

YEARS OF POTENTIAL LIFE LOST FROM CARDIOVASCULAR DISEASE AMONG HISPANICS

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Objective: To quantify the impact of cardiovascular disease and its subtypes on the premature mortality of Hispanics in the United States.

Methods: We used national death records to identify deaths for the three largest Hispanic subgroups (Mexicans, Puerto Ricans, and Cubans) in the United States from 2003 to 2012 (N = 832,550). We identified all deaths from cardiovascular disease and by subtype (ie, ischemic, cerebrovascular, hypertensive and heart failure) using the underlying cause of death via ICD-10 codes. Years of potential life lost (YPLL) was calculated by age categories standardizing with the 2000 US Census population. Population estimates were calculated using linear interpolation from 2000 and 2010 US Census data.

Results: After standardization, Puerto Ricans experienced the highest YPLL for all types of cardiovascular disease compared with Mexicans and Cubans (1,139 per 100,000 compared with 868 and 841, respectively), a disparity that remained consistent over the course of a decade. Among different subcategories of cardiovascular disease, Puerto Ricans had the highest YPLL for ischemic and hypertensive heart disease, while Mexicans had the highest YPLL from cerebrovascular disease.

Conclusions: In conclusion, disaggregation of Hispanic subgroups revealed marked heterogeneity in premature cardiovascular mortality. These findings suggest that measures to improve the cardiovascular health of Hispanics should incorporate subgroup status as a key part of public health strategy. *Ethn Dis.* 2019;29(3):477-484; doi:10.18865/ed.29.3.477

INTRODUCTION

Currently, more than 57 million Hispanics live in the United States, accounting for nearly 1 in 5 individuals. By 2060, this ethnic group is projected to double in size, such that 1 in 3 individuals in the United States will be of Hispanic origin.¹ Taken together, Hispanics represent a wide array of races, national origins, migration histories, cultures, lifestyles, and other socioeconomic characteristics. Despite their extraordinary population growth, relatively little is known about this diverse group, especially with regard to cardiovascular disease. In particular, comprehensive data examining cardiovascular mortality and other outcomes among Hispanic subgroups have been lacking.²⁻⁶ Aggregation of different Hispanic subgroups in public health analyses has led to

an incomplete understanding of the prevalence, risk factors, natural history, and outcomes for cardiovascular disease among specific subgroups.⁷

In recent years, the disaggregation of Hispanics in public health analyses has led to interesting observations about differences in cardiovascular disease risk factors and outcomes between Hispanic subgroups. For example, reports from the Hispanic Community Health Study/Study of Latinos observed marked heterogeneity in risk factors for cardiovascular disease among different Hispanic subgroups in urban settings. While Puerto Ricans had the highest rates of obesity and smoking, Central Americans experienced higher rates of hyperlipidemia and Mexicans had the highest prevalence of diabetes.⁸ In addition to these differences in risk factors, prior work by Rodriguez

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et al has demonstrated significant variation in cardiovascular disease mortality by Hispanic subgroup. In particular, Puerto Ricans were shown to experience higher mortality for ischemic and hypertensive heart disease, whereas Mexicans had higher mortality rates from cerebrovascular disease compared with other subgroups. Importantly, these groups were nearly 10 years younger than their non-Hispanic White (NHW) counterparts at time of death from

In this study, we used national death records to examine years of potential life lost (YPLL) from cardiovascular disease among Hispanic subgroups.

cardiovascular disease, suggesting that cardiovascular disease might play an important role in premature mortality for particular Hispanic subgroups.⁹

Although mortality rate is an essential metric of health status in a population, it fails to capture premature death, an important public health measure. Conversely, years of potential life lost (YPLL) is a more precise measure of premature mortality that places greater weight on deaths that occur at an earlier age. YPLL entails estimating the average time a person would have lived had he or she not

died prematurely by calibrating to the standard life expectancy of a given population. In doing so, YPLL helps quantify the social and economic losses from early death, and identifies potential disease processes that preferentially affect younger individuals.¹⁰ These methods may be more important for younger populations such as Hispanics, who represent the youngest major racial group in the United States, since nearly 60% of Hispanics are under the age of 33.¹¹ In this study, we used national death records to examine YPLL from cardiovascular disease among Hispanic subgroups.

