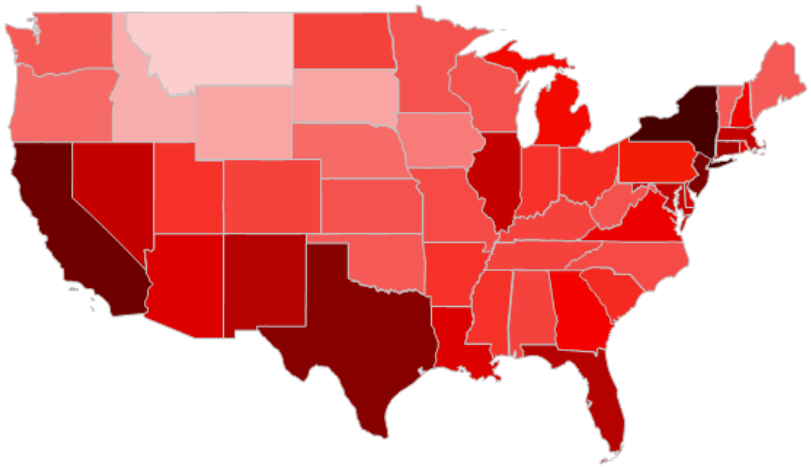
Smoking/Obesity factor scores



Notes: Factor scores reflect the relative standing of a state on a factor. Darker states have higher factor scores, meaning they have higher death rates for causes of death with high factor loadings for that factor. Hawaii is not included in the analysis. Alaska is not shown in the figure.

Figure 3: (Continued)

Rural/urban factor scores



Notes: Factor scores reflect the relative standing of a state on a factor. Darker states have higher factor scores, meaning they have higher death rates for causes of death with high factor loadings for that factor. Hawaii is not included in the analysis. Alaska is not shown in the figure.

Figure 3 presents a map of factor scores for Factor 1 for women. As in the case of substance abuse for men (Figure 2), scores for women are lowest in the upper Midwest and high in the Southwest, especially in New Mexico and Nevada. However, high scores are also found in Appalachia for women, whereas male scores in Appalachia were closer to zero.

Factor 2 for women is labeled "Smoking/Obesity", because out of the five causes of death with loadings over 0.60, two are strongly associated with smoking (lung cancer and ischaemic heart disease) and three are strongly associated with obesity (colorectal cancer and breast cancer, as well as ischaemic heart disease). In contrast to male Factor 1, neither COPD nor oral cancers makes the list of most highly correlated causes, thus failing to support a primary smoking interpretation for the factor. Males have historically and currently smoked more heavily than females, while obesity levels are similar for the two sexes (National Center for Health Statistics 2012a). So it may not be surprising that smoking is more strongly represented in male Factor 1 than in female Factor 2. In further support of the interpretation of female Factor 2 as a "Smoking/Obesity" factor, female Factor 2 scores and male Factor 1 scores are highly correlated at 0.82, suggesting that the two factors are responding to the same underlying sources of variation. Figure 3 also shows that the factors scores for this factor are

highest in a band that runs from West Virginia through Kentucky, Arkansas, and Oklahoma, with high scores in the Midwest as well. The lowest factor scores can be found in the West, especially the Four Corners. This map is quite similar to that of male Factor 1, as implied by the high correlation between the factors. Alcohol poisoning and alcoholic liver cirrhosis are two negatively loaded causes on this factor (see Appendix Table S3), implying a negative spatial association between alcohol abuse and smoking/obesity.

Factor 3 for females does not emerge as a coherent set of causes of death since only one cause, HIV/AIDS, has a factor loading above 0.60. This result is consistent with the fact that female Factor 3 explains less variance (8.4%) than male Factor 3 (13.4%). However, as shown below, Factor 3 for females has an important rural/urban dimension, as it does for males. The death rate from HIV/AIDS can be interpreted as a (negative) indicator of rurality. In fact, death rates from injury, which dominate Factor 3 for males, are negatively correlated with Factor 3 for females: falls (-0.416), transport injuries (-0.411), other accidents (-0.309) and self-inflicted wounds (-0.276). Male and female factor scores for Factor 3 have a fairly strong inverse relationship (r= -0.60). The highest scores on Factor 3 for females is found in states with the largest urban areas: New York, New Jersey, California, Texas, Illinois, and Florida. The lowest factor scores are concentrated in the Northwest.

4.1 Relation of factors to all-cause mortality

The factors have been identified through patterns of correlation between causes of death. These correlations take no account of the magnitude of a particular death rate, so there is no necessary relationship between a factor and the proportion of all-cause mortality that it accounts for. Nevertheless, the factors do account for a high degree of variation in all-cause mortality. The three male factors correlate with the age-standardized death rate from all causes, at 0.72, 0.45, and 0.47, respectively. The three female factors correlate with all-cause mortality, at 0.68, 0.65, and 0.20, respectively. In an Ordinary Least Squares regression, the three factors explain 94% of the variance in all-cause mortality for men and 93% for women.

Figure 4: Correlations between factor scores and age-specific death rates from all causes combined, for men

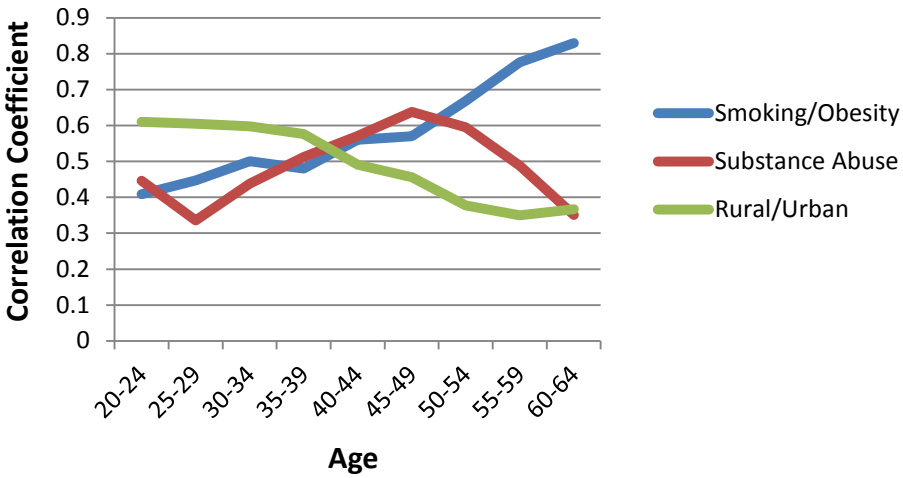
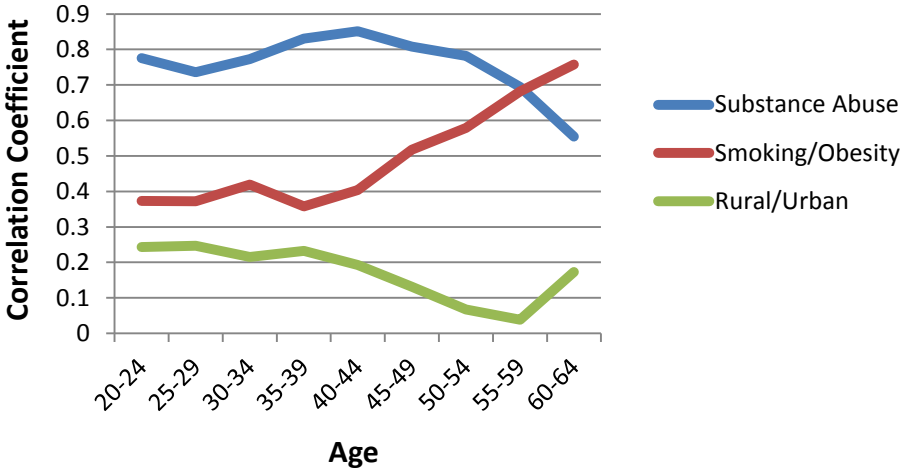


Figure 5: Correlations between factor scores and age-specific death rates from all causes combined, for women



So far we have used only age-standardized rates in the analysis. It would be reassuring if the factors identified had a plausible age pattern of correlation with all-cause mortality, one that reflected the age patterns of mortality by cause. Figure 4 for males and 5 for females show that this expectation is realized. The correlation between all-cause age-specific death rates and the smoking/obesity factor grows stronger with age, its correlation with the rural/urban factor grows weaker with age, and its correlation with the substance abuse factor is an inverted U-shape. These age patterns mimic the age patterns of mortality for the main causes of death associated with each of the factors (National Center for Health Statistics 2012a).

4.2 Validation

Table 4 presents correlations between factor scores and various measures related to the factors that we have identified. Most of these measures are drawn from the Behavioral Risk Factor Surveillance System (BRFSS), an annual survey conducted by the National Center for Health Statistics that provides data on risk factor distributions by state. Despite the flaws in BRFSS data as described in the introduction, it is the best source of information on how risky behaviors vary from state to state. For most measures we have been able to tabulate micro-level data in order to examine the distributions for the white population aged 20-64 by sex.

Table 4: Factor score correlations with variables of interest

		Men			Women		
	Measure	**Smoking/ Obesity**	**Substance Abuse**	**Rural/ Urban**	**Substance Abuse**	**Smoking/ Obesity**	**Rural/ Urban**
Health Behaviors	Percent Smoke Everyday (2005)[a]	0.765	0.040	0.325	0.553	0.556	-0.188
	Percent Obese I (BMI>30)[b]	0.759	-0.291	0.220	0.502	0.380	-0.369
	Percent Obese II (BMI>35)[c]	0.752	-0.319	0.085	0.557	0.415	-0.308
	Percent Nonmedical Painkiller Use, Past Month[d]	0.239	0.445	0.269	0.63	-0.095	-0.016
	Percent Drug Use, Past Month (Not Marijuana)[e]	0.199	0.526	0.072	0.528	-0.052	0.171

Table 4: (Continued)

		Men			Women		
	Measure	**Smoking/ Obesity**	**Substance Abuse**	**Rural/ Urban**	**Substance Abuse**	**Smoking/ Obesity**	**Rural/ Urban**
Health Behaviors	Percent Binge Drinker Last Month[f]	-0.333	-0.290	-0.355	-0.610	0.075	-0.007
Health Care Access	Percent Uninsured[g]	0.148	0.430	0.495	0.765	-0.235	-0.117
	Percent Cannot Afford Health Care Last 6 Months[h]	0.378	0.349	0.547	0.841	-0.118	-0.079
Poverty	Percent in Poverty[i]	0.419	0.470	0.419	0.254	0.280	0.024
Ecological Exposures	Yearly Miles Driven Per Person[j]	0.077	-0.090	0.765	0.438	-0.181	-0.543
	Percent Gun Ownership[k]	0.208	-0.347	0.873	0.345	-0.010	-0.787
	Percent Lives Outside MSA[l]	0.101	-0.464	0.630	0.084	0.082	-0.720

[a-c, f-h,l]2005 Behavioral Risk Factor Surveillance System (BRFSS) for white men/women ages 20-65 (Centers for Disease Control and Prevention 2005). [f]Binge drinking is defined as having 5 or more drinks on at least one occasion in the past 30 days. [i]2011 American Community Survey for whites.

