# DOHMH Roadmap: DALY Estimates

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# Background

## Objective

The objective of this analysis is to estimate DALYs lost in New York City due to the following major categories of conditions (with about 100 conditions in total within these categories):

- Major depression
- Alcohol use
- Marijuana use
- Heroin use
- Cocaine use
- Stimulant use
- Sedative use
- Tranquilizer use

## Definition of Key Terms

### DALY

**Disability-adjusted life years.** The DALY is a year of life lived in perfect health and consists of two elements: YLLs and YLDs. The DALY is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death. It was developed in the 1990s as a way of comparing the overall health and life expectancy of different countries.

$$DALY = YLL + YLD$$

### YLL

**Years of life lost.** Years of life lost is an estimate of the average years a person would have lived if he or she had not died prematurely.

$$YLL = (Number\ of\ deaths) * (Standard\ life\ expectancy\ at\ age\ of\ death\ in\ years)$$

### YLD

**Years of life lost due to disability.** This is the morbidity component of the DALY score. To estimate YLD for a particular cause in a particular time period, the number of incident cases in that period is multiplied by the average duration of the disease and a weight factor that reflects the severity of the disease on a scale from 0 (perfect health) to 1 (dead). The basic formula for YLD is the following:

$$YLD = (number\ of\ incident\ cases) * (disability\ weight) * (average\ duration\ of\ disease)$$

# Methods

## Data Sources

- 2013 NYCHANES - prevalence estimates
- 2002-2008 NSDUH - drug use prevalence estimates
- 2013 NYC Vital Statistics - mortality estimates
- 2010 Global Burden of Disease Study - national YLD/YLL rates
- 2013 NYC American Community Survey - population estimates

The challenge with using NYCHANES and NSDUH data to estimate the prevalence of a condition is that the `n` may be too small. To increase their utility of these surveys, we will aggregate age groups into the following strata: childhood (0-14), late adolescence/early adulthood (15-24), adulthood (25-64), and later life (65+).

## DALY Estimation

### YLLs

To estimate compute NYC YLLs, we will use NYC mortality counts stratified by age, sex, and race. In concodrance with the literature on DALY estimation, life expectancy estimates based on the life expectancy in Japan (82.5 years for women and 80.0 years for men) were used for the calculation of YLL. In order to remain consistent with the methodology of the 2010 Global Burden Disease Study, no age weighting or discounting was applied.

### YLDs

To compute NYC YLDs, we will use the two approaches described below:

**2005 NYC DOHMH / Michaud (2006)** In order to compare the magnitude of the DALY scores to the 2005 NYC DOHMH study, we will replicate the previous study's methodology, which was based on Michaud CM, et al. The burden of disease and injury in the United States 1996. Population Health Metrics 2006,4:11.

"For NYC YLD, U.S. Census Bureau population estimates for New York City in 2005 by sex were used to calculate years lived with disability (YLD) by applying national YLD rates and ratios from the Michaud et al. study. If the national YLL:YLD ratio was less than 10, then the NYC YLD was equal to the national YLD:YLL ratio multiplied by NYC YLL. If the national YLD:YLL ratio was greater than or equal to 10 (producing unreliable City estimates), then NYC YLD was equal to the national YLD rate multiplied by the NYC population."

Implementing the Michaud approach will thus require the following data elements:

- NYC Population by age, sex
- National YLD rates by age, sex
- NYC YLLs by age, sex

In order to remain consistent with the demographic weighting approach used by NYC DOHMH for the 2013 NYCHANES data, NYC population estimates were obtained from the 2013 American Community Survey, which is available on the NYC Department of City Planning website. Since the data from the Michaud study are from 1996 and patterns of disease and disability have changed, we will update the approach using national YLD/YLL rates from the 2010 Global Burden of Disease Study.

**Prevalence-based YLDs** Years lived with a disability (YLD) due to each disease can be calculated on the basis of either the incidence or the prevalence of the disease. The initial GBD studies estimated YLD on the basis of the incidence of each disease. Thus, in the 1990 study for example, the YLD estimates measured the future loss of health resulting from disease episodes that began in 1990. One advantage of this approach is that it is consistent with that used for mortality: YLL measure the future loss of life resulting from deaths in a particular year.

The 2010 GBD study adopted the alternative approach and calculated YLD based on the prevalence of the impairments resulting from each disease in the year for which the estimates are made. This approach has the advantage that it assigns YLD to the ages at which they are lived, rather than to the age at which the disease episode that produced them began.

Because prevalence is approximately incidence x duration, prevalence YLD for a condition (across all ages) is approximately the same as the no frills incidence YLD. As such, we can estimate YLDs using the following formula:

$$YLD = (number\ of\ prevalent\ cases) * (disability\ weight)$$

We can estimate the number of prevalent cases for each condition using survey data from 2013 NYCHANES. Annual prevalence for drug use can be estimated using data from 2002-2008 NSDUH. Disability weights can be extracted from the 2010 Global Burden of Disease study.However, we should note that the prevalence YLD for a condition may be quite different in magnitude to the incidence-based YLD, depending on how age weighting and discounting are applied. As such, comparisons to previous NYC DALY studies should be done with caution.

Further information about estimating DALYs can be found from the Global Burden of Disease concept paper (WHO, 2006).

## Disease Rankings

Since our goal is to communicate the burden of diseases in New York City, we will rank each condition in decreasing order of the DALY score. We will also test the stability of the rankings by comparing the results generated from the Michaud approach and the prevalence-based YLDs approach. Moreover, since the 2010 GBD study also provides 95% confidence intervals around point estimates for disability weights and national YLD/YLL rates, further stability checks can be conducted by reporting DALY estimations with their respective upper and lower bounds.

However, we should note that since the DALY estimations are not inclusive of all disease conditions, we will not be able to report our findings as the "top X conditions contributing to DALYs." Instead, we can only report mental health DALYs in reference to other highly prevalent chronic diseases.

## Estimation of Substance Use Dependence

Prevalence estimates of substance use cannot be directly substituted for prevalence of drug dependence or abuse disorders. We make the following assumptions about the average proportion of dependence among users (National Addiction Centre, 2003):

- Alcohol - 15.4%
- Cocaine - 16.7%
- Heroin - 23.1%
- Cannabis - 9.1%

## Estimation of Major Depressive Disorder Using PHQ-9

Prevalence estimates for 2-week depression was obtained for 2013 NYCHANES. While 2-week depression prevalence would lead to underestimation of 1-year depression, the use of PHQ-9 scores can also overestimate both MDD and any depressive disorder due to its low positive predictive value (~55%) for PHQ-9 scores below 10, the cutoff between mild and moderate depression (Kroenke, 2002). To adjust for this in the prevalence-based YLD approach, we did not consider PHQ-9 scores below 10 and assumed - from expert opinion - that only half of those with PHQ-9 scores above 10 were actually diagnosed with MDD.

## Sensitivity Analysis

In order to validate the Michaud approach, we will use 2005 NYC mortality estimates from the previous DOHMH to test the stability of our DALY rankings. However, since age-weighting is no longer used by the 2010 GBD due to ethical concerns, we suspect the magnitude of 2013 NYC DALYs to be slightly higher than that of the 2005 NYC DALYs.

## DALY Estimation

### Michaud YLD Approach

This section contains an implementation of the Michaud approach described in the above methods section. We first create a search index containing all the disease conditions of interest.

This search index is then fed through the `calculateDALY` workhorse function to estimate DALYs for each disease condition. The result is a `data.frame` object containing the following columns: `cause_name`, `sex`, `yll`, `yld`, `yld_upper`, `yld_lower`, `daly`, `daly_upper`, `daly_lower`.

### Prevalence-Based YLD Approach

Similar to the section, we implement the prevalence-based YLD approach here using the same search index.

