International Comparisons of U.S. Mortality

Abstract

U.S. life expectancy has been increasing, but not as much as in its peer countries. Recent studies have focused on mortality differences at older ages. However, 67.4% of the difference in male life expectancy at birth between the U.S. and the average of a set of comparison countries was attributable to mortality differences between ages 0-50; this figure was 42.0% for females. Common factors may contribute to the U.S. life expectancy shortfall across all ages. Sources of premature mortality at younger ages may have important consequences for health and mortality at older ages, and their effects may accumulate over time. We identify the main causes of death responsible for the U.S.'s poor mortality rankings between ages 0-50. Homicide, noncommunicable diseases, and unintentional injuries account for 71% and 66% of the difference in years of life lost between the U.S. and the mean of other countries for males and females, respectively.

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Background

Life expectancy at birth in the United States has been increasing since the 1960s, but not as much as in its peer countries. Between 1960 and 2007, American males gained 9.01 years in life expectancy at birth, while the average of a set of 16 comparison countries[1] gained 10.21 years. Over the same period, males went from being ranked 12th to 17th; in other words, the U.S. was the country with the lowest male life expectancy at birth in 2007. American females gained 7.47 years in life expectancy at birth between 1960 and 2007 – almost three years less than the average for the 16 comparison countries, who gained an average of 10.21 years over the same period. U.S. female life expectancy at birth has gone from being ranked 10th to 16th, in second to last place in 2007 (author's own calculations). It is clear that over time, the U.S. has been falling farther and farther behind other developed countries, and mortality improvements have been slower for both males and females. At the end of the first decade of the 21st century, the U.S. is the worst it has ever been since we have had reliable data. This is occurring on the heels of phenomenal mortality declines experienced during the 20th century, economic growth and dominance, and the highest levels of per capita health care spending in the world.

Several recent studies have focused on explaining differences in health and mortality at the older ages, and one of the most consistent findings has been that the U.S. has a higher burden of disease (e.g., Banks, Muriel, and Smith 2010). Examining differences at the older ages is important given that in 2007, 92.2% of males and 95.5% of females in the U.S. survived to age 50. However, it is crucial not to overlook the contribution of differences in mortality at the younger ages. In 2007, 67.4% of the difference in male life expectancy at birth between the U.S. and the average of the comparison countries was due to mortality differences at ages below 50, and this figure was 42.0% for women (author's own calculations). Sources of premature mortality at the younger ages may have important consequences for health and mortality at older ages, and their effects may accumulate over time. It is likely that common factors are contributing to the U.S. life expectancy shortfall across all ages.

Data and Methods

To that end, it is necessary to identify which causes of death are contributing most to the U.S.'s poor mortality rankings. Three main data sources were used for this analysis: the Human Mortality

[1] These countries are: Australia, Austria, Canada, Denmark, Germany, Finland, France, Italy, Japan, the Netherlands, Norway, Portugal, Sweden, Switzerland, Spain, and the United Kingdom.

Database (HMD), the World Health Organization (WHO) Mortality Database, and Statistics Canada. Country- and sex-specific life table all-cause death rates ($_nm_x's$) for age groups 0-1, 1-4, 5-9, 10-14, …, and 95-99 were taken from the HMD. Deaths from all causes and from the codes making up the cause of death categories of interest for age groups 0-1, 1-4, 5-9, 10-14, …, and 45-49 were drawn from the WHO Mortality Database. The latest year of mortality data available from the WHO differed across countries. In order to cover the most recent period possible and to maximize coverage of comparison countries, the latest year of data available between 2006 and 2008 was extracted for each country (see **Table 1** for the country-year pairs used in this analysis).[2] The deaths were then aggregated according to the cause of death categories of interest, specified per the standard classifications used in the Global Burden of Disease studies and the U.S. National Vital Statistics Reports (see **Table 2** for the list of categories and corresponding ICD-10 codes used). The proportions of total deaths attributable to each cause category were applied to the HMD all-cause age-specific death rates to obtain cause-specific death rates by age, sex, and country.