[d,e]2006-2007 Substance Abuse and Mental Health Services Administration survey data (Hughes et al. 2009). These measures are for the entire United States population

[j]Federal Highway Administration (2001) data for all Americans with drivers licenses. [k]2001 BRFSS measure for all Americans. (Centers for Disease Control and Prevention 2001)

The correlations in Table 4 provide solid support for the interpretations that we have given to the factors. Male Factor 1 (Smoking/Obesity) scores are correlated across states at 0.75 or above with measures of the prevalence of smoking and of obesity. These are among the highest correlations in Table 4. The highest correlation involving Male Factor 2 (Substance Abuse) is with self-reported nonmedical prescription drug use (0.53). Male Factor 3 is most highly correlated with indicators of rural residence: miles driven (0.77), gun ownership (0.87), and living outside a Metropolitan Statistical Area (0.63). The correlation between gun ownership and the male injury factor is the highest of any of the 72 correlations in Table 4. Gun ownership is also highly correlated at -0.79 with female Factor 3.

Consistent with the interpretation of female Factor 1 as one of substance abuse, the factor has moderately high loadings with painkiller abuse (0.63) and illicit drug abuse (0.53). However, the highest correlations for female Factor 1 are with the two measures of health care access. Health care access may play a strong role in the spatial patterning of this factor, which would be consistent with the broad range of causes of death highly

loaded on Factor 1 for females. On the other hand, the 'amenable causes' that are thought to be most sensitive to the quality of medical services are not prominent in female Factor 1. Female Factor 2 (Smoking/Obesity) is most highly correlated with the prevalence of smoking (0.56), obesity I (0.38), and obesity II (0.42). The correlations of other measures with female Factor 2 are very low. Female Factor 3 correlations are consistent with a rural/urban interpretation, as all three indicators of rural residence are negatively correlated: miles driven (-0.54), gun ownership (-0.79), and living outside a Metropolitan Service Area (MSA) (-0.72).

5. Discussion

The application of factor analysis to state-specific mortality by cause of death has revealed a set of factors with a substantial degree of epidemiologic coherence. Smoking/obesity, substance abuse, and rural/urban residence emerge as the most prominent sources of mortality variation among men. Similar but weaker patterns are observed in females. Confidence in the identification of these factors is increased by high correlations between the factors and survey-based estimates of exposure to various risks.

Of note, we found that three factors were able to explain the majority of US mortality variation among working-age adults in both men and women. The finding of a large contribution of behavioral risk factors to mortality variation is consistent with previous studies (Danaei et al. 2010; Fenelon and Preston 2012). One prior study estimated that targeting just four of the leading modifiable risk factors could increase overall life expectancy in the US by more than four years and reduce differences in life expectancy across population sub-groups by as much as 20% (Danaei et al. 2010).

The two leading behavioral risk factors in the United States, smoking and obesity, did not emerge as separate factors in the analysis. The identification of smoking and obesity as separate factors may have been prevented by the fact that these two behaviors are highly correlated at the population level. The correlation of smoking and obesity prevalence across states as measured in the 2005 BRFSS (variables in Table 4) was .63 for men and .52 for women. The fact that both behaviors have significant pathways operating through ischaemic heart disease and cerebrovascular disease further impedes their distinction. With respect to male Factor 1, however, the preeminence of lung cancer and the list of highly loaded causes of death clearly suggest a stronger role for smoking than for obesity.

Substance abuse, including alcohol and particularly drug-use, emerged as important sources of mortality variation for both men and women in our analysis. The role of drug-use in American mortality patterns is underappreciated, likely because it is

not easily amenable to measurement. However, our findings are consistent with recent literature, which shows rising death rates from prescription medication abuse, particularly among white women (Centers for Disease Control and Prevention 2013b).

Our analysis also revealed an important role for rural/urban status in US mortality patterns. This role was particularly prominent among males, for whom rurality was associated with higher injury death rates, including transport injuries and suicide. Our findings suggest that gun ownership and increased exposure to driving may be two factors underlying the rural penalty for males; however, future work should seek to identify a more complete set of risk factors associated with rurality.

The set of causes associated with a particular factor has greater coherence for men than for women, and the factors explain more variance for men. This gender difference is likely a result of the fact that risk factors like smoking and drug abuse, as well as the constellation of risk factors that give rise to injury, are more prominent among men. The clearer results for males may also be caused by the fact that there are many more male deaths for statistical analysis than female deaths (2,308,783 deaths for the male analysis compared to 1,215,719 deaths for the female analysis).

Causes of death that we expect to be most sensitive to the availability and quality of health services did not emerge in a latent variable for either sex. Uncertainty is added about the role of health services because the percent uninsured and the percent who cannot afford health care in a state are highly correlated with female Factor 1. It may be that health services manifest themselves in mortality over a wider variety of causes of death than implied by previous efforts to identify the set of sentinel or amenable causes of death.

Latent variable analysis of causes of death is complementary to the more standard attributable-risk approach in which a set of relative risks associated with a particular risk factor is applied to the risk factor distribution of the population. The latent variable approach does not require prevalence or relative risk estimates and is not sensitive to errors therein. Population exposure data and relative risks are typically available for only a small subset of risk factors and data errors may be especially prominent for data on sensitive health topics commonly elicited through self-report (e.g., body mass index, unsafe sex, and illicit drug-use). The present approach uses US vital statistics, a rich source of data with temporal depth and fine geographic detail.

Our latent variable analysis of US cause-of-death data reveals that the majority of mortality variation in white working-age adults can be explained by three readily interpretable factors. These factors are smoking/obesity, substance abuse, and rural/urban status. Although the patterns were stronger in men, findings were generally consistent across the sexes. Future analyses using the present approach should include extensions to older ages, to other racial/ethnic groups, to time series data, and to finer geographic detail (e.g., US counties). The present approach may also prove valuable for

identifying the contribution of modifiable risk factors to mortality patterns in other countries that have complete or near-complete vital registration and in which data to implement the standard attributable risk approach are lacking. More than 60 countries around the world met this criterion as of 2003 (Mathers et al. 2005).

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References

Anderson, R.N. and Rosenberg, H.M. (1998). Age standardization of death rates: implementation of the year 2000 standard. *National Vital Statistics Report* 47(3): 1–16. http://www.cdc.gov/nchs/data/nvsr/nvsr47/nvs47_03.pdf.

Brown, T.A. (2006). *Confirmatory factor analysis for applied research*. Guilford Press.

Centers for Disease Control and Prevention, (CDC) (2001). Behavioral Risk Factor Surveillance System Survey Data. Atlanta, GA: Department of Health and Human Services, Centers for Disease Control and Prevention. http://www.cdc.gov/brfss/annual_data/annual_2001.htm.

Centers for Disease Control and Prevention, (CDC) (2005). Behavioral Risk Factor Surveillance System Survey Data. Atlanta, GA: Department of Health and Human Services, Centers for Disease Control and Prevention. http://www.cdc.gov/brfss/annual_data/annual_2005.htm.

Centers for Disease Control and Prevention, (CDC) (2013a). Behavioral Risk Factor Surveillance System: 2011 Summary Data Quality Report. Atlanta, GA: Department of Health and Human Services, Centers for Disease Control and Prevention.

Centers for Disease Control and Prevention, (CDC) (2013b). Prescription Painkiller Overdoses: a growing epidemic, especially among women. Atlanta, GA: Department of Health and Human Services, Centers for Disease Control and Prevention. http://www.cdc.gov/vitalsigns/PrescriptionPainkillerOverdoses/.

Corrao, G., Bagnardi, V., Zambon, A., and La Vecchia, C. (2004). A meta-analysis of alcohol consumption and the risk of 15 diseases. *Preventive Medicine* 38(5): 613–619. doi:10.1016/j.ypmed.2003.11.027.

Danaei, G., Ding, E.L., Mozaffarian, D., Taylor, B., Rehm, J., Murray, C.J.L., and Ezzati, M. (2009). The preventable causes of death in the United States: comparative risk assessment of dietary, lifestyle, and metabolic risk factors. *PLoS Medicine 6*(4): e1000058. doi:10.1371/journal.pmed.1000058.

Danaei, G., Rimm, E.B., Oza, S., Kulkarni, S.C., Murray, C.J.L., and Ezzati, M. (2010). Correction: The promise of prevention: the effects of four preventable risk factors on national life expectancy and life expectancy disparities by race and county in the United States. *PLoS Medicine* 7(3): 1–12. doi:10.1371/journal.pmed.1000248.

Ezzati, M., Henley, S.J., Lopez, A.D., and Thun, M.J. (2005a). Role of smoking in global and regional cancer epidemiology: current patterns and data needs. *International Journal of Cancer. Journal International du Cancer* 116(6): 963–971. doi:10.1002/ijc.21100.

Ezzati, M., Henley, S.J., Thun, M.J., and Lopez, A.D. (2005b). Role of smoking in global and regional cardiovascular mortality. *Circulation* 112(4): 489–497. doi:10.1161/CIRCULATIONAHA.104.521708.

Federal Highway, Adminstration (2001). *Highway Statistics*. U.S. Department of Transportation, Federal Highway Administration. http://www.fhwa.dot.gov/ohim/ohimstat.htm.

Fenelon, A. and Preston, S.H. (2012). Estimating smoking-attributable mortality in the United States. *Demography* 49(3): 797–818. doi:10.1007/s13524-012-0108-x.

Gavrilova, N.S., Semyonova, V.G., and Evdokushkina, G.N. (2002). Mortality Crisis in Russia : New Health Threats. Center on Aging, University of Chicago. http://health-studies.org/PAA-2002-Russia.pdf.