# Results

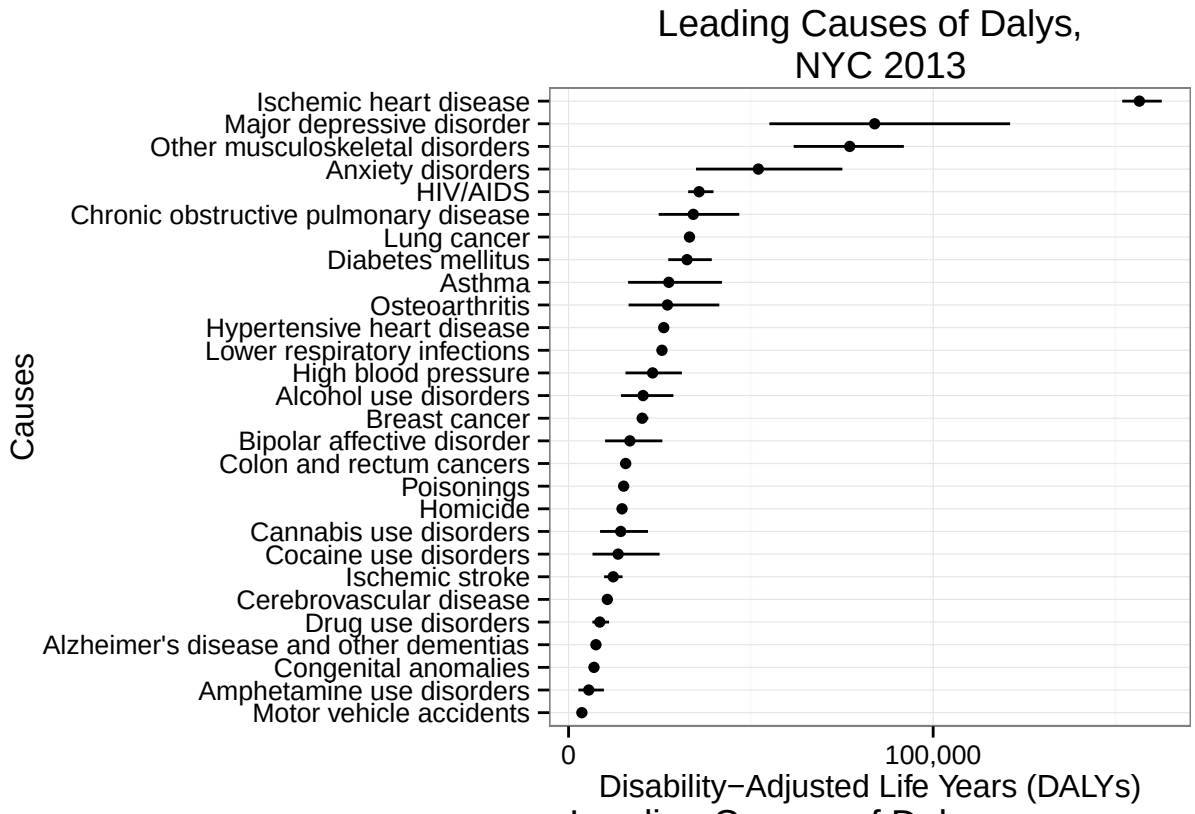
## Michaud YLD Approach

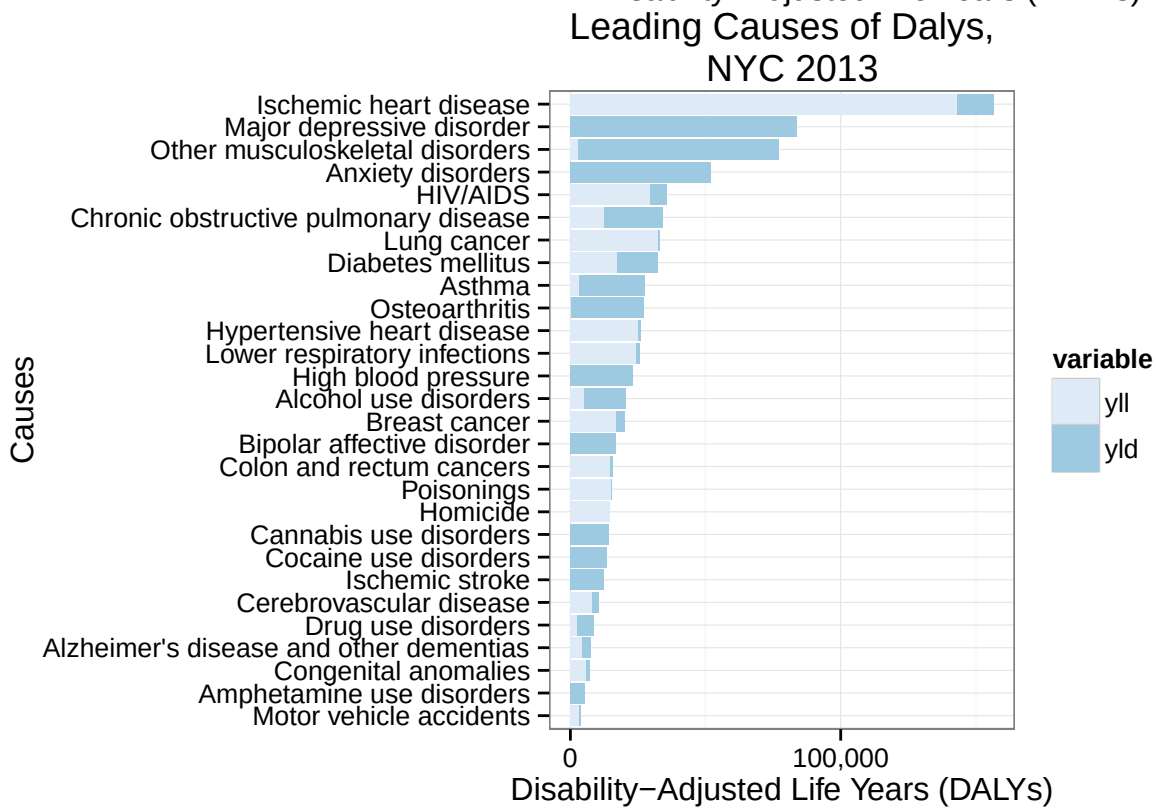
Raw results for this approach can be found under the `results` directory under the filename `nyc_daly_michaud.csv`. The file can be opened in Excel and manipulated with a pivot table for aggregation and stratification purposes.

### 2013 NYC DALY Estimates, Total

| cause_name | yll | yld | yld_upper | yld_lower | daly | daly_upper | daly_lower |
|---|---|---|---|---|---|---|---|
| Ischemic heart disease | 142893 | 13658 | 19810 | 8966 | 156550 | 162703 | 151859 |
| Major depressive disorder | 0 | 83953 | 121100 | 55076 | 83953 | 121100 | 55076 |
| Other musculoskeletal disorders | 2885 | 74223 | 89073 | 58852 | 77108 | 91957 | 61737 |
| Anxiety disorders | 0 | 52051 | 75105 | 34951 | 52051 | 75105 | 34951 |
| HIV/AIDS | 29554 | 6239 | 10198 | 3244 | 35793 | 39752 | 32798 |
| Chronic obstructive pulmonary disease | 12759 | 21453 | 34059 | 11961 | 34212 | 46818 | 24720 |
| Lung cancer | 32684 | 485 | 883 | 225 | 33169 | 33567 | 32909 |
| Diabetes mellitus | 17422 | 15059 | 21862 | 9929 | 32481 | 39284 | 27351 |
| Asthma | 3187 | 24307 | 38885 | 13140 | 27494 | 42073 | 16327 |
| Osteoarthritis | 149 | 26968 | 41201 | 16316 | 27117 | 41350 | 16465 |
| Hypertensive heart disease | 25274 | 835 | 1519 | 384 | 26108 | 26792 | 25658 |
| Lower respiratory infections | 24303 | 1312 | 1981 | 809 | 25615 | 26284 | 25112 |
| High blood pressure | 0 | 23051 | 31082 | 15615 | 23051 | 31082 | 15615 |
| Alcohol use disorders | 4921 | 15510 | 23839 | 9449 | 20431 | 28761 | 14370 |
| Breast cancer | 17147 | 3054 | 4732 | 1956 | 20201 | 21880 | 19103 |
| Bipolar affective disorder | 0 | 16820 | 25727 | 10012 | 16820 | 25727 | 10012 |
| Colon and rectum cancers | 14606 | 1055 | 1774 | 618 | 15661 | 16380 | 15224 |
| Poisonings | 15023 | 88 | 230 | 13 | 15111 | 15253 | 15036 |
| Homicide | 14663 | NA | NA | NA | 14663 | NA | NA |
| Cannabis use disorders | 0 | 14303 | 21780 | 8642 | 14303 | 21780 | 8642 |
| Cocaine use disorders | 0 | 13584 | 24968 | 6554 | 13584 | 24968 | 6554 |
| Ischemic stroke | 0 | 12250 | 14808 | 9752 | 12250 | 14808 | 9752 |
| Cerebrovascular disease | 8046 | 2585 | 3094 | 2076 | 10630 | 11139 | 10122 |
| Drug use disorders | 2326 | 6231 | 8780 | 4202 | 8557 | 11106 | 6528 |

| cause_name | yll | yld | yld_upper | yld_lower | daly | daly_upper | daly_lower |
|---|---|---|---|---|---|---|---|
| Alzheimer's disease and other dementias | 4452 | 3053 | 4060 | 2154 | 7505 | 8512 | 6606 |
| Congenital anomalies | 5859 | 1111 | 1741 | 672 | 6971 | 7600 | 6531 |
| Amphetamine use disorders | 0 | 5547 | 9689 | 2694 | 5547 | 9689 | 2694 |
| Motor vehicle accidents | 3135 | 512 | 775 | 325 | 3647 | 3910 | 3460 |