Following Preston, Heuveline, and Guillot (2001), cause-deleted life tables were produced to estimate what temporary life expectancy (expected number of years lived between ages 0 and 50) would be in the absence of a particular cause of death. This approach uses Chiang's assumption, which assumes that the force of decrement function from cause i is proportional to the force of decrement function from all causes combined in each age interval. Temporary life expectancy between ages 0 and 50 in the absence of a specific cause of death was obtained by summing the number of life-years that would have been lived between those ages ($_n^*L_x^{-i}$'s) in the absence of that cause. Life years lost from a specific cause of death was calculated as:

$$\sum_{x=0}^{45} {}_nL_x - \sum_{x=0}^{45} {}_n^*L_x^{-i} .$$

Preliminary Results

Figure 1 shows the ranking of U.S. age-specific mortality rates between ages 0 and 99 among the set of comparison countries in a recent period, 2006-2008. Until roughly age 75, males and females in the United States perform poorly, ranking last or close to last in every age group. After age 75, the U.S. rankings improve dramatically until males and females experience the second lowest death rates in the age group 95-99. Ho and Preston (2010) considered possible explanations for the unique pattern of U.S. mortality rankings at ages 40 and above. We now extend this research to identify factors

[2] For Canada, mortality data by cause was taken from Statistics Canada since it had more recent data available than the WHO. These data were aggregated using the same cause of death categorizations and merged with the master data set.

contributing to the life expectancy deficit at younger ages.

As might be expected from its poor life expectancy ranking, the U.S. loses the most years of life before age 50 for both males and females (**Figures 2** and **3**), while Swedish males and females lose the fewest. Notably, the other English-speaking countries, Australia, Canada, and the United Kingdom, are clustered at the left hand side of the figures, indicating that they, along with the U.S., tend to lose more years of life at younger ages than their counterparts. This has two implications: first, factors common to social structures in these countries may be contributing to this phenomenon; second, studies comparing the U.S. and the U.K. are examining differences between the U.S. and one of its nearest, relatively low-performing neighbors. These studies often find large health differences, suggesting that comparisons between the U.S. and its higher-performing peers would be even more dramatic.

First, we discuss the cause-deleted life table results for males (**Figures 4a** and **4b**). Compared to the mean of the other countries, U.S. males lose more years of life before age 50 from communicable diseases, and the differential is similar for HIV and all other communicable diseases, excluding HIV. They also lose more years of life from noncommunicable diseases. Looking at specific noncommunicable diseases, we see that U.S. males do well where cancer is concerned, but worse for diabetes, ischemic heart disease, and cerebrovascular disease. The largest differential between the U.S. and the mean of other countries exists for unintentional injuries, which is composed of transport and non-transport accidents. The U.S. performs poorly for both of those subcauses. U.S. males also lose more years of life from intentional injuries, which is composed of suicide and homicide. The differential in homicide mortality is particularly large. Finally, U.S. males also lose more years of life from drug-related causes. These findings are best summarized in **Figure 5**, which shows the contribution of mutually exclusive and exhaustive causes to the difference in years of life lost between the U.S. and the mean of other countries (0.59 years). Unintentional injuries are the largest contributor, accounting for 34% of the difference, followed by homicide (19%) and noncommunicable diseases (18%).[3] Communicable diseases and suicide contribute relatively little to the U.S. excess in male years of life lost.

Figures 6a and **6b** present the corresponding figures for females. U.S. females also lose more years of life from communicable diseases and noncommunicable diseases than other countries on average. This differential exists for cancer, diabetes, ischemic heart disease, and cerebrovascular disease. The difference in years of life lost between the U.S. and the mean of other countries for unintentional injuries is quite substantial and similar for transport and nontransport accidents. U.S. females also lose more years of life from intentional injuries, and that difference comes entirely from

[3] The residual category will be further broken down.

homicide since they lose fewer years of life from suicide. Finally, they lose more years of life before age 50 from drug-related causes and maternal conditions. **Figure 7** shows the contribution of mutually exclusive and exhaustive causes to the difference in years of life lost between the U.S. and the mean of other countries (0.35 years). Similar to the situation for males, unintentional injuries play the largest role, accounting for 30% of the difference in years of life lost before age 50. Noncommunicable diseases and homicide are also important, accounting for 28% and 7% of the difference, respectively.