METHODS

Study Population

Individuals were identified in US mortality records from the National Center for Health Statistics (NCHS) Multiple Causes of Death mortality files from 2003 to 2012.¹² The study population consisted of deaths for Hispanics (N = 1,388,575) aged <75 years from 2003 to 2012. We identified all deaths from cardiovascular disease and by subtype (ie, ischemic, cerebrovascular, hypertensive and heart failure) using the underlying cause of death (ICD-10: I00-I78, I20-I25, I60-I69, I11, I13 and I50, respectively). Ethnicity was recorded on death certificates by the funeral director according to state guidelines. From 2003 to 2012, Hispanics were categorized into one of the following explicitly identified ethnic subgroups on US mortality records: Mexican, Puerto Rican, Cuban, Central or South American, and other or unknown Hispanic.¹² Due to the

heterogeneity and limited sampling of the last two categories, these populations were aggregated into “Other Hispanics” in Table 1 for comparison. Further analyses were restricted to the three largest Hispanic subgroups (Mexican, Puerto Rican, Cuban), which were consistently documented on US death certificates throughout the study period, account for ~80% of the total Hispanic group and have been included in previous analyses of disaggregated Hispanics in the United States.^{9,13} The institutional review board of Stanford University approved this study and provided a waiver for use of these publicly available mortality and US Census data.

Statistical Analysis

All data were analyzed using SAS version 9.4. Descriptive statistics were obtained for the three major Hispanic subgroups (Cubans, Mexicans, and Puerto Ricans) in the study population, including mean and standard deviation of age at death, and total number of deaths from cardiovascular disease and subtypes. We used 75 as the standard upper reference age.¹⁴

Calculation of YPLL

Decedents were stratified into the following age groups by Hispanic subgroups (Cubans, Mexicans, and Puerto Ricans) and for all Hispanics in aggregate: <1, 1-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74. Age-adjusted YPLL was determined according to the equation $YPLL = \sum (\{ [X_{ac} (75 - MP_{ac})] / P_{ac} \} * S_{ac})$. The middle point (MP_{ac}) in each age category was calculated. The number of deaths (X_{ac}) in each age group was multiplied by the years of life lost by

Table 1. Demographic characteristics and cardiovascular disease death count by subtype

	All Hispanics	Cuban	Mexican	Puerto Rican	Other Hispanics
Total number of deaths	1,388,575	132,744	785,514	176,166	294,151
Female (%)	44.5	48.5	42.8	45.3	46.8
Foreign (%)	54.4	94.9	42.7	77.0	53.8
Educational attainment (%)					
No formal education	54.3	40.3	63.2	44.8	42.9
High school or GED completed	26.6	31.7	21.3	37.6	31.9
Some college	9.5	9.4	8.7	8.7	12.0
Bachelor's degree or higher	5.8	15.1	3.3	5.2	8.9
Deaths from cardiovascular disease and subtypes n (%)					
Cardiovascular disease (all types)	394,977 (28.4)	49,219 (37.1)	212,053 (27.0)	52,796 (30.0)	80,909 (27.5)
Ischemic heart disease	208,291 (15.0)	29,678 (22.4)	106,839 (13.6)	30,312 (17.2)	41,462 (14.1)
Hypertensive heart disease	20,365 (1.5)	2,224 (1.7)	10,263 (1.3)	3,283 (1.9)	4,595 (1.6)
Heart failure	193,18 (1.4)	1,819 (1.4)	11,328 (1.4)	2,134 (1.2)	4,037 (1.4)
Cerebrovascular disease	71,708 (5.2)	6,629 (5.0)	42,515 (5.4)	7,664 (4.4)	14,900 (5.1)
Mean age at death (SD)					
All cause	62.9 (24.7)	76.3 (16.1)	60.3 (25.6)	64.0 (22.1)	62.9 (24.8)
Cardiovascular disease	73.4 (16.6)	80.1 (12.6)	72.0 (17.1)	72.6 (15.7)	73.5 (16.9)
Ischemic heart disease	74.8 (14.4)	80.4 (12.1)	73.5 (14.6)	74.1 (14.0)	74.9 (14.7)
Hypertensive heart disease	69.5 (17.5)	74.7 (15.9)	68.8 (17.7)	67.9 (16.8)	69.8 (17.6)
Heart failure	79.6 (13.9)	84.8 (10.0)	78.8 (14.3)	77.4 (14.2)	80.8 (13.7)
Cerebrovascular disease	72.5 (17.0)	80.0 (12.2)	71.2 (17.4)	72.2 (16.0)	73.0 (17.5)