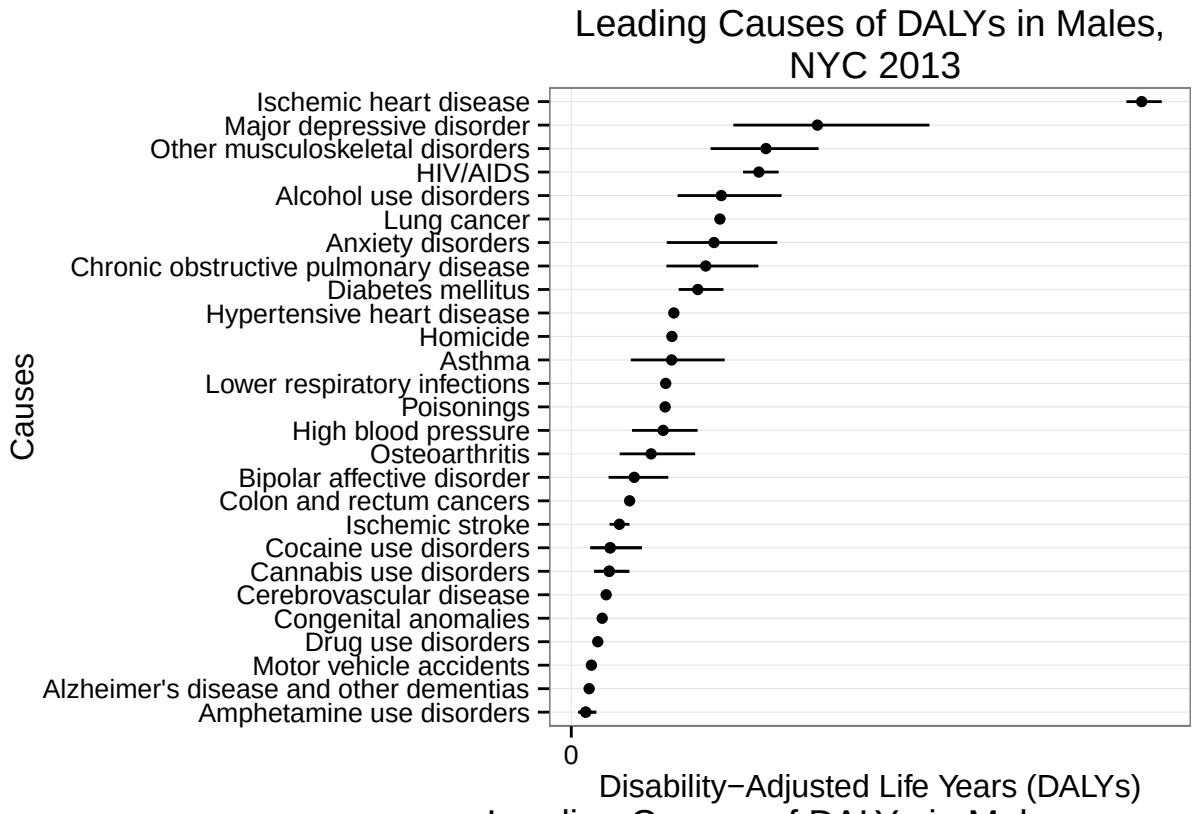


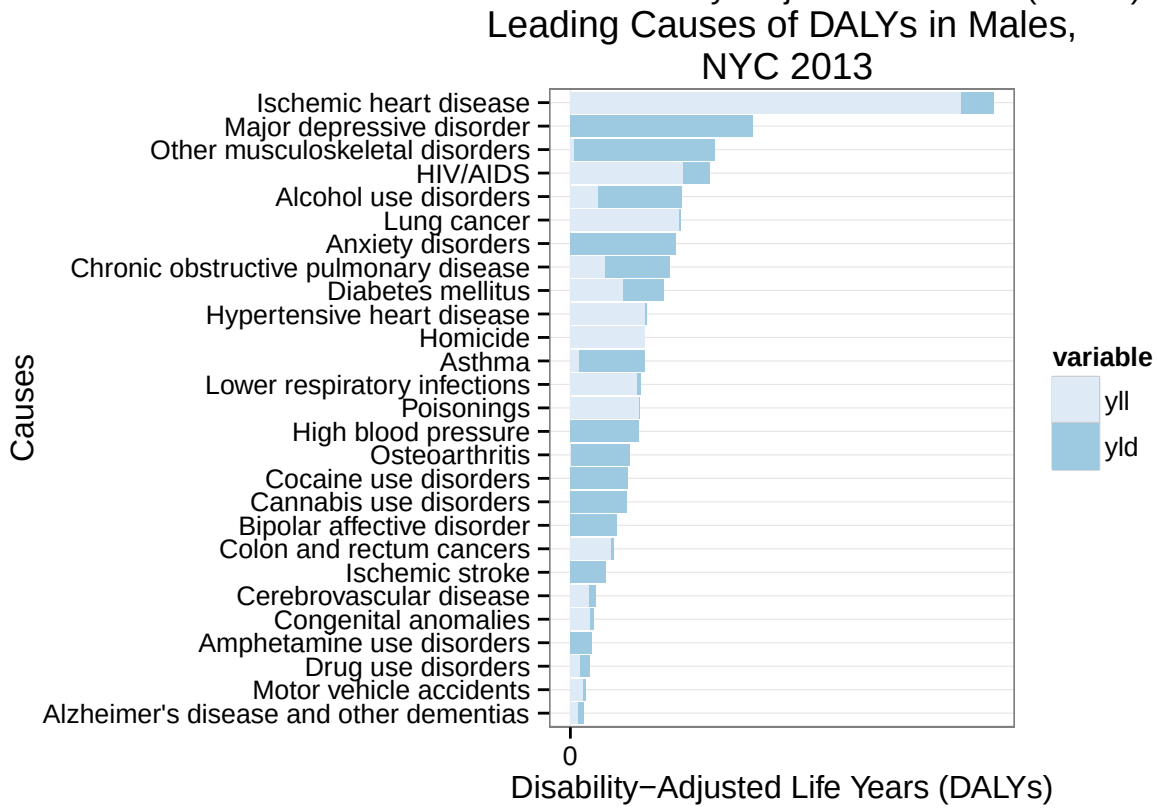




- `Ischemic heart disease` is the leading cause of disease in 2013, but has a wide range of uncertainty
- Disaggregated drug use disorders ranked relatively low, particularly for non-alcohol-related substances
- `Major depressive disorder` just missed the top 10 cutoff