Next Steps

We have arrived at a picture of how the U.S. compares to other high income countries in a recent period. It has the lowest and second lowest life expectancy at birth for males and females, respectively, it experiences some of the highest age-specific death rates from most causes of death below age 50, and it loses the most years of life before age 50. For both men and women, unintentional injuries, noncommunicable disease, and homicide are the causes contributing most to the greater loss of life in the U.S. at these ages. Two of these three causes are causes of death that can be affected by the functioning of the health care system (e.g., factors such as receiving timely treatment and quality of care); however, it is clear that other factors leading to these causes of death are inherently social, such as the spatial organization of communities, poverty, and income inequality. Our next steps will be to explore the relationship between several of these factors and U.S. mortality rankings over time.

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Tables and Figures

Table 1. Country-Year Pairs Used in Analysis

Country	Year
Australia	2006
Austria	2008
Canada	2007
Denmark	2006
Finland	2008
France	2008
Germany	2006
Italy	2007
Japan	2008
Netherlands	2008
Norway	2008
Portugal	2008
Spain	2008
Sweden	2008
Switzerland	2007
United Kingdom	2008
United States	2007

Table 2. Cause of Death Categories and Corresponding ICD-10 Codes

Category	ICD-10 Codes	Source
1. Communicable and nutritional conditions	1. A00-B99, D50-D53, D64.9, E00-E02, E40-E46, E50, E51-E64, G00, G03-G04, H65-H66, J00-J06, J10-J18, J20-J22, N70-N73	
a. HIV	a. B20-B24	GBD
b. All other communicable diseases, excluding HIV/AIDS	b. A00-B99, D50-D53, D64.9, E00-E02, E40-E46, E50, E51-E64, G00, G03-G04, H65-H66, J00-J06, J10-J18, J20-J22, N70-N73, excluding B20-B24	
2. Noncommunicable diseases	2. C00–C97, D00–D48, D55–D64 (minus D 64.9), D65–D89, E03–E07, E10–E16, E20–E34, E65–E88, F01–F99, G06–G98, H00–H61, H68–H93, I00–I99, J30–J98, K00–K92, N00–N64, N75–N98, L00–L98, M00–M99, Q00–Q99	
a. Malignant neoplasms	a. C00-C97	
i. Lung cancer	i. C33-C34	GBD
ii. All cancers, excluding lung cancer	ii. C00-C97, excluding C33-C34	
b. Diabetes mellitus	b. E10-E14	
c. Ischemic heart disease	c. I20-I25	
d. Cerebrovascular disease	d. I60–I69	
3. Maternal conditions	3. O00–O99	GBD
4. Unintentional injuries	4. V01–X59,Y85–Y86	
a. Transport accidents	a. V01–V99,Y85	NVSR
b. Nontransport accidents	b. W00–X59,Y86	
5. Intentional injuries	5. X60-Y09, Y87.0-Y87.1	
a. Suicide	a. X60–X84,Y87.0	NVSR
b. Homicide	b. X85-Y09, Y87.1	
6. Drug-related causes[4]	6. D52.1, D59.0, D59.2, D61.1, D64.2, E06.4, E16.0, E23.1, E24.2, E24.4, E27.3, E66.1, F10, F11.0-F11.5, F11.7-F11.9, F12.0–F12.5, F12.7–F12.9, F13.0–F13.5, F13.7–F13.9, F14.0–F14.5, F14.7–F14.9, F15.0–F15.5, F15.7–F15.9, F16.0–F16.5, F16.7–F16.9, F17.0, F17.3–F17.5, F17.7-F17.9, F18.0-F18.5,F18.7-F18.9, F19.0–F19.5, F19.7–F19.9, G21.1, G24.0, G25.1, G25.4, G25.6, G31.2, G44.4, G62.0, G62.1, G72.0, G72.1, I42.6, I95.2, J70.2–J70.4, K29.2, K70, K85.2, K85.3, K86.0, L10.5, L27.0–L27.1, M10.2, M32.0, M80.4, M81.4, M83.5, M87.1, R50.2, R78.0, R78.1–R78.5, X40–X44, X45, X60–X64, X65, X85, Y10–Y14, Y15	NVSR