SD, standard deviation

that age group ($75 - MP_{ac}$); that result was divided by the total number of the study population within that age group (P_{ac}) to calculate age-specific YPLL per person in the specific ethnic group. Then this age-specific YPLL was standardized to the 2000 US Census reference population by multiplying the fraction of the reference population in that age group (S_{ac}) in order to get the standardized YPLL per age group. Finally, we summed up the standardized YPLL per age group to result in total YPLL. Study population estimates by Hispanic subgroup were calculated using linear interpolation from 2000 and 2010 US Census data. Similar methods were used to calculate YPLL per

year from 2003 to 2012 per Hispanic subgroups and for all Hispanics.

RESULTS

Demographic Characteristics

From 2003 to 2012, there were 1,338,575 Hispanic decedents. Table 1 describes demographic data regarding sex distribution and educational achievement for Hispanics by major subgroups. Men slightly outnumbered women among the entire study population as well as within individual subgroups. More than half of the population was foreign born (54.4%), but the percentage of foreign born was higher within the Cuban and Puerto

Rican subgroups (94.9% and 77.0%, respectively) compared with Mexicans (42.7%). Mexicans had the lowest rates of formal education (33.3%). Cubans had the highest rate of attaining a bachelor's degree or higher (15.1%), compared with 5.2% for Puerto Rican and 3.3% for Mexicans.

Total Deaths from Cardiovascular Disease

Table 1 shows the proportion of deaths due to cardiovascular disease and subtype by Hispanic subgroup. Among the total studied Hispanic population, more than one-quarter (394,977 out of 1,388,575, or 28.4%) died from cardiovascular disease. The majority of cardiovas-

Table 2. Years of potential life lost (YPLL) by cardiovascular disease subtype among Hispanics

Total YPLL (per 100,000)				
Cause of mortality	Hispanic	Puerto Rican	Mexican	Cuban
Cardiovascular disease	820.89	1,113.18	868.33	841.69
Ischemic heart disease	385.12	553.91	399.13	465.16
Cerebrovascular disease	156.66	164.67	179.85	107.19
Hypertensive heart disease	58.36	100.91	54.27	84.13
Heart failure	21.52	28.31	25.16	11.88
All cause	4,978.88	6,259.65	5,223.35	4274.74
Proportionate YPLL				
Cause of mortality	Hispanic	Puerto Rican	Mexican	Cuban
Cardiovascular disease	16.5%	17.8%	16.6%	19.7%
Ischemic heart disease	7.7%	8.8%	7.6%	10.9%
Cerebrovascular disease	3.1%	2.6%	3.4%	2.5%
Hypertensive heart disease	1.2%	1.6%	1.0%	2.0%
Heart failure	0.4%	0.5%	0.5%	0.3%

cular deaths were due to ischemic heart disease (208,291, 52.7%), followed by cerebrovascular disease (18.2%), hypertensive heart disease (5.2%), and heart failure (4.9%).

Age at Death

Table 1 also shows the mean age of death among different Hispanic subgroups. For all-cause mortality, Mexicans and Puerto Ricans died more than a decade earlier than Cubans (60.3 and 64.0 years of age compared with 76.3, respectively). This disparity between Cubans and the other Hispanic subgroups was similar for deaths due to cardiovascular disease and each of its subtypes. Across all subgroups, the mean age of death was lowest for those who died from hypertensive heart disease and highest for those died from heart failure.

Years of Potential Life Lost

Figure 1 and Table 2 depict the YPLL per 100,000 from cardiovascular disease and its subtypes by Hispanic subgroup. In general, Puerto Ricans had the highest YPLL due to

all causes of death (6,259 per 100,000 people) compared with Mexicans and Cubans (5,223 per 100,000 people for Mexican and 4,275 for Cuban, respectively). Although Puerto Ricans experienced the highest absolute YPLL due to cardiovascular disease (1,113 per 100,000 people), Cubans suffered from the highest proportion of YPLL due to cardiovascular disease (842 per 100,000 people due to cardiovascular disease, accounting for almost 20% of the total YPLL for all causes of death), followed by Puerto Ricans and Mexicans (17.8% and 16.6% of total YPLL for all causes of death, respectively). Mexicans had the lowest absolute and proportionate YPLL due to ischemic heart disease (399 per 100,000, accounting for 46.0% of all YPLL due to cardiovascular deaths) compared with either Puerto Ricans or Cubans (545 and 465 per 100,000 people, accounting for 49.8% and 55.3% of all YPLL due to cardiovascular deaths, respectively). In contrast, Mexicans had the highest absolute YPLL and proportionate YPLL due to cerebro-

vascular disease (180 per 100,000, accounting for 20.7% of all YPLL due to cardiovascular deaths) compared with Puerto Ricans and Cubans (165 and 107 per 100,000, accounting for 14.8% and 12.7%, respectively).