**2013 NYC DALY Estimates, Male**

| cause_name | sex | yll | yld | yld_upper | yld_lower | daly | daly_upper | daly_lo |
|---|---|---|---|---|---|---|---|---|
| Ischemic heart disease | Male | 62241 | 5253 | 7628 | 3433 | 67494 | 69869 | 65 |
| Major depressive disorder | Male | 0 | 29122 | 42380 | 19172 | 29122 | 42380 | 19 |
| Other musculoskeletal disorders | Male | 604 | 22433 | 28657 | 15884 | 23036 | 29261 | 16 |
| HIV/AIDS | Male | 17948 | 4244 | 6583 | 2371 | 22192 | 24532 | 20 |
| Alcohol use disorders | Male | 4438 | 13308 | 20434 | 8139 | 17747 | 24873 | 12 |
| Lung cancer | Male | 17348 | 238 | 411 | 121 | 17586 | 17759 | 17 |
| Anxiety disorders | Male | 0 | 16888 | 24380 | 11291 | 16888 | 24380 | 11 |
| Chronic obstructive pulmonary disease | Male | 5605 | 10302 | 16528 | 5655 | 15907 | 22133 | 11 |
| Diabetes mellitus | Male | 8440 | 6526 | 9561 | 4265 | 14967 | 18002 | 12 |
| Hypertensive heart disease | Male | 11866 | 268 | 491 | 120 | 12134 | 12357 | 11 |
| Homicide | Male | 11903 | NA | NA | NA | 11903 | NA | |
| Asthma | Male | 1409 | 10463 | 16739 | 5641 | 11871 | 18148 | 7 |
| Lower respiratory infections | Male | 10657 | 513 | 786 | 311 | 11170 | 11443 | 10 |
| Poisonings | Male | 11035 | 70 | 176 | 12 | 11105 | 11210 | 11 |
| High blood pressure | Male | 0 | 10872 | 14946 | 7183 | 10872 | 14946 | 7 |
| Osteoarthritis | Male | 59 | 9384 | 14597 | 5661 | 9443 | 14656 | 5 |
| Bipolar affective disorder | Male | 0 | 7449 | 11473 | 4414 | 7449 | 11473 | 4 |
| Colon and rectum cancers | Male | 6478 | 421 | 680 | 250 | 6899 | 7158 | 6 |
| Ischemic stroke | Male | 0 | 5693 | 6885 | 4521 | 5693 | 6885 | 4 |
| Cocaine use disorders | Male | 0 | 4601 | 8347 | 2259 | 4601 | 8347 | 2 |
| Cocaine use disorders | Male | 0 | 4601 | 8347 | 2259 | 4601 | 8347 | 2 |
| Cannabis use disorders | Male | 0 | 4486 | 6858 | 2705 | 4486 | 6858 | 2 |
| Cannabis use disorders | Male | 0 | 4486 | 6858 | 2705 | 4486 | 6858 | 2 |
| Cerebrovascular disease | Male | 3085 | 1042 | 1250 | 834 | 4126 | 4334 | 3 |
| Congenital anomalies | Male | 3108 | 550 | 855 | 333 | 3658 | 3963 | 3 |
| Drug use disorders | Male | 1620 | 1512 | 2134 | 1006 | 3132 | 3755 | 2 |
| Motor vehicle accidents | Male | 2060 | 323 | 489 | 206 | 2383 | 2549 | 2 |
| Alzheimer's disease and other dementias | Male | 1280 | 832 | 1114 | 589 | 2112 | 2395 | 1 |
| Amphetamine use disorders | Male | 0 | 1711 | 2950 | 839 | 1711 | 2950 | |
| Amphetamine use disorders | Male | 0 | 1711 | 2950 | 839 | 1711 | 2950 | |

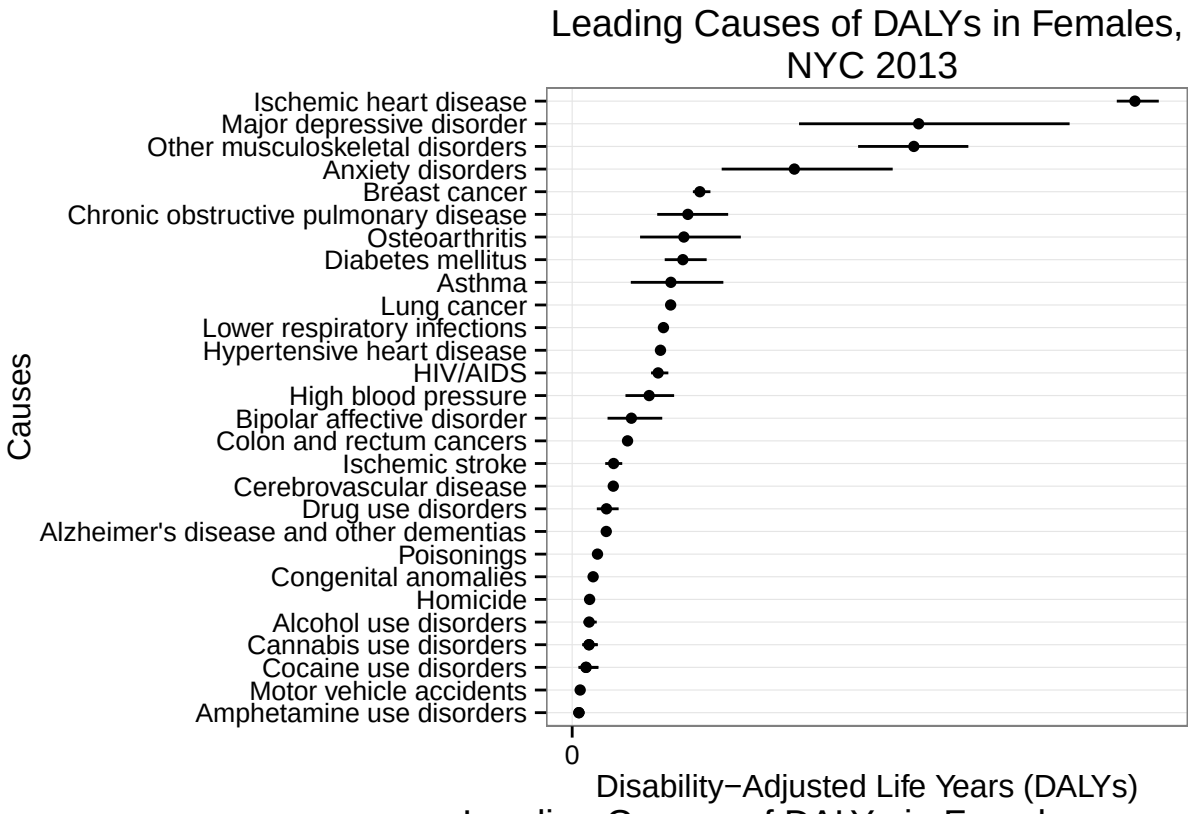


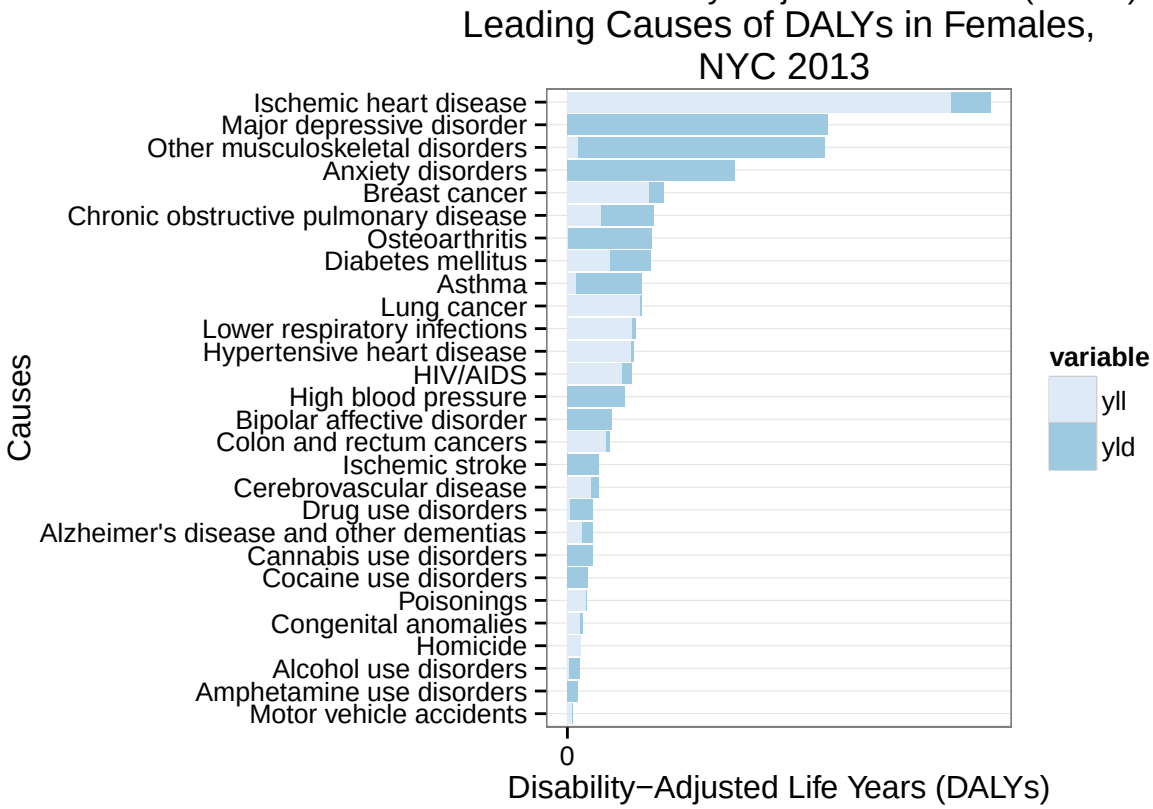




- `Alcohol use disorders` rises to the #4 slot
- `Homicide` and accidental deaths such as `poisonings` and `motor vehicle accidents` rise in rankings