[4] Composed of the "drug-induced causes" and "alcohol-induced causes" categories from the NVSR.

Figure 1. Ranking of U.S. Age-Specific Death Rates Among 17 Countries, 2006-2008

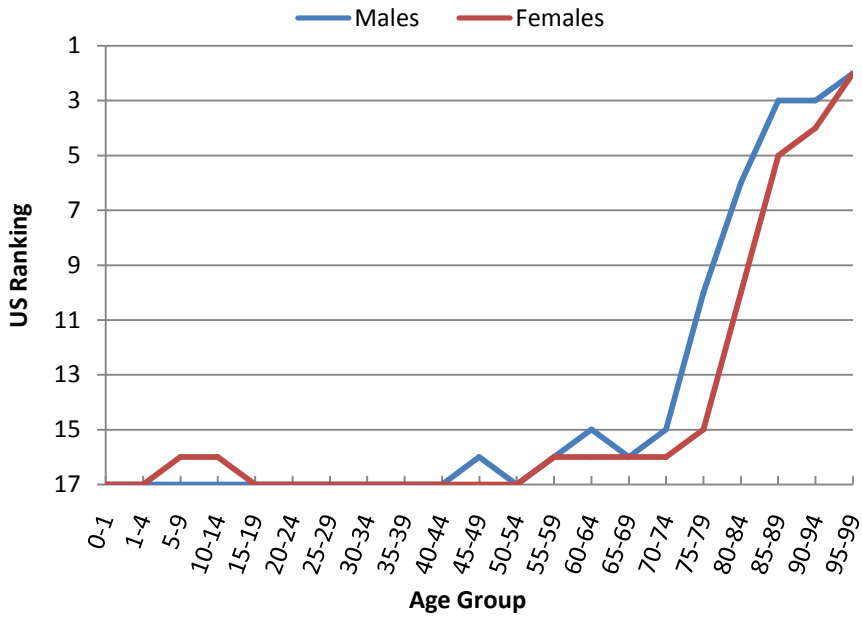

Figure 2. Years of Life Lost Before Age 50, Males, 2006-2008

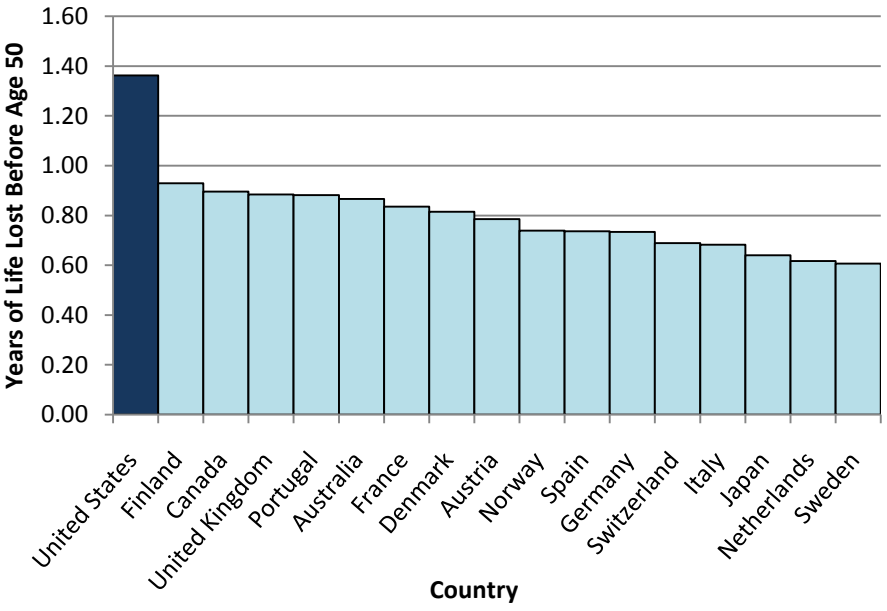