Figure 2 demonstrates YPLL for cardiovascular disease each year across the study period as a function of the three major Hispanic subgroups in the United States from 2003 to 2012. Although each group has had decreasing YPLL due to cardiovascular disease over the study period, the differences between groups remained similar. Specifically, Puerto Ricans experienced consistently higher YPLL from cardiovascular disease over time compared with Mexicans and Cubans, with differences in YPLL ranging from 193 per 100,000 in 2005 to 331 per 100,000 in 2010.

DISCUSSION

Using 10 years of national mortality data, we discovered marked heterogeneity in premature cardiovas-

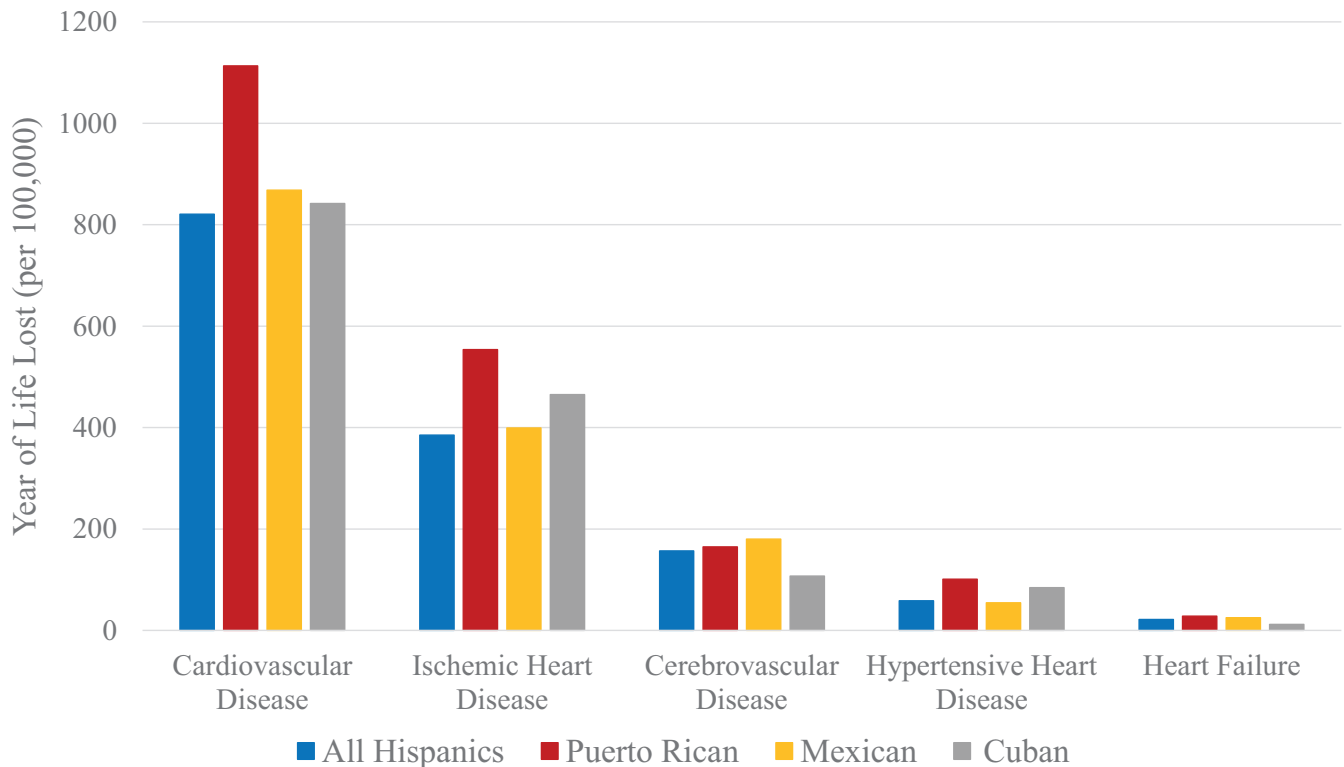


Figure 1. Years of potential life lost by cardiovascular disease subtype among Hispanics