**2013 NYC DALY Estimates, Female**

| cause_name | sex | yll | yld | yld_upper | yld_lower | daly | daly_upper | daly_ |
|---|---|---|---|---|---|---|---|---|
| Ischemic heart disease | Female | 80652 | 8404 | 12182 | 5533 | 89056 | 92834 | |
| Major depressive disorder | Female | 0 | 54832 | 78719 | 35904 | 54832 | 78719 | |
| Other musculoskeletal disorders | Female | 2281 | 51790 | 60415 | 42969 | 54071 | 62696 | |
| Anxiety disorders | Female | 0 | 35163 | 50725 | 23660 | 35163 | 50725 | |
| Breast cancer | Female | 17147 | 3054 | 4732 | 1956 | 20201 | 21880 | |
| Chronic obstructive pulmonary disease | Female | 7154 | 11151 | 17530 | 6307 | 18305 | 24685 | |
| Osteoarthritis | Female | 90 | 17585 | 26605 | 10655 | 17674 | 26694 | |
| Diabetes mellitus | Female | 8982 | 8533 | 12301 | 5665 | 17514 | 21282 | |
| Asthma | Female | 1779 | 13844 | 22146 | 7499 | 15623 | 23925 | |
| Lung cancer | Female | 15336 | 247 | 472 | 104 | 15583 | 15808 | |
| Lower respiratory infections | Female | 13646 | 799 | 1196 | 498 | 14445 | 14841 | |
| Hypertensive heart disease | Female | 13407 | 567 | 1028 | 264 | 13974 | 14436 | |
| HIV/AIDS | Female | 11606 | 1995 | 3615 | 873 | 13601 | 15221 | |
| High blood pressure | Female | 0 | 12180 | 16136 | 8433 | 12180 | 16136 | |
| Bipolar affective disorder | Female | 0 | 9371 | 14254 | 5598 | 9371 | 14254 | |
| Colon and rectum cancers | Female | 8128 | 634 | 1095 | 368 | 8762 | 9223 | |
| Ischemic stroke | Female | 0 | 6556 | 7923 | 5231 | 6556 | 7923 | |
| Cerebrovascular disease | Female | 4961 | 1543 | 1844 | 1242 | 6504 | 6805 | |
| Drug use disorders | Female | 706 | 4719 | 6645 | 3197 | 5424 | 7351 | |
| Alzheimer's disease and other dementias | Female | 3172 | 2221 | 2946 | 1565 | 5393 | 6118 | |
| Poisonings | Female | 3988 | 18 | 54 | 1 | 4006 | 4042 | |
| Congenital anomalies | Female | 2751 | 562 | 886 | 339 | 3313 | 3637 | |
| Homicide | Female | 2760 | NA | NA | NA | 2760 | NA | |
| Alcohol use disorders | Female | 483 | 2202 | 3405 | 1310 | 2685 | 3888 | |
| Cannabis use disorders | Female | 0 | 2665 | 4032 | 1616 | 2665 | 4032 | |
| Cannabis use disorders | Female | 0 | 2665 | 4032 | 1616 | 2665 | 4032 | |
| Cocaine use disorders | Female | 0 | 2191 | 4138 | 1017 | 2191 | 4138 | |
| Cocaine use disorders | Female | 0 | 2191 | 4138 | 1017 | 2191 | 4138 | |
| Motor vehicle accidents | Female | 1074 | 189 | 287 | 119 | 1264 | 1361 | |
| Amphetamine use disorders | Female | 0 | 1062 | 1895 | 508 | 1062 | 1895 | |
| Amphetamine use disorders | Female | 0 | 1062 | 1895 | 508 | 1062 | 1895 | |




- `Breast cancer` makes the top 3
- `Alzheimer's disease and other dementias` ranks very high
- Drug-related disorders get pushed to the bottom