Figure 3. Years of Life Lost Before Age 50, Females, 2006-2008

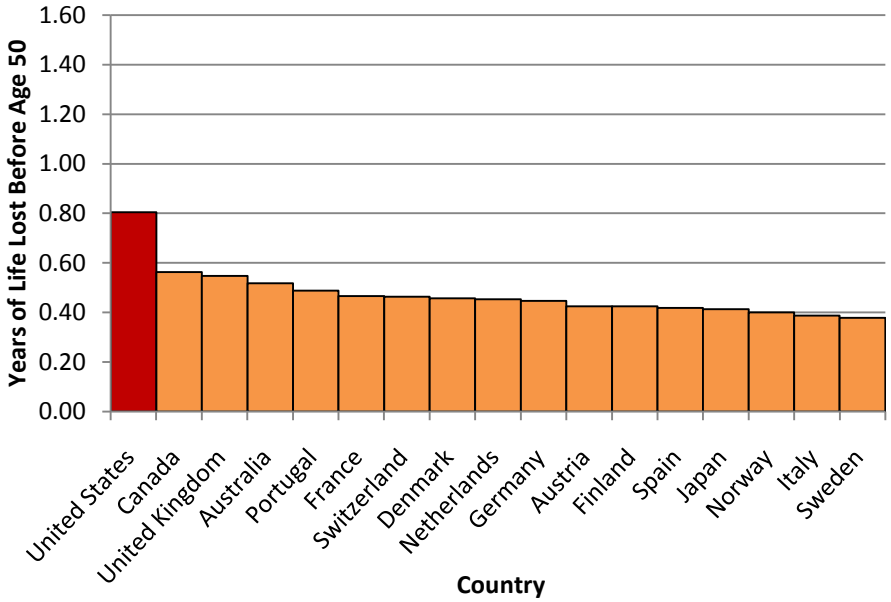

Figure 4a. Years of Life Lost due to Specific Causes of Death, Males, 2006-2008 (Part 1)

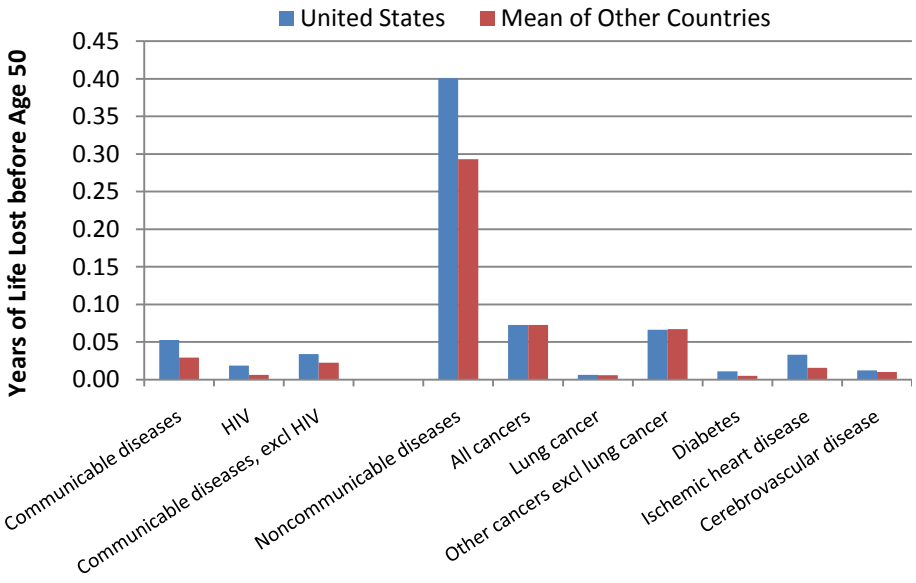

Figure 4b. Years of Life Lost due to Specific Causes of Death, Males, 2006-2008 (Part 2)