cular mortality among the three largest Hispanic subgroups in the United States. Cubans outlived Mexicans and Puerto Ricans by more than a decade. Puerto Ricans experienced the highest absolute YPLL from cardiovascular disease, but Cubans suffered the highest proportion of YPLL due to cardiovascular disease. Among different subcategories of cardiovascular disease, Puerto Ricans had both the highest absolute and proportionate YPLL for ischemic heart disease, while Mexicans suffered both the highest absolute and proportionate YPLL due to cerebrovascular disease. In temporal analyses, we identified that Puerto Ricans experienced persistently higher YPLL between 2003-2012

from cardiovascular disease in comparison with Cubans and Mexicans. Importantly, this disparity between Puerto Ricans and the other subgroups remained similar year-to-year, despite an overall decrease in YPLL among each subgroup over time.

Understanding the factors that contribute to premature mortality has important implications for public health policy.¹⁵ For deaths that are multifactorial in etiology, such as those due to cardiovascular disease, there are multiple described approaches to determine premature mortality including health loss, life expectancy or longevity, attributable mortality, disability adjusted life years (DALY), and years lived with dis-

ability (YLD).¹⁵ YPLL has also been reported by the CDC since the early 1980s as a common summary measure of premature death and its incorporation in public health analysis has helped lead to effective policy change.^{16,17} The key advantage of YPLL over traditional mortality statistics is its emphasis on deaths that occur at an earlier age, whereas crude mortality is weighted by the larger proportion of deaths that occur in the elderly.¹⁰ Thus, YPLL more selectively evaluates leading causes of mortality in the young. Indeed, multiple public health analyses in cardiovascular disease have already incorporated YPLL as a standard index of premature mortality.¹⁸⁻²⁸ Moreover,