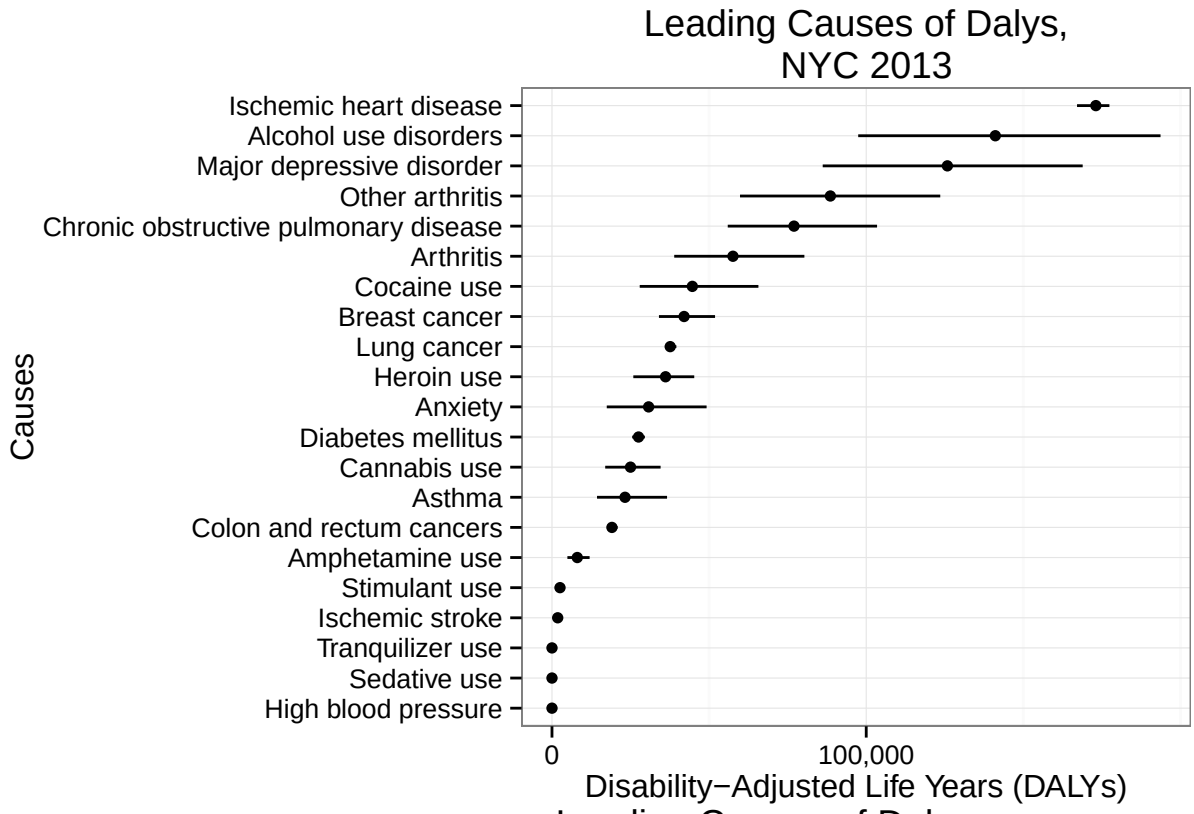
## Prevalence-Based YLD Approach

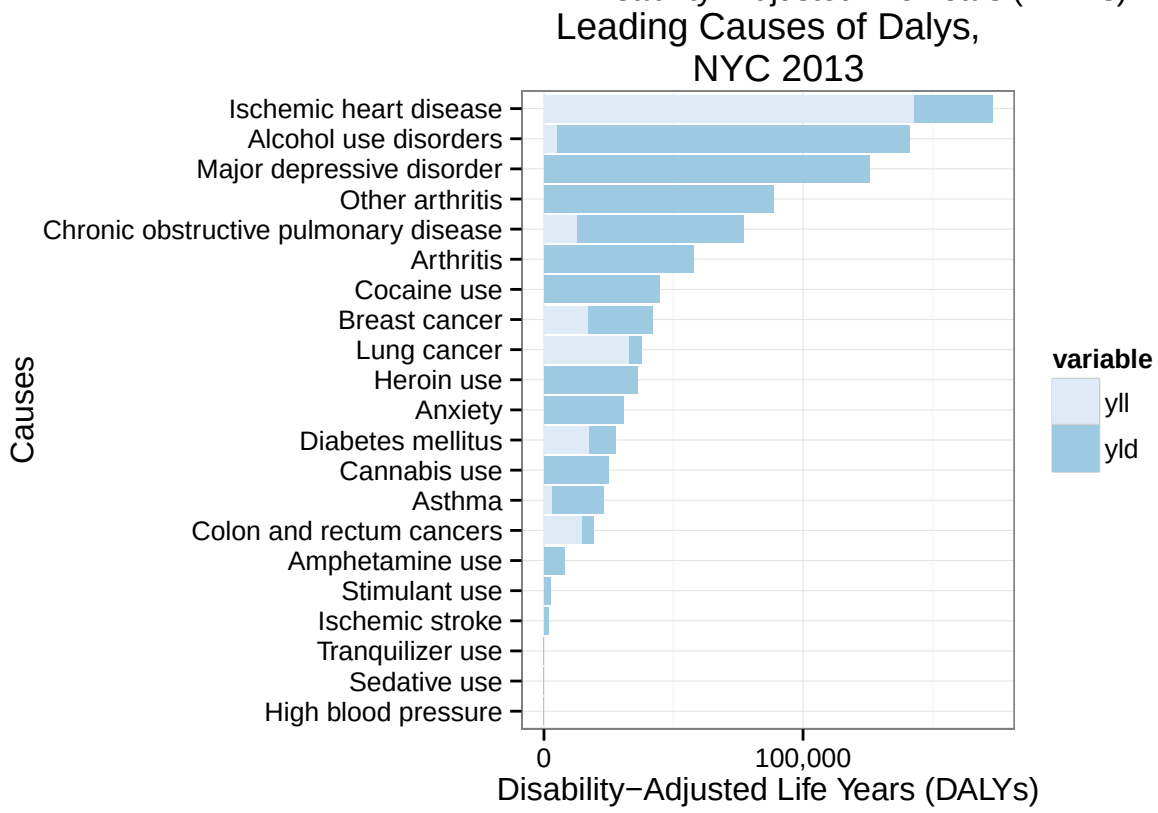
Raw results for this approach can be found under the `results` directory under the filename `nyc_daly_prevalence.csv`. The file can be opened in Excel and manipulated with a pivot table for aggregation and stratification purposes.

### 2013 NYC DALY Estimates, Total

| cause_name | yll | yld | yld_upper | yld_lower | daly | daly_upper | daly_lower |
|---|---|---|---|---|---|---|---|
| Ischemic heart disease | 142893 | 30186 | 34498 | 24197 | 173078 | 177391 | 167089 |
| Alcohol use disorders | 4921 | 136164 | 188737 | 92528 | 141085 | 193658 | 97450 |
| Major depressive disorder | NA | 125830 | 168883 | 86154 | 125830 | 168883 | 86154 |
| Other arthritis | NA | 88591 | 123561 | 59838 | 88591 | 123561 | 59838 |
| Chronic obstructive pulmonary disease | 12759 | 64253 | 90690 | 43170 | 77012 | 103449 | 55929 |
| Arthritis | NA | 57587 | 80319 | 38896 | 57587 | 80319 | 38896 |
| Cocaine use | NA | 44665 | 65691 | 27916 | 44665 | 65691 | 27916 |
| Breast cancer | 17269 | 24769 | 34626 | 16765 | 42038 | 51895 | 34035 |
| Lung cancer | 32684 | 4937 | 6902 | 3342 | 37622 | 39587 | 36026 |
| Heroin use | NA | 36139 | 45272 | 25878 | 36139 | 45272 | 25878 |
| Anxiety | NA | 30752 | 49203 | 17426 | 30752 | 49203 | 17426 |
| Diabetes mellitus | 17422 | 10119 | 12143 | 8095 | 27541 | 29565 | 25517 |
| Cannabis use | NA | 24991 | 34562 | 16939 | 24991 | 34562 | 16939 |
| Asthma | 3187 | 20058 | 33430 | 11143 | 23245 | 36617 | 14331 |
| Colon and rectum cancers | 14606 | 4471 | 6251 | 3027 | 19077 | 20857 | 17633 |
| Amphetamine use | NA | 8050 | 11972 | 4903 | 8050 | 11972 | 4903 |
| Stimulant use | NA | 2549 | 3790 | 1552 | 2549 | 3790 | 1552 |
| Ischemic stroke | NA | 1820 | 3207 | 953 | 1820 | 3207 | 953 |
| High blood pressure | NA | 0 | 0 | 0 | 0 | 0 | 0 |
| Sedative use | NA | 0 | 0 | 0 | 0 | 0 | 0 |
| Tranquilizer use | NA | 0 | 0 | 0 | 0 | 0 | 0 |

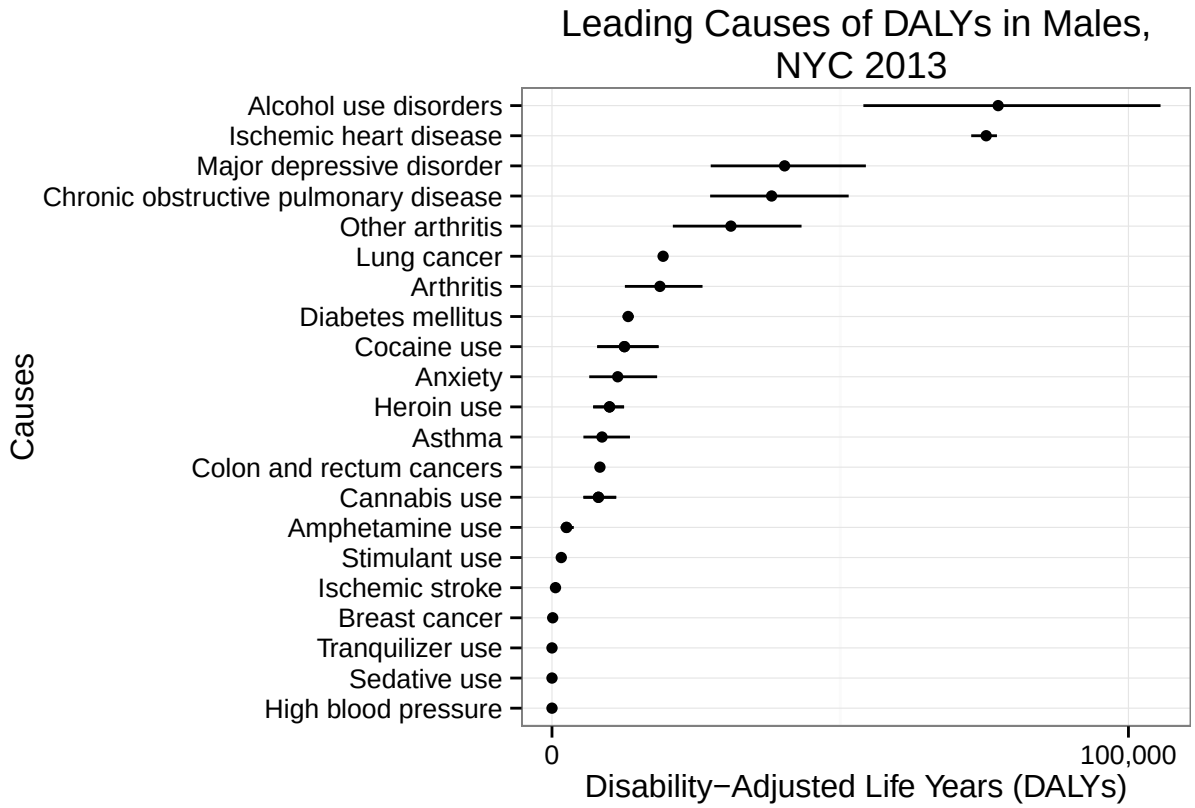
- `Major depressive disorder` ranks number one, beating out the number two slot by almost twice the number of DALYs However, DALY estimates appear to be unstable, taking a wide range of possible values.
- Not enough information to calculate DALY estimates for `sedative use`, `stimulant use`, `tranquilizer use`.