Howden, L.M. and Meyer, J.A. (2010). Age and sex composition: 2010. 2010 Census Briefs, US Department of Commerce, Economics and Statistics Administration. US CENSUS BUREAU.

Hughes, A., Sathe, N., and Spagnola, K. (2009). *State estimates of substance use from the 2006-2007 National Surveys on Drug Use and Health*. Rockville, MD: Office of Applied Studies, Substance Abuse and Mental Health Services Administration,NSDUH Series H-35, HHS Publication No. SMA 09-4362. http://www.samhsa.gov/data/2k7state/2k7state.pdf.

Kaku, D.A. and Lowenstein, D.H. (1990). Emergence of recreational drug abuse as a major risk factor for stroke in young adults. *Annals of Internal Medicine* 113(11): 821–827. doi:10.7326/0003-4819-113-11-821.

Levi, J., Segal, L.M., and Kohn, D. (2012). *The Facts Hurt: A State-By-State Injury Prevention Policy Report*. Washington, D.C.: Trust for America's Health. http://www.rwjf.org/content/dam/farm/reports/reports/2013/rwjf72972.

Lim, S.S., Vos, T., Flaxman, A.D., Danaei, G., Shibuya, K., Adair-Rohani, H. et al. (2013). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *The Lancet* 380(9859): 2224–2260. doi:10.1016/S0140-6736(12)61766-8.

Mathers, C.D., Fat, D.M., Inoue, M., Rao, C., and Lopez, A.D. (2005). Counting the dead and what they died from: an assessment of the global status of cause of death data. *Bulletin of the World Health Organization* 83(3): 171–177. http://www.who.int/bulletin/volumes/83/3/171.pdf.

McCarthy, J.F., Blow, F.C., Ignacio, R.V., Ilgen, M.A., Austin, K.L., and Valenstein, M. (2012). Suicide among patients in the Veterans Affairs health system: rural-urban differences in rates, risks, and methods. *American Journal of Public Health* 102(S1): S111–S117. doi:10.2105/AJPH.2011.300463.

Mehta, N.K. and Chang, V.W. (2009). Mortality attributable to obesity among middle-aged adults in the United States. *Demography* 46(4): 851–872. doi:10.1353/dem.0.0077.

Mehta, N. and Preston, S. (2012). Continued increases in the relative risk of death from smoking. *American Journal of Public Health* 102(11): 2181–2186. doi:10.2105/AJPH.2011.300489.

Mokdad, A.H., Marks, J.S., Stroup, D.F., and Gerberding, J.L. (2004). Actual causes of death in the United States, 2000. *JAMA: the Journal of the American Medical Association* 291(10): 1238–1245. doi:10.1001/jama.291.10.1238.

Mokdad, A.H., Marks, J.S., Stroup, D.F., and Gerberding, J.L. (2005). Correction : Actual Causes of Death in the United States, 2000. *JAMA: the Journal of the American Medical Association* 293(3): 293–294. doi:10.1001/jama.293.3.293.

Murray, C.J.L., Kulkarni, S.C., Michaud, C., Tomijima, N., Bulzacchelli, M.T., Iandiorio, T.J., and Ezzati, M. (2006). Eight Americas: Investigating Mortality Disparities across Races, Counties, and Race-Counties in the United States. *PLoS Medicine* 3(9): 1513–1524. doi:10.1353/tam.2006.0127.

Murray, C.J., Abraham, J., Ali, M.K., Alvarado, M., Atkinson, C., Baddour, L.M., and Gutierrez, H.R. (2013). The state of US health, 1990-2010: burden of diseases, injuries, and risk factors. *JAMA* 310(6): 591–606. doi:10.1001/jama.2013.13805.

Myers, S.R., Branas, C.C., French, B.C., Nance, M.L., Kallan, M.J., Wiebe, D.J., and Carr, B.G. (2013). Safety in Numbers: Are Major Cities the Safest Places in the United States? *Annals of Emergency Medicine*. doi:10.1016/j.annemergmed.2013.05.030.

Naghavi, M., Makela, S., Foreman, K., O'Brien, J., Pourmalek, F., and Lozano, R. (2010). Algorithms for enhancing public health utility of national causes-of-death data. *Population Health Metrics* 8(9): 1–14.

National Center, for Health Statistics (2010). *Mortality data, multiple cause-of-death public-use data files*. Hyattsville, MD: National Center for Health Statistics. http://www.cdc.gov/nchs/data_access/Vitalstatsonline.htm#Mortality_Multiple.

National Center, for Health Statistics (2012a). *Health, United States, 2012: With Special Feature on Emergency Care*. Hyattsville, MD. http://www.cdc.gov/nchs/data/hus/hus12.pdf.

National Center, for Health Statistics (2012b). *Bridged-race intercensal estimates of the resident population of the United States for July 1, 2000-July 1, 2009, by year, county, single-year of age (0, 1, 2, .., 85 years and over), bridged race, hispanic origin, and sex.* http://www.cdc.gov/nchs/nvss/bridged_race.htm.

Nolte, E. and McKee, C.M. (2008). Measuring the health of nations: updating an earlier analysis. *Health affairs* 27(1): 58–71. doi:10.1377/hlthaff.27.1.58.

Nolte, E. and Mckee, M. (2004). *Does health care save lives? Avoidable mortality revisited*. The Nuttfield Trust.

Oza, S., Thun, M.J., Henley, S.J., Lopez, A.D., and Ezzati, M. (2011). How many deaths are attributable to smoking in the United States? Comparison of methods for estimating smoking-attributable mortality when smoking prevalence changes. *Preventive Medicine* 52: 428–433. doi:10.1016/j.ypmed.2011.04.007.

Peto, R., Lopez, A.D., Boreham, J., Thun, M., and Heath, C. (1992). Mortality from tobacco in developed countries: indirect estimation from national vital statistics. *The Lancet* 339(8804): 1268–1278. doi:10.1016/0140-6736(92)91600-D.

Pirie, K., Peto, R., Reeves, G.K., Green, J., and Beral, V. (2012). The 21st century hazards of smoking and benefits of stopping: a prospective study of one million women in the UK. *Lancet* 381(9861): 133–141. doi:10.1016/S0140-6736(12)61720-6.

Polednak, A.P. (2000). Black-white differences in sentinel causes of death: counties in large metropolitan areas. *Journal of Urban Health Bulletin of the New York Academy of Medicine* 77(3): 501–507.

Preston, S., Glei, D., and Wilmoth, J. (2011). Contribution of Smoking to International Differences in Life Expectancy. In: E. Crimmins, S.H. Preston, and B. Cohen (eds.). *International Differences in Mortality at Older Ages: Dimensions and Sources*. Washington, D.C.: National Academies press: 105–131.

Preston, S.H., Glei, D.A., and Wilmoth, J.R. (2010). A new method for estimating smoking-attributable mortality in high-income countries. *International Journal of Epidemiology* 39(2): 430–438. doi:10.1093/ije/dyp360.

Preston, S., Heuveline, P., and Guillot, M. (2001). *Demography: Measuring and Modeling Population Processes*. London: Blackwell Publishing.

Rehm, J. (2011). The risks associated with alcohol use and alcoholism. *Alcohol Research and Health* 34(2): 135–143. http://www.researchgate.net/publication/221828484_The_risks_associated_with_alcohol_use_and_alcoholism.

Renehan, A.G., Tyson, M., Egger, M., Heller, R.F., and Zwahlen, M. (2008). Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. *Lancet* 371: 569–578. doi:10.1016/S0140-6736(08)60269-X.

Singh, G.K. and Siahpush, M. (2002). Increasing Rural – Urban Gradients in US Suicide. *American Journal of Public Health* 92(7): 1161–1167. doi:10.2105/AJPH.92.7.1161.

Single, E., Robson, L., Rehm, J., Xie, X., and Xi, X. (1999). Morbidity and mortality attributable to alcohol, tobacco, and illicit drug use in Canada. *American Journal of Public Health* 89(3): 385–390. doi:10.2105/AJPH.89.3.385.

Taylor, B., Irving, H. M., Kanteres, F., Room, R., Borges, G., and Cherpitel, C. et al. (2010). The more you drink, the harder you fall: a systematic review and meta-analysis of how acute alcohol consumption and injury or collision risk increase together. *Drug and Alcohol Dependence* 110(1): 108–116. doi:10.1016/j.drugalcdep.2010.02.011.

United States, Fire Administration (2013). www.usfa.fema.gov/campaigns/smoking.

United, Nations (1982). *Model Life Tables for Developing Countries*. New York: United Nations Publication, Sales No. E.81.XIII.7.

United States, Census Bureau. (2013). 2011 American Community Survey. Tabulations supplied by Alemayehu Bishaw of the U.S. Census Bureau.

Van Den Berg, C., Smit, C., Van Brussel, G., Coutinho, R., and Prins, M. (2007). Full participation in harm reduction programmes is associated with decreased risk for human immunodeficiency virus and hepatitis C virus: evidence from the Amsterdam Cohort Studies among drug users. *Addiction (Abingdon, England)* 102(9): 1454–1462. doi:10.1111/j.1360-0443.2007.01912.x.

Whitlock, G., Lewington, S., Sherliker, P., Clarke, R., Emberson, J., and Halsey et al. (2009). Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. *Lancet* 373(9669): 1083–1096. doi:10.1016/S0140-6736(09)60318-4.

Wijetunga, M., Seto, T., Lindsay, J., and Schatz, I. (2003). Crystal methamphetamine-associated cardiomyopathy: tip of the iceberg? *Clinical Toxicology* 41(7): 981–986. doi:10.1081/CLT-120026521.

Appendix

Causes of death list

The Global Burden of Disease (GBD) cause-of-death groupings were chosen because they could be traced to ICD-9 and ICD-10, they identified 'garbage' codes, and they focused on public health. However, the GBD groupings are primarily for international comparisons, so several changes were made to make a list more appropriate for identifying latent variables in the United States. These changes are outlined below.

Important causes of death that meet the criterion for inclusion, but were grouped in "other" categories, were separately enumerated. These "other" categories included other cancers and other circulatory diseases.

Causes of death that are part of a broader category but are clear markers of behavioral risk factors were added to the list used in this analysis:

- COPD was taken out of respiratory diseases.
- Alcoholic liver cirrhosis was separated from non-alcoholic liver cirrhosis.
- Alcohol poisoning was separated from several categories then combined.
- Deaths from war and capital punishment were removed.