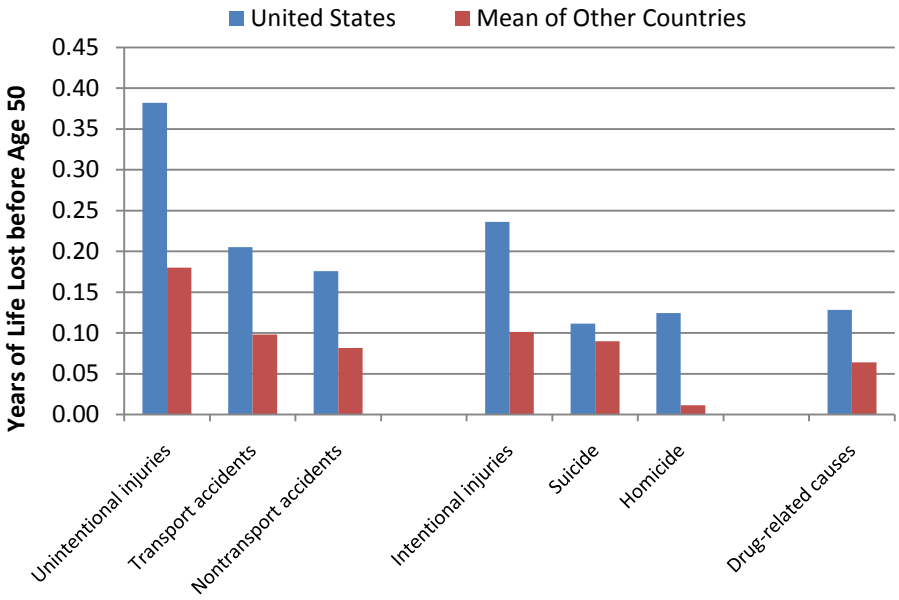

Figure 5. Contribution of Cause Categories to Difference in Years of Life Lost Between the U.S. and the Mean of Other Countries, Males, 2006-2008

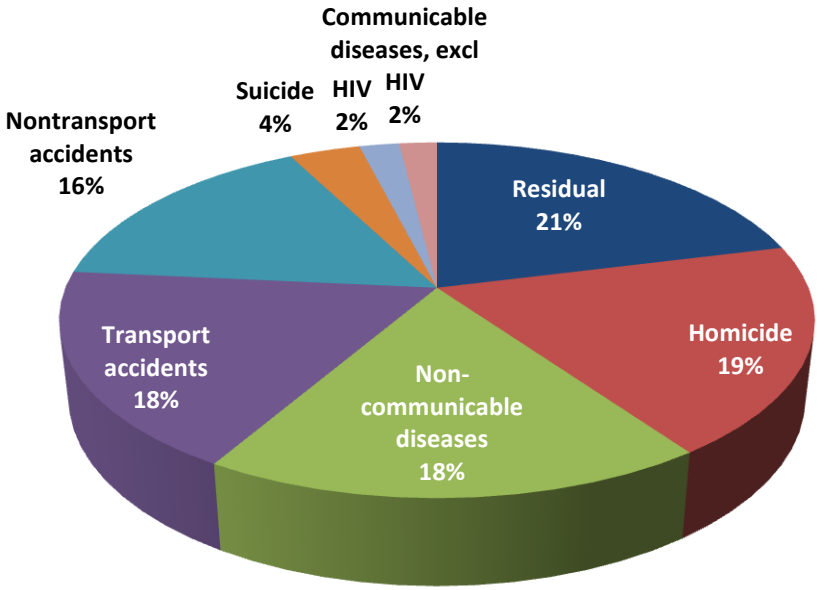

Figure 6a. Years of Life Lost due to Specific Causes of Death, Females, 2006-2008 (Part 1)