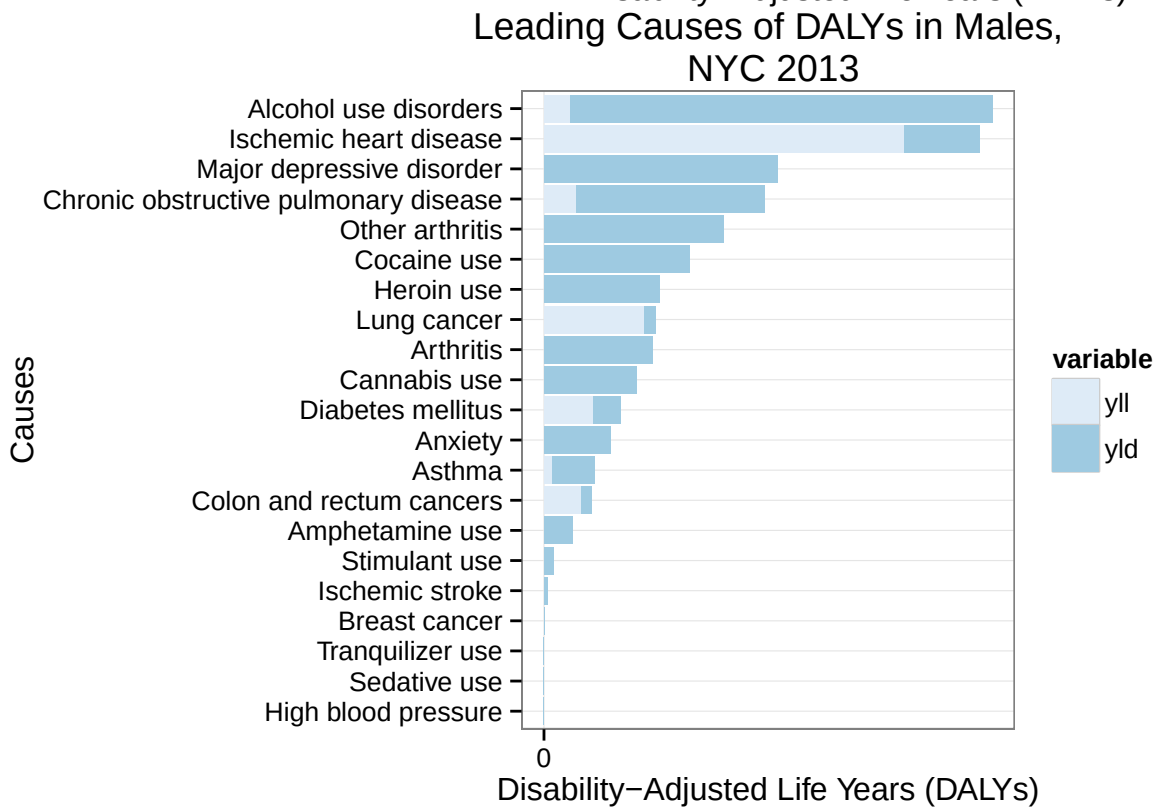



**2013 NYC DALY Estimates, Male**

| cause_name | sex | yll | yld | yld_upper | yld_lower | daly | daly_upper | daly_low |
|---|---|---|---|---|---|---|---|---|
| Alcohol use disorders | Male | 4438 | 72958 | 101127 | 49577 | 77396 | 105565 | 540 |
| Ischemic heart disease | Male | 62241 | 13079 | 14947 | 10484 | 75320 | 77188 | 727 |
| Major depressive disorder | Male | NA | 40352 | 54452 | 27533 | 40352 | 54452 | 275 |
| Chronic obstructive pulmonary disease | Male | 5605 | 32495 | 45865 | 21833 | 38100 | 51470 | 274 |
| Other arthritis | Male | NA | 31037 | 43288 | 20963 | 31037 | 43288 | 209 |
| Lung cancer | Male | 17348 | 1926 | 2692 | 1304 | 19274 | 20041 | 186 |
| Arthritis | Male | NA | 18723 | 26114 | 12647 | 18723 | 26114 | 126 |
| Diabetes mellitus | Male | 8440 | 4770 | 5724 | 3816 | 13210 | 14164 | 122 |
| Cocaine use | Male | NA | 12568 | 18484 | 7855 | 12568 | 18484 | 78 |
| Cocaine use | Male | NA | 12568 | 18484 | 7855 | 12568 | 18484 | 78 |
| Anxiety | Male | NA | 11399 | 18238 | 6459 | 11399 | 18238 | 64 |
| Heroin use | Male | NA | 9980 | 12502 | 7146 | 9980 | 12502 | 71 |
| Heroin use | Male | NA | 9980 | 12502 | 7146 | 9980 | 12502 | 71 |
| Asthma | Male | 1409 | 7269 | 12115 | 4038 | 8678 | 13523 | 54 |
| Colon and rectum cancers | Male | 6478 | 1835 | 2565 | 1242 | 8313 | 9043 | 77 |
| Cannabis use | Male | NA | 8054 | 11138 | 5459 | 8054 | 11138 | 54 |
| Cannabis use | Male | NA | 8054 | 11138 | 5459 | 8054 | 11138 | 54 |
| Amphetamine use | Male | NA | 2514 | 3740 | 1531 | 2514 | 3740 | 15 |
| Amphetamine use | Male | NA | 2514 | 3740 | 1531 | 2514 | 3740 | 15 |
| Stimulant use | Male | NA | 1610 | 2394 | 980 | 1610 | 2394 | 9 |
| Ischemic stroke | Male | NA | 608 | 1071 | 318 | 608 | 1071 | 3 |
| Breast cancer | Male | 122 | 0 | 0 | 0 | 122 | 122 | 1 |
| High blood pressure | Male | NA | 0 | 0 | 0 | 0 | 0 | |
| Sedative use | Male | NA | 0 | 0 | 0 | 0 | 0 | |
| Tranquilizer use | Male | NA | 0 | 0 | 0 | 0 | 0 | |