Extremely broad categories were removed, as interpretation of these categories would be unclear. These categories were "Endocrine, nutritional, blood and immune disorders", "Skin diseases, genitourinary diseases, musculoskeletal diseases", and "Mental and behavioral disorders, neurological conditions, and sense organ diseases". Also, the remainder of the "other circulatory diseases" and "other cancers" were removed after extracting causes that had over 5,000 deaths.

Table S1: Eigenvalues and the percent of cause of death variance explained by each factor

Male				Female			
Eigenvector	Eigenvalue	Percent of Variance Explained	Cumulative Percent	Eigenvector	Eigenvalue	Percent of Variance Explained	Cumulative Percent
1	13.276	0.34	0.34	1	11.474	0.328	0.328
2	5.28	0.135	0.476	2	5.151	0.147	0.475
3	5.227	0.134	0.61	3	2.967	0.085	0.56
4	1.73	0.044	0.654	4	2.296	0.066	0.625
5	1.678	0.043	0.697	5	1.881	0.054	0.679
6	1.492	0.038	0.735	6	1.272	0.036	0.715
7	1.305	0.033	0.769	7	1.11	0.032	0.747
8	1.004	0.026	0.795	8	0.901	0.026	0.773
9	0.886	0.023	0.817	9	0.85	0.024	0.797
10	0.714	0.018	0.836	10	0.681	0.019	0.817

Notes: Death registration data is taken from the NCHS and includes white men/women ages 20-64 and years 2000-2009. Factor analysis is run on a state by age-standardized cause of death matrix. This procedure produces 49 eigenvectors (factors) that are ordered by the amount of variance they explain. The first three factors were included in our analysis.

Table S2: Male factor loadings

Factor 1		Factor 2		Factor 3	
Cause of Death	Loading	Cause of Death	Loading	Cause of Death	Loading
Lung, Trachea, and Bronchus Cancer	0.947	Liver Cancer	0.844	Self-Inflicted Injuries	0.849
Colorectal Cancer	0.884	Interpersonal Violence	0.834	Transport Injures	0.794
Ischemic Heart Disease	0.880	Hepatitis	0.804	Exposure to Mechanical Forces	0.770
Oral Cancer	0.837	Non-Alcoholic Liver Cirrhosis	0.771	Other Accidents	0.753
Larynx Cancer	0.820	HIV/AIDS	0.758	Accidental Drowning	0.611
Cerebrovascular Disease	0.757	Accidental Poisoning	0.706	Falls	0.586
COPD	0.749	Other Digestive Diseases	0.670	COPD	0.494
Exposure to Smoke or Heat	0.744	Hypertensive Heart Disease	0.643	Multiple Myeloma	0.401
Pancreatic Cancer	0.729	Alcoholic Liver Cirrhosis	0.640	Prostate Cancer	0.401
Non-Hodgkins Lymphoma	0.717	Cardiomyopathy	0.520	Exposure to Smoke or Heat	0.384
Leukemia	0.706	Stomach Cancer	0.501	Alcohol Poisoning	0.363
Respiratory Disease	0.690	Alcohol Poisoning	0.431	Respiratory Disease	0.343
Diabetes Mellitus	0.635	Oral Cancer	0.332	Diabetes Mellitus	0.326
Esophagus Cancer	0.594	Cerebrovascular Disease	0.328	Skin Cancer	0.319
Aneurysm	0.567	Diabetes Mellitus	0.281	Cerebrovascular Disease	0.311
Non-Alcoholic Liver Cirrhosis	0.477	Aneurysm	0.254	Interpersonal Violence	0.308
Skin Cancer	0.474	Larynx Cancer	0.247	Aneurysm	0.293
Bladder Cancer	0.457	Self-Inflicted Injuries	0.233	Other Digestive Diseases	0.289
Other Digestive Diseases	0.449	Respiratory Disease	0.224	Alcoholic Liver Cirrhosis	0.278

Table S2: (Continued)

Factor 1		Factor 2		Factor 3	
Cause of Death	**Loading**	**Cause of Death**	**Loading**	**Cause of Death**	**Loading**
Exposure to Mechanical Forces	0.437	Transport Injures	0.222	Ischemic Heart Disease	0.240
Transport Injures	0.409	Colorectal Cancer	0.214	Brain Cancer	0.134
Other Accidents	0.386	Falls	0.210	Colorectal Cancer	0.111
Stomach Cancer	0.320	Ischemic Heart Disease	0.189	Lung, Trachea, and Bronchus Cancer	0.106
Brain Cancer	0.298	Skin Cancer	0.171	Hepatitis	0.100
Multiple Myeloma	0.281	Non-Hodgkins Lymphoma	0.164	Accidental Poisoning	0.096
Liver Cancer	0.230	COPD	0.158	Non-Alcoholic Liver Cirrhosis	0.094
Accidental Poisoning	0.226	Bladder Cancer	0.116	Oral Cancer	0.006
Interpersonal Violence	0.201	Accidental Drowning	0.092	Liver Cancer	-0.018
Cardiomyopathy	0.193	Prostate Cancer	0.073	Non-Hodgkins Lymphoma	-0.081
Hypertensive Heart Disease	0.165	Pancreatic Cancer	0.061	Hypertensive Heart Disease	-0.095
HIV/AIDS	0.134	Leukemia	0.052	Leukemia	-0.119
Prostate Cancer	0.130	Exposure to Smoke or Heat	0.027	Larynx Cancer	-0.195
Hepatitis	0.080	Lung, Trachea, and Bronchus Cancer	0.001	Esophagus Cancer	-0.229
Accidental Drowning	0.021	Other Accidents	-0.058	Pancreatic Cancer	-0.233
Self-Inflicted Injuries	-0.039	Multiple Myeloma	-0.087	Tissue Cancer	-0.242
Falls	-0.260	Tissue Cancer	-0.168	HIV/AIDS	-0.372
Alcoholic Liver Cirrhosis	-0.293	Exposure to Mechanical Forces	-0.188	Cardiomyopathy	-0.411
Tissue Cancer	-0.297	Esophagus Cancer	-0.278	Bladder Cancer	-0.479
Alcohol Poisoning	-0.508	Brain Cancer	-0.386	Stomach Cancer	-0.480

Notes: Death registration data is taken from the NCHS and includes white men ages 20-64 and years 2000-2009. Factor analysis is run on a state by age-standardized cause of death matrix that generates three factors. Factor loadings represent the correlations between causes of death and these factors.

Table S3: Female factor loadings

Factor 1		Factor 2		Factor 3	
Cause of Death	**Loading**	**Cause of Death**	**Loading**	**Cause of Death**	**Loading**
Interpersonal Violence	0.879	Colorectal Cancer	0.743	HIV/AIDS	0.728
Cerebrovascular Disease	0.876	Breast Cancer	0.740	Stomach Cancer	0.580
Other Digestive Diseases	0.869	Lung, Trachea, and Bronchus Cancer	0.725	Hypertensive Heart Disease	0.466
Non-Alcoholic Liver Cirrhosis	0.837	Non-Hodgkins Lymphoma	0.651	Non-Alcoholic Liver Cirrhosis	0.372
Accidental Poisoning	0.778	Ischaemic Heart Disease	0.618	Breast Cancer	0.339
Chronic Obstructive Pulmonary Disease	0.769	Leukemia	0.548	Leukemia	0.287
Transport Injures	0.761	Oral Cancer	0.495	Hepatitis	0.279
Respiratory Diseases	0.751	Tissue Cancer	0.435	Liver Cancer	0.215

Table S3: (Continued)

Factor 1		Factor 2		Factor 3	
Cause of Death	**Loading**	**Cause of Death**	**Loading**	**Cause of Death**	**Loading**
Cervical Uteri Cancer	0.749	Chronic Obstructive Pulmonary Disease	0.396	Cardiomyopathy	0.206
Ischaemic Heart Disease	0.726	Cervical Uteri Cancer	0.363	Cervical Uteri Cancer	0.167
Self-inflicted Injuries	0.718	Pancreatic Cancer	0.362	Interpersonal Violence	0.144
Diabetes Mellitus	0.690	Corpus Uteri Cancer	0.311	Tissue Cancer	0.107
Hepatitis	0.663	Cerebrovascular Disease	0.298	Alcohol Poisoning	0.071
Liver Cancer	0.654	Diabetes Mellitus	0.281	Accidental Poisoning	0.065
Other Accidents	0.613	HIV/AIDS	0.255	Other Digestive Diseases	0.036
Cardiomyopathy	0.573	Other Accidents	0.254	Multiple Myeloma	0.005
Colorectal Cancer	0.548	Esophagus Cancer	0.227	Respiratory Diseases	-0.023
Hypertensive Heart Disease	0.538	Skin Cancer	0.221	Ischaemic Heart Disease	-0.044
Leukemia	0.381	Other Digestive Diseases	0.172	Non-Hodgkins Lymphoma	-0.048
Lung, Trachea, and Bronchus Cancer	0.357	Multiple Myeloma	0.169	Colorectal Cancer	-0.049
Skin Cancer	0.297	Respiratory Diseases	0.162	Esophagus Cancer	-0.074
Breast Cancer	0.280	Brain Cancer	0.157	Lung, Trachea, and Bronchus Cancer	-0.078
Non-Hodgkins Lymphoma	0.248	Stomach Cancer	0.148	Pancreatic Cancer	-0.089
Alcoholic Liver Cirrhosis	0.197	Liver Cancer	0.091	Oral Cancer	-0.111
Brain Cancer	0.139	Cardiomyopathy	0.060	Alcoholic Liver Cirrhosis	-0.112
Alcohol Poisoning	0.114	Transport Injures	0.049	Diabetes Mellitus	-0.166
Stomach Cancer	0.099	Hypertensive Heart Disease	-0.009	Cerebrovascular Disease	-0.171
Oral Cancer	-0.040	Interpersonal Violence	-0.014	Corpus Uteri Cancer	-0.259
Pancreatic Cancer	-0.055	Non-Alcoholic Liver Cirrhosis	-0.032	Self-inflicted Injuries	-0.276
HIV/AIDS	-0.060	Accidental Poisoning	-0.164	Other Accidents	-0.309
Falls	-0.155	Falls	-0.211	Skin Cancer	-0.313
Multiple Myeloma	-0.183	Hepatitis	-0.311	Chronic Obstructive Pulmonary Disease	-0.370
Tissue Cancer	-0.193	Self-inflicted Injuries	-0.523	Transport Injures	-0.411
Esophagus Cancer	-0.319	Alcoholic Liver Cirrhosis	-0.725	Falls	-0.416
Corpus Uteri Cancer	-0.632	Alcohol Poisoning	-0.815	Brain Cancer	-0.629

Notes: Death registration data is taken from the NCHS and includes white men ages 20-64 and years 2000-2009. Factor analysis is run on a state by age-standardized cause of death matrix that generates three factors. Factor loadings represent the correlations between causes of death and these factors.