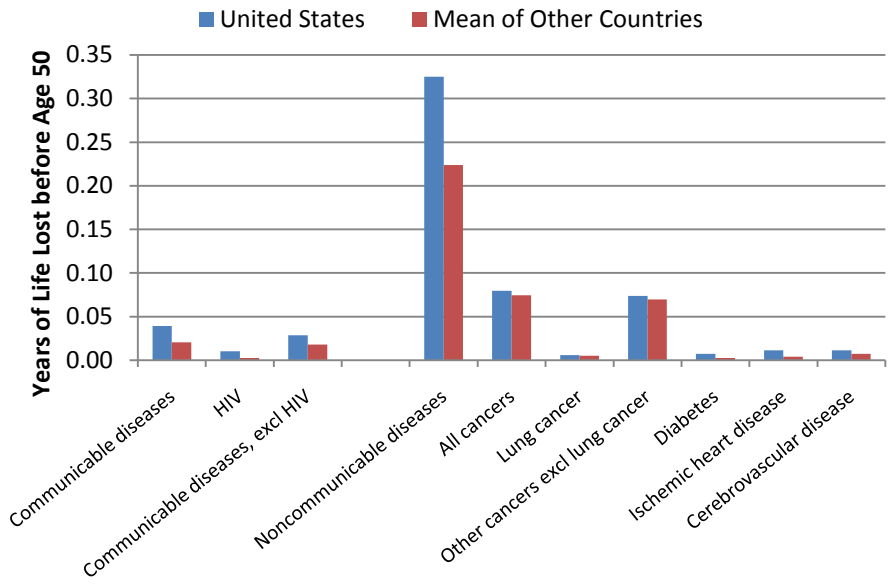

Figure 6b. Years of Life Lost due to Specific Causes of Death, Females, 2006-2008 (Part 2)

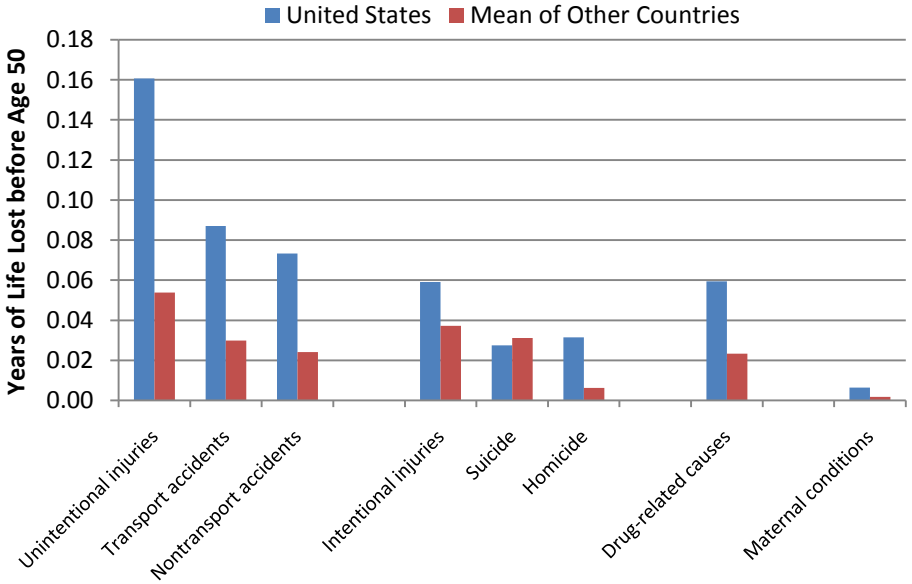

Figure 7. Contribution of Cause Categories to Difference in Years of Life Lost Between the U.S. and the Mean of Other Countries, Females, 2006-2008