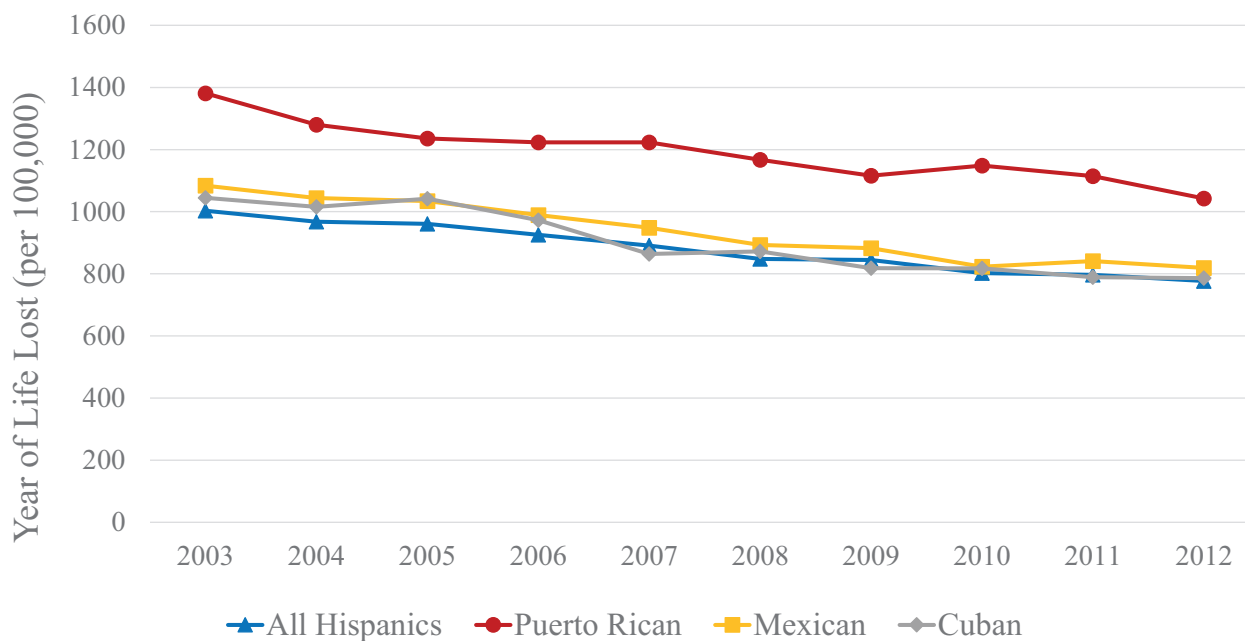


Figure 2. Years of potential life lost by year, 2003 to 2012

this metric has also been used to quantify disease-specific premature mortality among multiple minority populations in the United States including Blacks, Asians, and Native Americans.²⁹⁻³¹ As populations age and the need for more precise measures of life expectancy increases, the utility of YPLL and other methods of premature mortality in cardiovascular medicine is expected to grow.³²

Our results are complementary to and extend prior findings that show significant heterogeneity in cardiovascular outcomes in disaggregated Hispanics.⁹ In particular, Puerto Ricans experience higher rates of death from ischemic heart disease, while Mexicans experience higher rates of cerebrovascular death, compared with other major Hispanic subgroups.⁴ The latter finding has also been corroborated by data from the Brain At-

tack Surveillance in Corpus Christi, Texas, which found that Mexican Americans between the ages of 45 to 49 experienced twice the incidence of stroke compared with their NHW counterparts.³³ By studying YPLL, our study supplements these observations by identifying that death rates from ischemic heart disease for Puerto Ricans and the cerebrovascular death rate for Mexicans also contribute to increased premature mortality for these subgroups, respectively. While some of this heterogeneity may relate to genetic differences between the three major Hispanic subgroups, they are also likely explained by difference in risk factors for cardiovascular disease. For example, the increased rates of smoking seen in Puerto Ricans may contribute to the increased YPLL from ischemic heart disease, while the high rates of uncontrolled

blood pressure among Mexicans with hypertension may partially explain the high YPLL from cerebrovascular disease.^{34,35} Efforts aimed at prevention or treatment of such risk factors may reduce the marked disparities in premature cardiovascular mortality among Hispanic subgroups.

There are several limitations that warrant mention. First, the misclassification of race and/or ethnicity on death certificates should not be dismissed and may have led to underreporting of mortality rates. A recent report from the US Census Bureau, which used data from the National Longitudinal Mortality Study and linked population survey records to death certificates, showed an improvement in the misclassification rate for the Hispanic American population from 5% between 1979 to 1998 to 3% between 1999 to 2011.³⁶ Thus, a

potential 3% misclassification rate on death records may yield a relatively small underestimation of subgroup-specific mortality rates. Second, although YPLL is commonly used as a metric for premature mortality, there are disadvantages that affect its interpretation. For example, although the upper reference 75 is a conventional cut point, it is an arbitrary cut-off and may need to be adjusted to the

undermining the coherence of the overall picture.^{15,37} Given that the majority of the deaths in our study population occurred in the elderly, this latter phenomenon is unlikely to significantly affect our interpretability of YPLL for premature mortality.

PUBLIC HEALTH IMPLICATIONS

Using 10 years of national mortality data, we found marked heterogeneity in premature cardiovascular mortality among the three largest Hispanic subgroups in the United States. These findings suggest that traditional methods of aggregating Hispanics fail to capture important disparities in premature mortality patterns from cardiovascular disease for this rapidly growing population. Public health interventions that target individualized risk factors for each Hispanic subgroup may be a useful approach to reducing premature cardiovascular death.

CONFLICT OF INTEREST

No conflicts of interest to report.

AUTHOR CONTRIBUTIONS

Research concept and design: Manjunath, Palaniappan, Rodriguez; Acquisition of data: Palaniappan, Rodriguez; Data analysis and interpretation: Manjunath, Hu, Palaniappan, Rodriguez; Manuscript draft: Manjunath, Hu, Rodriguez; Statistical expertise: Hu; Acquisition of funding: Palaniappan, Rodriguez; Administrative: Manjunath; Supervision: Palaniappan, Rodriguez

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specific population of interest. YPLL also requires extrapolation of survival and multiple statistical assumptions must be made regarding the nature of the survival curve, which potentially reduces accuracy. Furthermore, YPLL tends to produce large numbers for individuals that die under the age of 50, which can make specific causes of death appear to contribute more to the overall number of deaths from that particular cause. As a result, premature mortality attributed to certain causes can appear variable based on different age categories, potentially

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