Table S4: Factor scores

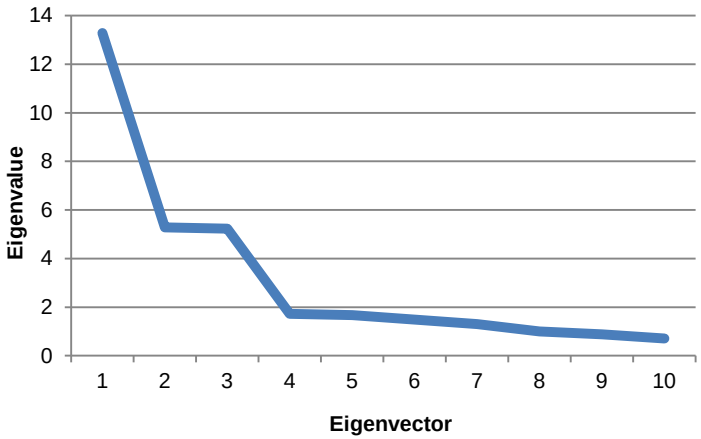
	Men			Women		
State	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 1**	**Factor 2**	**Factor 3**
AL	1.423	-0.105	0.824	1.303	0.466	-0.435
AK	-1.913	-0.067	1.825	0.207	-2.830	0.522
AR	1.599	0.197	1.230	1.540	1.265	-0.348
AZ	-0.777	1.834	0.084	0.611	-1.335	0.666
CA	-0.924	1.890	-0.778	0.264	-0.490	2.089
CO	-1.841	0.633	0.644	0.072	-1.905	-0.415
CT	-0.942	0.077	-1.627	-1.067	-0.162	1.363
DE	0.418	0.596	-1.300	0.392	0.085	0.637
FL	0.444	1.815	-0.506	0.490	-0.562	1.101
GA	0.085	0.342	0.144	0.527	-0.191	0.234
IA	-0.025	-1.462	0.056	-0.897	0.834	-1.041
ID	-0.655	-1.071	0.936	-0.298	-0.988	-1.581
IL	-0.045	-0.162	-1.094	-0.725	0.675	0.956
IN	1.040	-0.745	-0.121	0.303	1.105	-0.342
KS	0.195	-0.851	0.234	-0.028	-0.111	-0.629
KY	1.879	-0.246	0.831	1.024	1.637	-0.457
LA	1.133	0.739	0.473	1.333	0.506	0.653
MA	-0.271	0.012	-1.799	-1.324	0.390	0.973
MD	-0.317	-0.342	-0.914	-0.776	0.265	0.949
ME	0.457	-0.911	-0.634	-0.907	0.373	-0.731
MI	0.455	-0.334	-0.950	-0.154	0.295	0.103
MN	-0.886	-1.290	-0.292	-1.623	-0.186	-0.602
MO	0.637	-0.218	0.126	0.393	0.784	-0.524
MS	1.682	0.231	1.493	1.720	0.696	-0.360
MT	-1.289	-0.607	1.635	-0.380	-1.199	-1.878
NC	0.258	-0.004	0.354	0.224	0.101	-0.507
ND	-0.488	-1.574	0.188	-1.559	-0.195	-0.409
NE	-0.562	-1.287	0.137	-0.960	-0.127	-0.900
NH	-0.227	-0.824	-0.811	-1.099	-0.250	0.156
NJ	-0.228	0.323	-1.947	-1.262	0.810	1.860
NM	-1.303	3.143	1.421	1.485	-2.178	1.181
NV	-0.426	2.109	0.052	1.497	-1.217	0.967
NY	0.120	0.417	-1.951	-1.085	1.091	2.576
OH	0.955	-0.389	-0.988	-0.113	1.073	-0.182
OK	1.606	0.518	0.818	2.041	1.119	-0.714
OR	-0.483	0.190	0.475	0.128	-0.758	-0.833
PA	0.467	-0.286	-0.858	-0.619	0.992	0.035
RI	-0.010	-0.093	-1.455	-0.760	0.511	0.491
SC	0.717	0.621	0.445	0.792	-0.009	-0.198
SD	-0.588	-1.599	0.858	-1.464	0.613	-1.468
TN	1.684	0.485	0.550	1.553	0.716	-0.452
TX	-0.018	1.548	-0.307	0.788	-0.097	1.817
UT	-1.570	-0.585	0.436	-0.230	-1.632	-0.335

Table S4: (Continued)

	Men			Women		
State	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 1**	**Factor 2**	**Factor 3**
VA	-0.288	-0.600	-0.464	-0.670	0.309	0.358
VT	-0.694	-0.692	-0.407	-1.195	0.128	-0.797
WA	-0.679	0.251	-0.206	-0.225	-0.595	-0.734
WI	-0.501	-1.040	-0.135	-1.112	-0.321	-0.694
WV	2.163	-0.173	1.069	1.206	1.913	-0.628
WY	-1.468	-0.416	2.207	0.640	-1.415	-1.492

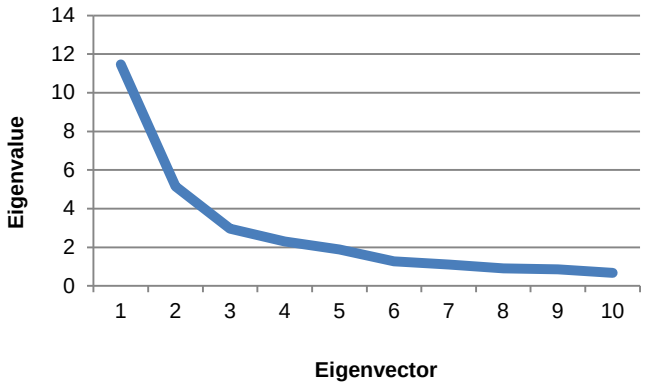
Notes: Death registration data is taken from the NCHS and includes white men/women ages 20-64 and years 2000-2009. Factor analysis is run on a state by age-standardized cause of death matrix. After the analysis, the factor scores above are estimated using the regression approach.

Figure S1: Male scree plot



Notes: Death registration data is taken from the NCHS and includes white men/women ages 20-64 and years 2000-2009. Factor analysis is run on a state by age-standardized cause of death matrix. This procedure produces 49 eigenvectors (factors) that are ordered by the amount of variance they explain. The first three factors were included in our analysis.

Figure S2: Female scree plot



Notes: Death registration data is taken from the NCHS and includes white men/women ages 20-64 and years 2000-2009. Factor analysis is run on a state by age-standardized cause of death matrix. This procedure produces 49 eigenvectors (factors) that are ordered by the amount of variance they explain. The first three factors were included in our analysis.

Table S5: Correlations between factor loadings when retaining 3 factors and factor loadings when retaining 1-5 factors

		Male Factors from Analysis			Female Factors from Analysis		
Number of Factors Retained	**Factor**	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 1**	**Factor 2**	**Factor 3**
1 Factor Retained	1	**0.863**	0.153	0.116	**0.948**	0.250	0.077
2 Factors Retained	1	**0.845**	0.307	-0.226	**1.000**	-0.083	0.064
	2	0.070	-0.429	**0.958**	-0.057	**1.000**	0.044
3 Factors Retained	1	**1.000**	-0.249	-0.135	**1.000**	-0.071	0.047
	2	-0.249	**1.000**	-0.190	-0.071	**1.000**	0.025
	3	-0.135	-0.190	**1.000**	0.047	0.025	**1.000**
4 Factors Retained	1	**1.000**	-0.259	-0.137	**0.961**	0.177	-0.076
	2	-0.206	**0.995**	-0.189	-0.262	**0.957**	0.115
	3	-0.075	-0.181	**0.987**	0.267	-0.058	**0.964**
	4	-0.393	-0.043	0.332	-0.388	0.325	-0.147
5 Factors Retained	1	**0.911**	-0.274	0.264	**0.960**	0.180	-0.073
	2	-0.161	**0.987**	-0.320	-0.250	**0.959**	0.106
	3	-0.501	0.011	**0.851**	0.316	-0.053	**0.839**
	4	0.421	-0.128	-0.734	-0.414	0.345	-0.092
	5	-0.135	-0.062	0.339	0.051	-0.031	0.666

Notes: Factors at the top of the table are from our original analysis. Their factor loadings are correlated with factor loadings from factors that were generated by running the same analysis, but specifying a different number of factors to retain. When specifying 1 to 5 factors, the same factors as the original analysis are identified in the same order with one exception: when 2 factors are retained for men, the "injury" factor becomes the second factor.

Table S6: Correlation between factor loadings when using varimax rotation and factor loadings when using promax rotation

	Varimax Rotation					
	Factor 1		Factor 2		Factor 3	
	Male	Female	Male	Female	Male	Female
Promax(1)	1.000	1.000	1.000	1.000	1.000	1.000
Promax(2)	0.998	0.999	0.996	0.999	0.999	0.998
Promax(3)	0.996	0.998	0.994	0.998	0.998	0.995
Promax(4)	0.995	0.997	0.993	0.997	0.999	-0.993
Promax(5)	0.994	0.996	0.993	0.997	0.999	-0.991

Notes: Factor loadings produced using varimax rotation (the specification chosen in the analysis) are correlated with factor loadings produced using promax rotation. Promax rotation allows factors to be correlated, and the higher the number in parenthesis next to promax, the more correlation is allowed. Correlations between factor loadings go down slightly as more correlation is allowed between factors, but correlations are still very high for any specification.

Table S7: Correlations between factor scores when using regression estimation and factor scores when using Bartlett's estimation

Factor	Male	Female
1	1.000	0.997
2	1.000	0.993
3	1.000	0.984

Notes: Stata provides two of the most common methods for estimating factor scores: Bartlett and Regression. The correlations above demonstrate that this specification does not affect factor scores.

Table S8: Correlations between factor loadings when using the 2000 age distribution and using the 2010 age distribution for death rate calculations

Factor	Male	Female
1	0.998	0.940
2	0.998	0.954
3	0.999	0.843

Notes: Factor loadings are largely unaffected by which age distribution is used for death rate calculations. Age distributions are taken from the United States Census (Howden and Meyer 2010; Anderson and Rosenberg 1998).

Table S9: Factor loadings ages 20-64 with men and women combined

Factor 1		Factor 2		Factor 3	
Cause of Death	Factor Loading	Cause of Death	Factor Loading	Cause of Death	Factor Loading
Ischaemic Heart Disease	0.92429	Liver Cancer	0.83098	Self-Inflicted Injuries	0.85972
Colorectal Cancer	0.90851	Interpersonal Violence	0.82123	Exposure to Forces of Nature	0.79888
Lung, Trachea, and Bronchus Cancer	0.90739	Hepatitis	0.80609	Transport Injures	0.66112
Chronic Obstructive Pulmonar Disease	0.863	Cirrhosis of the Liver	0.79085	Accidental Drowning	0.65741
Cerebrovascular Disease	0.82453	HIV/AIDS	0.70626	Other Accidents	0.5777
Oral Cancer	0.78727	Hypertensive Heart Disease	0.66948	Exposure to Mechanical Forces	0.57411
Exposure to Smoke or Heat	0.78267	Accidental Poisoning	0.65418	Falls	0.54859
Non-Hodgkins Lymphoma	0.76017	Other Digestive Diseases	0.62599	Rheumatic Heart Disease	0.51581
Larynx Cancer	0.73807	Stomach Cancer	0.54015	Alcohol Poisoning	0.51086
Leukemia	0.73792	Alcoholic Liver Cirrhosis	0.53619	Prostate Cancer	0.4641
Cervical Uteri Cancer	0.73519	Cardiomyopathy	0.52878	Alcoholic Liver Cirrhosis	0.43043
Respiratory Diseases	0.73201	Cervical Uteri Cancer	0.45251	Chronic Obstructive Pulmonar Disease	0.31467
Diabetes Mellitus	0.7167	Alcohol Poisoning	0.3896	Aneurysm	0.2755
Exposure to Mechanical Forces	0.6711	Cerebrovascular Disease	0.34509	Interpersonal Violence	0.25958
Aneurysm	0.63677	Gall Bladder Cancer	0.32448	Brain Cancer	0.23567
Other Accidents	0.62317	Respiratory Diseases	0.30939	Cerebrovascular Disease	0.21847
Transport Injures	0.60087	Self-Inflicted Injuries	0.26613	Skin Cancer	0.21298
Other Digestive Diseases	0.5758	Diabetes Mellitus	0.24125	Other Digestive Diseases	0.19822
Breast Cancer	0.57139	Oral Cancer	0.23973	Respiratory Diseases	0.19687
Pancreatic Cancer	0.54636	Breast Cancer	0.21978	Diabetes Mellitus	0.19037
Skin Cancer	0.52218	Aneurysm	0.21589	Multiple Myeloma	0.18424
Cirrhosis of the Liver	0.47342	Transport Injures	0.1953	Exposure to Smoke or Heat	0.16369
Esophagus cancer	0.43919	Ischaemic Heart Disease	0.1817	Accidental Poisoning	0.15455
Hodgkins Lymphoma	0.4163	Rheumatic Heart Disease	0.1767	Hepatitis	0.14909
Interpersonal Violence	0.32528	Colorectal Cancer	0.16912	Ischaemic Heart Disease	0.0388
Brain Cancer	0.31295	Larynx Cancer	0.16561	Cirrhosis of the Liver	0.01738
Accidental Poisoning	0.30789	Accidental Drowning	0.14715	Cervical Uteri Cancer	0.00179
Multiple Myeloma	0.27415	Leukemia	0.13912	Liver Cancer	-0.01048
Liver Cancer	0.27137	Chronic Obstructive Pulmonar Disease	0.11889	Hypertensive Heart Disease	-0.07343
Bladder Cancer	0.27047	Non-Hodgkins Lymphoma	0.09627	Colorectal Cancer	-0.1362
Rheumatic Heart Disease	0.22099	Exposure to Smoke or Heat	0.08004	Lung, Trachea, and Bronchus Cancer	-0.17795
Prostate Cancer	0.19043	Skin Cancer	0.0745	Oral Cancer	-0.21178
Cardiomyopathy	0.17204	Falls	0.06534	Non-Hodgkins Lymphoma	-0.23852
Self-Inflicted Injuries	0.16261	Bladder Cancer	0.06057	Esophagus cancer	-0.28141
Hypertensive Heart Disease	0.16165	Exposure to Forces of Nature	-0.00627	Cardiomyopathy	-0.28794

Table S9: (Continued)

Factor 1		Factor 2		Factor 3	
Cause of Death	Factor Loading	Cause of Death	Factor Loading	Cause of Death	Factor Loading
Gall Bladder Cancer	0.14052	Other Accidents	-0.0266	Pancreatic Cancer	-0.35418
Accidental Drowning	0.13388	Lung, Trachea, and Bronchus Cancer	-0.03514	Corpus Uteri Cancer	-0.36773
Stomach Cancer	0.13095	Prostate Cancer	-0.05704	Gall Bladder Cancer	-0.36895
Hepatitis	0.11022	Pancreatic Cancer	-0.09289	Larynx Cancer	-0.37022
HIV/AIDS	0.0264	Hodgkins Lymphoma	-0.10998	Leukemia	-0.3928
Corpus Uteri Cancer	-0.10064	Exposure to Mechanical Forces	-0.16886	Tissue Cancer	-0.41207
Tissue Cancer	-0.12727	Tissue Cancer	-0.18181	Hodgkins Lymphoma	-0.44727
Exposure to Forces of Nature	-0.17466	Multiple Myeloma	-0.22567	Bladder Cancer	-0.4583
Falls	-0.18125	Esophagus cancer	-0.37969	HIV/AIDS	-0.46767
Alcoholic Liver Cirrhosis	-0.26152	Brain Cancer	-0.40537	Stomach Cancer	-0.51539
Alcohol Poisoning	-0.42201	Corpus Uteri Cancer	-0.57831	Breast Cancer	-0.63016

Notes: Death registration data is taken from the NCHS and includes white men and women ages 20-64 and years 2000-2009. Factor analysis is run on a state by age-standardized cause of death matrix and generates three factors. Factor loadings represent the correlations between causes of death and these factors. The same 3 factors are identified with the order being the same as the original male analysis.

Table S9 shows that the same factors are identified when men and women are included in the same analysis. The factor loadings in table S9 have correlations of .96, .98, and .95 with the original male factor loadings.

Table S10: Female factor loadings ages 20-74

Factor 1		Factor 2		Factor 3	
Cause of Death	Factor Loading	Cause of Death	Factor Loading	Cause of Death	Factor Loading
Interpersonal Violence	0.90609	Colorectal Cancer	0.8448	Brain Cancer	0.64755
Cirrhosis of the Liver	0.86165	Lung, Trachea, and Bronchus Cancer	0.79921	Rheumatic Heart Disease	0.63772
Accidental Poisoning	0.78308	Ischaemic Heart Disease	0.76053	Transport Injures	0.5757
Hepatitis	0.76738	Breast Cancer	0.66998	Chronic Obstructive Pulmonar Disease	0.49038
Other Digestive Diseases	0.74373	Leukemia	0.65281	Cerebrovascular Disease	0.43365
Self-Inflicted Injuries	0.71202	Non-Hodgkins Lymphoma	0.6477	Aneurysm	0.43045
Cerebrovascular Disease	0.69489	Exposure to Smoke or Heat	0.54355	Other Accidents	0.42172
Cervical Uteri Cancer	0.69194	Intestinal Infectious Diseases	0.52092	Self-Inflicted Injuries	0.41856
Liver Cancer	0.68016	Chronic Obstructive Pulmonar Disease	0.51605	Multiple Myeloma	0.3596
Hypertensive Heart Disease	0.67004	Bladder Cancer	0.50805	Respiratory Diseases	0.30806
Transport Injures	0.65006	Cervical Uteri Cancer	0.48188	Other Digestive Diseases	0.28733
Cardiomyopathy	0.56083	Cerebrovascular Disease	0.4613	Diabetes Mellitus	0.27875

Table S10: (Continued)

Factor 1		Factor 2		Factor 3	
Cause of Death	**Factor Loading**	**Cause of Death**	**Factor Loading**	**Cause of Death**	**Factor Loading**
Respiratory Diseases	0.55845	Aneurysm	0.45452	Falls	0.19195
Chronic Obstructive Pulmonar Disease	0.542	Skin Cancer	0.36803	Exposure to Smoke or Heat	0.18518
Exposure to Smoke or Heat	0.51683	Respiratory Diseases	0.36248	Skin Cancer	0.18184
Other Accidents	0.50786	Cardiomyopathy	0.35422	Non-Hodgkins Lymphoma	0.1425
Ischaemic Heart Disease	0.49306	Diabetes Mellitus	0.3513	Alcoholic Liver Cirrhosis	0.09296
Diabetes Mellitus	0.41099	Other Digestive Diseases	0.33854	Colorectal Cancer	0.09221
Lung, Trachea, and Bronchus Cancer	0.22339	Other Accidents	0.32229	Alcohol Poisoning	0.08884
Alcoholic Liver Cirrhosis	0.21231	Tissue Cancer	0.30683	Interpersonal Violence	0.07648
Alcohol Poisoning	0.19602	Gall Bladder Cancer	0.28086	Accidental Poisoning	0.06606
Non-Hodgkins Lymphoma	0.16627	Pancreatic Cancer	0.24231	Lung, Trachea, and Bronchus Cancer	0.00644
Colorectal Cancer	0.15378	Esophagus cancer	0.22991	Oral Cancer	0.00322
Stomach Cancer	0.11312	Cirrhosis of the Liver	0.18318	Corpus Uteri Cancer	0.00234
HIV/AIDS	0.07898	Brain Cancer	0.14784	Ischaemic Heart Disease	-0.04857
Leukemia	0.07284	Transport Injures	0.14481	Cervical Uteri Cancer	-0.06593
Breast Cancer	0.07178	Corpus Uteri Cancer	0.10933	Cardiomyopathy	-0.08192
Skin Cancer	0.06025	Interpersonal Violence	0.09484	Leukemia	-0.1216
Rheumatic Heart Disease	0.04368	Hypertensive Heart Disease	0.09234	Hepatitis	-0.20747
Intestinal Infectious Diseases	0.04104	HIV/AIDS	0.08876	Cirrhosis of the Liver	-0.20977
Oral Cancer	-0.03093	Accidental Poisoning	0.05882	Tissue Cancer	-0.22732
Aneurysm	-0.03672	Oral Cancer	0.02813	Liver Cancer	-0.22909
Brain Cancer	-0.05776	Liver Cancer	0.02405	Esophagus cancer	-0.24102
Falls	-0.10411	Stomach Cancer	-0.05058	Pancreatic Cancer	-0.29092
Bladder Cancer	-0.20036	Multiple Myeloma	-0.06512	Breast Cancer	-0.37436
Gall Bladder Cancer	-0.22863	Hepatitis	-0.1484	Hypertensive Heart Disease	-0.38248
Multiple Myeloma	-0.28729	Rheumatic Heart Disease	-0.24079	Bladder Cancer	-0.41841
Pancreatic Cancer	-0.30545	Self-Inflicted Injuries	-0.29965	Intestinal Infectious Diseases	-0.4422
Tissue Cancer	-0.35793	Falls	-0.3571	Gall Bladder Cancer	-0.52807
Esophagus cancer	-0.43094	Alcoholic Liver Cirrhosis	-0.57433	Stomach Cancer	-0.55207
Corpus Uteri Cancer	-0.76297	Alcohol Poisoning	-0.62324	HIV/AIDS	-0.76282

Notes: Death registration data is taken from the NCHS and includes white women ages 20-74 and years 2000-2009. Factor analysis is run on a state by age-standardized cause of death matrix and generates three factors. Factor loadings represent the correlations between causes of death and these factors. The same three factors are identified with only small differences.

Table S11: Male factor loadings age 20-74

Factor 1		Factor 2		Factor 3	
Cause of Death	**Factor Loading**	**Cause of Death**	**Factor Loading**	**Cause of Death**	**Factor Loading**
Non-Hodgkins	0.80385	Transport Injures	0.89867	Liver Cancer	0.86001
Leukemia	0.79146	Other Accidents	0.8498	Interpersonal Violence	0.82628
Lung, Trachea, and Bronchus Cancer	0.7912	Chronic Obstructive Pulmonar Disease	0.84804	Cirrhosis of the Liver	0.82097
Colorectal Cancer	0.78357	Exposure to Mechanical Forces	0.84556	HIV/AIDS	0.7837
Larynx Cancer	0.7687	Self-Inflicted Injuries	0.76401	Hepatitis	0.77757
Pancreatic Cancer	0.7211	Exposure to Smoke or Heat	0.68569	Accidental Poisoning	0.74839
Ischaemic Heart Disease	0.71175	Cerebrovascular Disease	0.66376	Hypertensive Heart Disease	0.70811
Oral Cancer	0.62382	Aneurysm	0.66233	Other Digestive Diseases	0.55621
Cerebrovascular Disease	0.51702	Respiratory Diseases	0.5996	Stomach Cancer	0.53096
Exposure to Smoke or Heat	0.51064	Accidental Drowning and Submersion	0.52214	Cardiomyopathy	0.52155
Aneurysm	0.50702	Lung, Trachea, and Bronchus Cancer	0.49735	Oral Cancer	0.45938
Bladder Cancer	0.47721	Other Digestive Diseases	0.45898	Alcoholic Liver Cirrhosis	0.4305
Cardiomyopathy	0.44242	Ischaemic Heart Disease	0.45591	Larynx Cancer	0.34902
Esophagus cancer	0.44197	Diabetes Mellitus	0.41728	Ischaemic Heart Disease	0.31672
Chronic Obstructive Pulmonar Disease	0.32069	Interpersonal Violence	0.38635	Cerebrovascular Disease	0.28131
Diabetes Mellitus	0.30914	Colorectal Cancer	0.35454	Alcohol Poisoning	0.27894
Brain Cancer	0.30498	Skin Cancer	0.32102	Skin Cancer	0.27518
Multiple Myeloma	0.26875	Oral Cancer	0.28788	Diabetes Mellitus	0.25899
Skin Cancer	0.26644	Falls	0.255	Colorectal Cancer	0.21592
Other Digestive Diseases	0.25994	Cirrhosis of the Liver	0.24524	Transport Injures	0.21288
Cirrhosis of the Liver	0.25162	Brain Cancer	0.24266	Respiratory Diseases	0.16346
Respiratory Diseases	0.24997	Multiple Myeloma	0.17643	Accidental Drowning and Submersion	0.1546
Stomach Cancer	0.23335	Accidental Poisoning	0.17572	Exposure to Smoke or Heat	0.14918
Gall Bladder Cancer	0.1937	Prostate Cancer	0.14357	Self-Inflicted Injuries	0.14634
Exposure to Mechanical Forces	0.16936	Alcohol Poisoning	0.12867	Lung, Trachea, and Bronchus Cancer	0.13534
Liver Cancer	0.16465	Leukemia	0.12654	Gall Bladder Cancer	0.11235
HIV/AIDS	0.10367	Non-Hodgkins Lymphoma	0.1125	Pancreatic Cancer	0.09064
Other Accidents	0.07633	Alcoholic Liver Cirrhosis	0.10629	Chronic Obstructive Pulmonar Disease	0.08424
Hypertensive Heart Disease	0.06681	Hepatitis	0.10099	Bladder Cancer	0.03744
Accidental Poisoning	0.01993	Larynx Cancer	0.07221	Falls	0.00391
Transport Injures	0.00647	Hypertensive Heart Disease	0.01778	Non-Hodgkins Lymphoma	-0.00358

Table S11: (Continued)

Factor 1		Factor 2		Factor 3	
Cause of Death	**Factor Loading**	**Cause of Death**	**Factor Loading**	**Cause of Death**	**Factor Loading**
Tissue Cancer	-0.05541	Liver Cancer	-0.01071	Other Accidents	-0.01441
Interpersonal Violence	-0.08953	Pancreatic Cancer	-0.21329	Aneurysm	-0.09086
Hepatitis	-0.12861	Cardiomyopathy	-0.23283	Leukemia	-0.17972
Prostate Cancer	-0.2065	Gall Bladder Cancer	-0.25316	Prostate Cancer	-0.21898
Accidental Drowning and Submersion	-0.25989	Esophagus cancer	-0.28118	Esophagus cancer	-0.23204
Self-Inflicted Injuries	-0.41674	HIV/AIDS	-0.29601	Exposure to Mechanical Forces	-0.23662
Falls	-0.48553	Tissue Cancer	-0.32329	Tissue Cancer	-0.26361
Alcoholic Liver Cirrhosis	-0.50646	Stomach Cancer	-0.42534	Multiple Myeloma	-0.3877
Alcohol Poisoning	-0.71376	Bladder Cancer	-0.47418	Brain Cancer	-0.44252

Notes: Death registration data is taken from the NCHS and includes white men ages 20-74 and years 2000-2009. Factor analysis is run on a state by age-standardized cause of death matrix and generates three factors. Factor loadings represent the correlations between causes of death and these factors. The same three factors are identified. The only major difference is that the order of factors 2 and 3 switched.

Table S12: Female factor loadings 20-84

Factor 1		Factor 2		Factor 3	
Cause of Death	**Factor Loading**	**Cause of Death**	**Factor Loading**	**Cause of Death**	**Factor Loading**
Interpersonal Violence	0.92698	Colorectal Cancer	0.77869	Brain Cancer	0.63236
Cirrhosis of the Liver	0.84791	Lung, Trachea, and Bronchus Cancer	0.76096	Other Digestive Diseases	0.59284
Accidental Poisoning	0.75497	Bladder Cancer	0.73152	Cerebrovascular Disease	0.57116
Cervical Uteri Cancer	0.71468	Breast Cancer	0.72284	Multiple Myeloma	0.54913
Transport Injures	0.70648	Leukemia	0.694	Aneurysm	0.5393
Cerebrovascular Disease	0.69602	Ischaemic Heart Disease	0.66342	Rheumatic Heart Disease	0.53081
Self-Inflicted Injuries	0.66217	Intestinal Infectious Diseases	0.59722	Respiratory Diseases	0.52169
Hepatitis	0.65166	Non-Hodgkins Lymphoma	0.56425	Chronic Obstructive Pulmonar Disease	0.5176
Exposure to Smoke or Heat	0.64279	Leukemia	0.4848	Non-Hodgkins Lymphoma	0.48361
Hypertensive Heart Disease	0.64095	Cervical Uteri Cancer	0.43152	Transport Injures	0.44712
Liver Cancer	0.60845	Cardiomyopathy	0.41551	Diabetes Mellitus	0.4396
Chronic Obstructive Pulmonar Disease	0.59652	Esophagus cancer	0.413	Nutritional Deficiencies	0.40516
Other Accidents	0.57574	Exposure to Smoke or Heat	0.38476	Other Accidents	0.39491
Cardiomyopathy	0.56418	Tissue Cancer	0.3832	Self-Inflicted Injuries	0.32522
Other Digestive Diseases	0.5625	Pancreatic Cancer	0.35182	Oral Cancer	0.27958
Nutritional Deficiencies	0.54935	Nutritional Deficiencies	0.3232	Exposure to Smoke or Heat	0.23441
Respiratory Diseases	0.46921	Skin Cancer	0.30225	Alcohol Poisoning	0.1892
Ischaemic Heart Disease	0.4655	Chronic Obstructive Pulmonar Disease	0.29381	Leukemia	0.17341
Lung, Trachea, and Bronchus Cancer	0.30141	Aneurysm	0.29352	Retroperi Cancer	0.16897

Table S12: (Continued)

Factor 1		Factor 2		Factor 3	
Cause of Death	Factor Loading	Cause of Death	Factor Loading	Cause of Death	Factor Loading
Diabetes Mellitus	0.28812	Gall Bladder Cancer	0.28116	Lung, Trachea, and Bronchus Cancer	0.16349
Leukemia	0.16088	HIV/AIDS	0.23288	Colorectal Cancer	0.14273
Skin Cancer	0.13517	Diabetes Mellitus	0.20102	Alcoholic Liver Cirrhosis	0.13376
Stomach Cancer	0.09421	Oral Cancer	0.19786	Skin Cancer	0.11986
HIV/AIDS	0.09335	Cirrhosis of the Liver	0.17602	Accidental Poisoning	0.10916
Non-Hodgkins Lymphoma	0.06156	Hypertensive Heart Disease	0.16521	Corpus Uteri Cancer	0.10535
Oral Cancer	0.05713	Other Digestive Diseases	0.15788	Falls	0.0902
Breast Cancer	0.0559	Cerebrovascular Disease	0.12507	Leukemia	0.02083
Colorectal Cancer	0.04798	Stomach Cancer	0.0975	Cervical Uteri Cancer	0.01011
Brain Cancer	0.04467	Corpus Uteri Cancer	0.08587	Interpersonal Violence	-0.00613
Alcohol Poisoning	0.0099	Liver Cancer	0.07271	Esophagus cancer	-0.03776
Alcoholic Liver Cirrhosis	0.00637	Other Accidents	0.0637	Cardiomyopathy	-0.0504
Leukemia	-0.02527	Accidental Poisoning	0.05886	Thyroid Cancer	-0.06869
Intestinal Infectious Diseases	-0.10105	Thyroid Cancer	0.04681	Pancreatic Cancer	-0.12578
Falls	-0.12374	Interpersonal Violence	-0.02513	Ischaemic Heart Disease	-0.14859
Thyroid Cancer	-0.13455	Brain Cancer	-0.06167	Hepatitis	-0.18025
Bladder Cancer	-0.20577	Respiratory Diseases	-0.06233	Bladder Cancer	-0.1956
Aneurysm	-0.30311	Transport Injures	-0.11913	Breast Cancer	-0.21113
Rheumatic Heart Disease	-0.30605	Multiple Myeloma	-0.12386	Cirrhosis of the Liver	-0.21299
Tissue Cancer	-0.33782	Retroperi Cancer	-0.1283	Hypertensive Heart Disease	-0.21588
Multiple Myeloma	-0.40188	Hepatitis	-0.12901	Tissue Cancer	-0.21783
Pancreatic Cancer	-0.41812	Rheumatic Heart Disease	-0.33651	Liver Cancer	-0.24843
Gall Bladder Cancer	-0.44012	Self-Inflicted Injuries	-0.38739	Intestinal Infectious Diseases	-0.31106
Esophagus cancer	-0.55544	Alcoholic Liver Cirrhosis	-0.42506	Gall Bladder Cancer	-0.42853
Retroperi Cancer	-0.67902	Alcohol Poisoning	-0.45553	Stomach Cancer	-0.7313
Corpus Uteri Cancer	-0.82488	Falls	-0.48747	HIV/AIDS	-0.76676

Notes:Death registration data is taken from the NCHS and includes white women ages 20-84 and years 2000-2009. Factor analysis is run on a state by age-standardized cause of death matrix and generates three factors. Factor loadings represent the correlations between causes of death and these factors. The same three factors are identified with only minor differences.

Table S13: Male factor loadings ages 20-84

Factor 1		Factor 2		Factor 3	
Cause of Death	Factor Loading	Cause of Death	Factor Loading	Cause of Death	Factor Loading
Transport Injures	0.90459	Lung, Trachea, and Bronchus Cancer	0.79115	Liver Cancer	0.8367
Chronic Obstructive Pulmonar Disease	0.87403	Colorectal Cancer	0.7884	Cirrhosis of the Liver	0.83361
Exposure to Mechanical Forces	0.85933	Larynx Cancer	0.76333	Interpersonal Violence	0.82788
Other Accidents	0.79943	Non-Hodgkins Lymphoma	0.74266	HIV/AIDS	0.79271

Table S13: (Continued)

Factor 1		Factor 2		Factor 3	
Cause of Death	Factor Loading	Cause of Death	Factor Loading	Cause of Death	Factor Loading
Self-Inflicted Injuries	0.74709	Leukemia	0.712	Hepatitis	0.76569
Cerebrovascular Disease	0.71735	Ischaemic Heart Disease	0.70972	Accidental Poisoning	0.7093
Exposure to Smoke or Heat	0.7079	Pancreatic Cancer	0.6593	Hypertensive Heart Disease	0.69432
Aneurysm	0.57656	Nutritional Deficiencies	0.62037	Cardiomyopathy	0.50098
Other Digestive Diseases	0.52479	Oral Cancer	0.52977	Stomach Cancer	0.43223
Nutritional Deficiencies	0.51533	Hodgkins Lymphoma	0.52043	Larynx Cancer	0.4003
Lung, Trachea, and Bronchus Cancer	0.50553	Cardiomyopathy	0.49251	Oral Cancer	0.3962
Accidental Drowning	0.49215	Exposure to Smoke or Heat	0.49001	Skin Cancer	0.3394
Exposure to Forces of Nature	0.4917	Intestinal Infectious Diseases	0.4531	Alcoholic Liver Cirrhosis	0.31538
Respiratory Diseases	0.49072	Cerebrovascular Disease	0.44813	Ischaemic Heart Disease	0.30144
Interpersonal Violence	0.39611	Bladder Cancer	0.3912	Other Digestive Diseases	0.28737
Diabetes Mellitus	0.37682	Esophagus cancer	0.37456	Transport Injures	0.21793
Oral Cancer	0.328	Aneurysm	0.31558	Hodgkins Lymphoma	0.20279
Multiple Myeloma	0.32622	Cirrhosis of the Liver	0.27846	Alcohol Poisoning	0.18834
Ischaemic Heart Disease	0.30522	Gall Bladder Cancer	0.26767	Colorectal Cancer	0.18233
Brain Cancer	0.25074	Brain Cancer	0.26628	Nutritional Deficiencies	0.17606
Skin Cancer	0.22309	Skin Cancer	0.25179	Accidental Drowning	0.16969
Colorectal Cancer	0.21928	Liver Cancer	0.24057	Lung, Trachea, and Bronchus Cancer	0.168
Leukemia	0.21482	Other Digestive Diseases	0.20099	Intestinal Infectious Diseases	0.15834
Cirrhosis of the Liver	0.20028	Chronic Obstructive Pulmonar Disease	0.19911	Exposure to Smoke or Heat	0.1575
Accidental Poisoning	0.1797	Diabetes Mellitus	0.19437	Self-Inflicted Injuries	0.14767
Alcohol Poisoning	0.12348	Stomach Cancer	0.18973	Gall Bladder Cancer	0.07169
Alcoholic Liver Cirrhosis	0.09062	Exposure to Mechanical Forces	0.18597	Pancreatic Cancer	0.05419
Hepatitis	0.08865	Tissue Cancer	0.15478	Cerebrovascular Disease	0.0311
Falls	0.0767	Respiratory Diseases	0.11548	Diabetes Mellitus	0.03087
Hypertensive Heart Disease	0.06406	Other Accidents	0.10131	Other Accidents	0.00573
Prostate Cancer	0.05665	Hypertensive Heart Disease	0.09284	Chronic Obstructive Pulmonar Disease	0.00399
Larynx Cancer	0.05324	Multiple Myeloma	0.06244	Bladder Cancer	-0.00859
Non-Hodgkins Lymphoma	0.0524	HIV/AIDS	0.04167	Respiratory Diseases	-0.0232
Rheumatic Heart Disease	0.04201	Accidental Poisoning	0.00547	Exposure to Forces of Nature	-0.07152
Liver Cancer	-0.06841	Transport Injures	-0.01749	Falls	-0.16101
Hodgkins Lymphoma	-0.10745	Interpersonal Violence	-0.12121	Tissue Cancer	-0.16566
Cardiomyopathy	-0.17579	Hepatitis	-0.15294	Non-Hodgkins Lymphoma	-0.21271
HIV/AIDS	-0.29278	Accidental Drowning	-0.2198	Exposure to Mechanical Forces	-0.23792
Gall Bladder Cancer	-0.29964	Rheumatic Heart Disease	-0.36174	Esophagus cancer	-0.27897
Pancreatic Cancer	-0.31871	Prostate Cancer	-0.417	Brain Cancer	-0.38557
Esophagus cancer	-0.41054	Self-Inflicted Injuries	-0.44495	Leukemia	-0.4028
Tissue Cancer	-0.43825	Falls	-0.47653	Aneurysm	-0.45189

Table S13: (Continued)

Factor 1		Factor 2		Factor 3	
Cause of Death	Factor Loading	Cause of Death	Factor Loading	Cause of Death	Factor Loading
Bladder Cancer	-0.47958	Exposure to Forces of Nature	-0.53754	Rheumatic Heart Disease	-0.47574
Intestinal Infectious Diseases	-0.50401	Alcoholic Liver Cirrhosis	-0.56444	Prostate Cancer	-0.51662
Stomach Cancer	-0.53139	Alcohol Poisoning	-0.69824	Multiple Myeloma	-0.60882

Notes: Death registration data is taken from the NCHS and includes white men ages 20-84 and years 2000-2009. Factor analysis is run on a state by age-standardized cause of death matrix and generates three factors. Factor loadings represent the correlations between causes of death and these factors. The same three factors are identified, but factor 1 became factor 2, factor 2 became factor 3, and factor 3 became factor 1.

Table S10 shows the factor loadings for females ages 20–74. These new factor loadings have correlations of .95, .90, and -.85 with the original factor loadings. The only difference is the reversal of factor 3. Table S11 shows the factor loadings for males ages 20–74. The new factor 1 loadings have a correlation of .91 with the old factor 1 loadings, the new factor 2 loadings have a correlation of .94 with the old factor 3 loadings, and the new factor 3 loadings have a correlation of .87 with the old factor 2 loadings. The only change here is a switch in the order of factors 2 and 3. Table S12 shows the factor loadings for females ages 20–84. These new factor loadings have correlations of .93, .88, and -.75 with the original factor loadings. The only difference is the reversal of factor 3. Table S13 shows the factor loadings for males ages 20–84. The new factor 1 loadings have a correlation of .86 with the old factor 3 loadings, the new factor 2 loadings have a correlation of .83 with the old factor 1 loadings, and the new factor 3 loadings have a correlation of .85 with the old factor 2 loadings. The only difference here is a change in the order of factors. These results show that the same male and female factors are identified when expanding the age range.