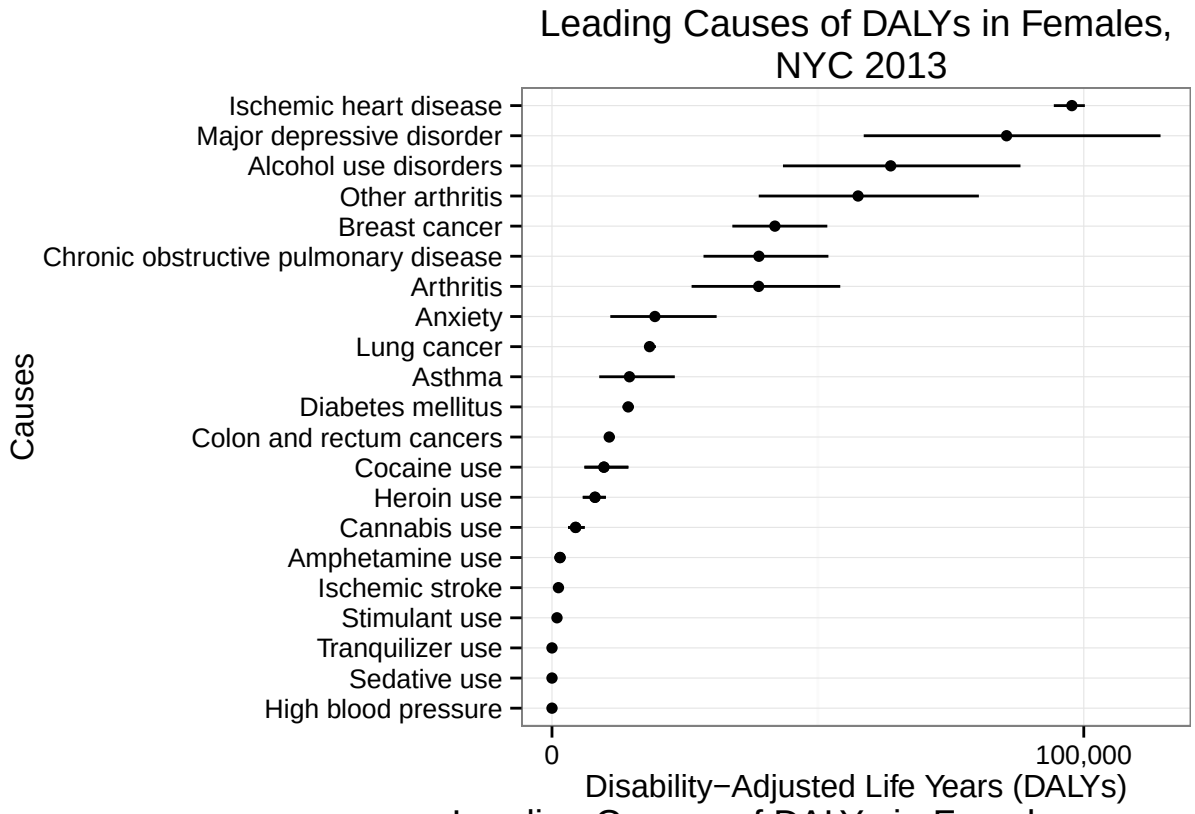


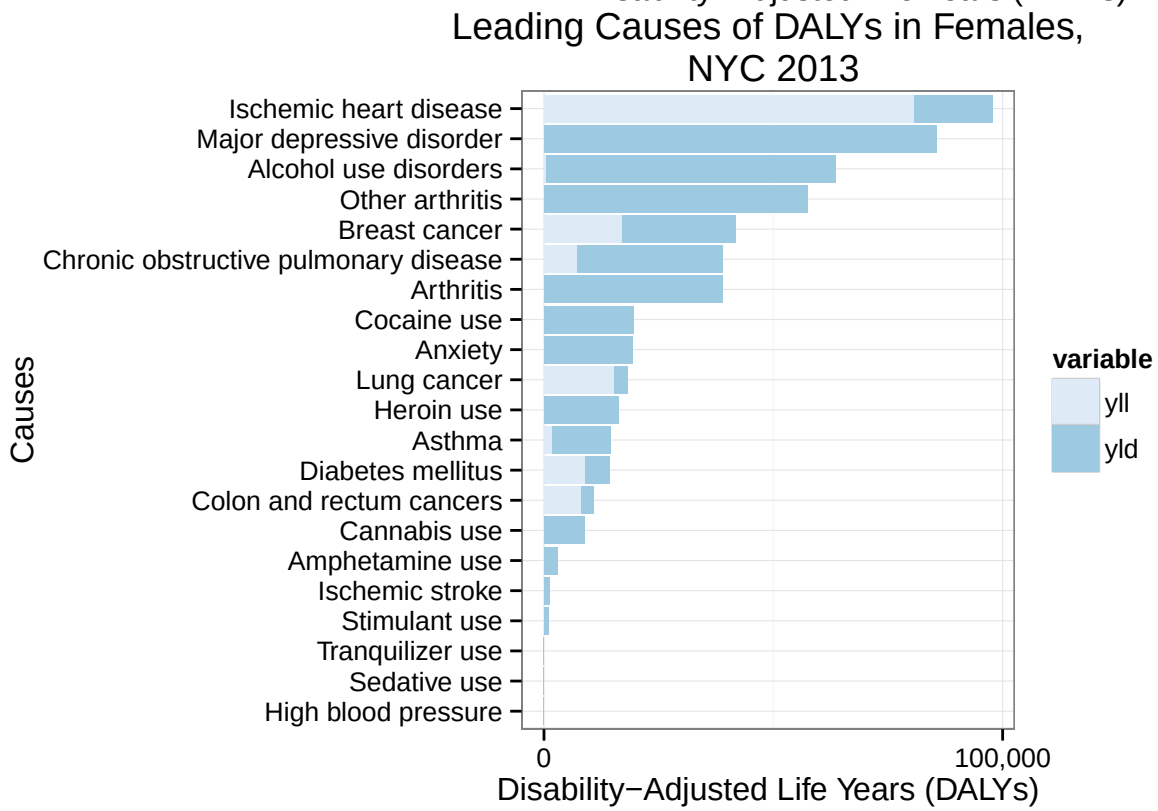




- `Alcohol use disorders` rises in proportion to `major depressive disorder`

**2013 NYC DALY Estimates, Female**

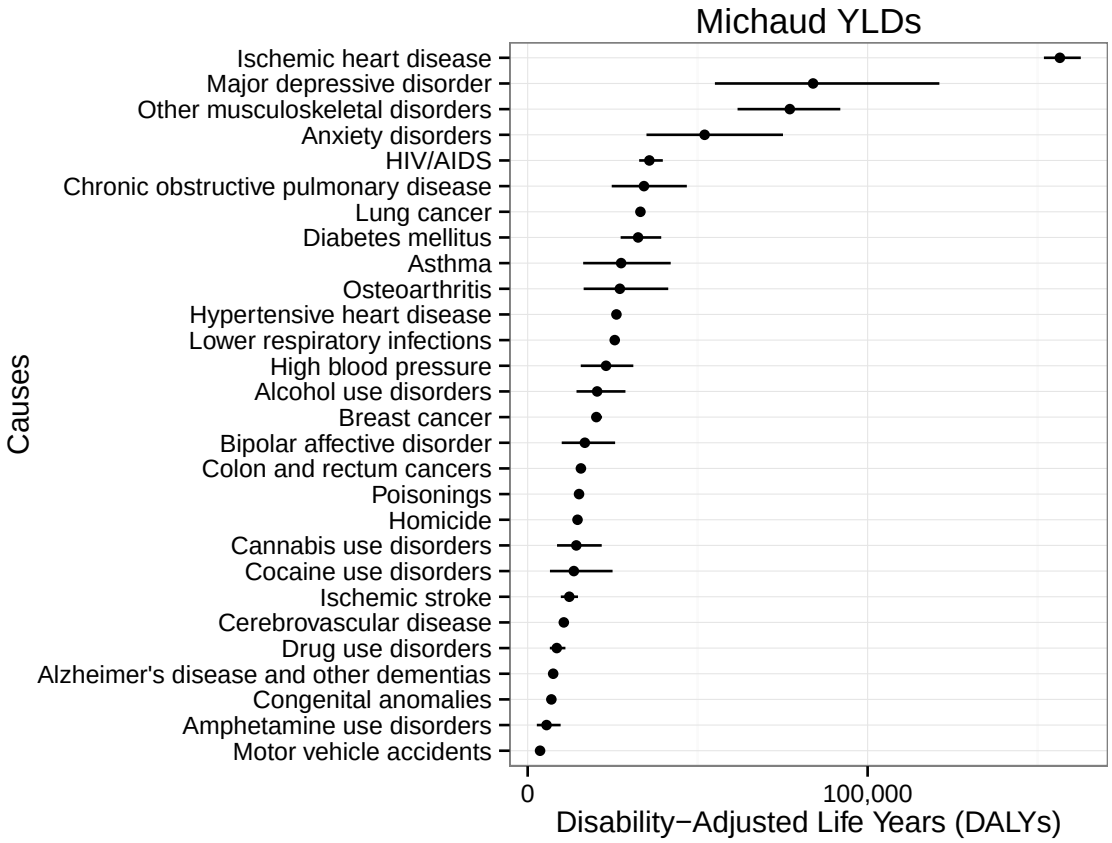
| cause_name | sex | yll | yld | yld_upper | yld_lower | daly | daly_upper | daly_l |
|---|---|---|---|---|---|---|---|---|
| Ischemic heart disease | Female | 80652 | 17107 | 19551 | 13713 | 97758 | 100202 | 9 |
| Major depressive disorder | Female | NA | 85478 | 114432 | 58621 | 85478 | 114432 | 5 |
| Alcohol use disorders | Female | 483 | 63206 | 87610 | 42951 | 63689 | 88093 | 4 |
| Other arthritis | Female | NA | 57555 | 80274 | 38875 | 57555 | 80274 | 3 |
| Breast cancer | Female | 17147 | 24769 | 34626 | 16765 | 41916 | 51773 | 3 |
| Chronic obstructive pulmonary disease | Female | 7154 | 31758 | 44824 | 21337 | 38912 | 51979 | 2 |
| Arthritis | Female | NA | 38863 | 54204 | 26250 | 38863 | 54204 | 2 |
| Anxiety | Female | NA | 19353 | 30965 | 10967 | 19353 | 30965 | 1 |
| Lung cancer | Female | 15336 | 3011 | 4210 | 2038 | 18347 | 19546 | 1 |
| Asthma | Female | 1779 | 12789 | 21315 | 7105 | 14568 | 23094 | |
| Diabetes mellitus | Female | 8982 | 5349 | 6419 | 4279 | 14331 | 15401 | 1 |
| Colon and rectum cancers | Female | 8128 | 2636 | 3685 | 1784 | 10764 | 11814 | |
| Cocaine use | Female | NA | 9765 | 14361 | 6103 | 9765 | 14361 | |
| Cocaine use | Female | NA | 9765 | 14361 | 6103 | 9765 | 14361 | |
| Heroin use | Female | NA | 8090 | 10134 | 5793 | 8090 | 10134 | |
| Heroin use | Female | NA | 8090 | 10134 | 5793 | 8090 | 10134 | |
| Cannabis use | Female | NA | 4442 | 6142 | 3010 | 4442 | 6142 | |
| Cannabis use | Female | NA | 4442 | 6142 | 3010 | 4442 | 6142 | |
| Amphetamine use | Female | NA | 1510 | 2246 | 920 | 1510 | 2246 | |
| Amphetamine use | Female | NA | 1510 | 2246 | 920 | 1510 | 2246 | |
| Ischemic stroke | Female | NA | 1212 | 2136 | 635 | 1212 | 2136 | |
| Stimulant use | Female | NA | 939 | 1396 | 572 | 939 | 1396 | |
| High blood pressure | Female | NA | 0 | 0 | 0 | 0 | 0 | |
| Sedative use | Female | NA | 0 | 0 | 0 | 0 | 0 | |
| Tranquilizer use | Female | NA | 0 | 0 | 0 | 0 | 0 | |

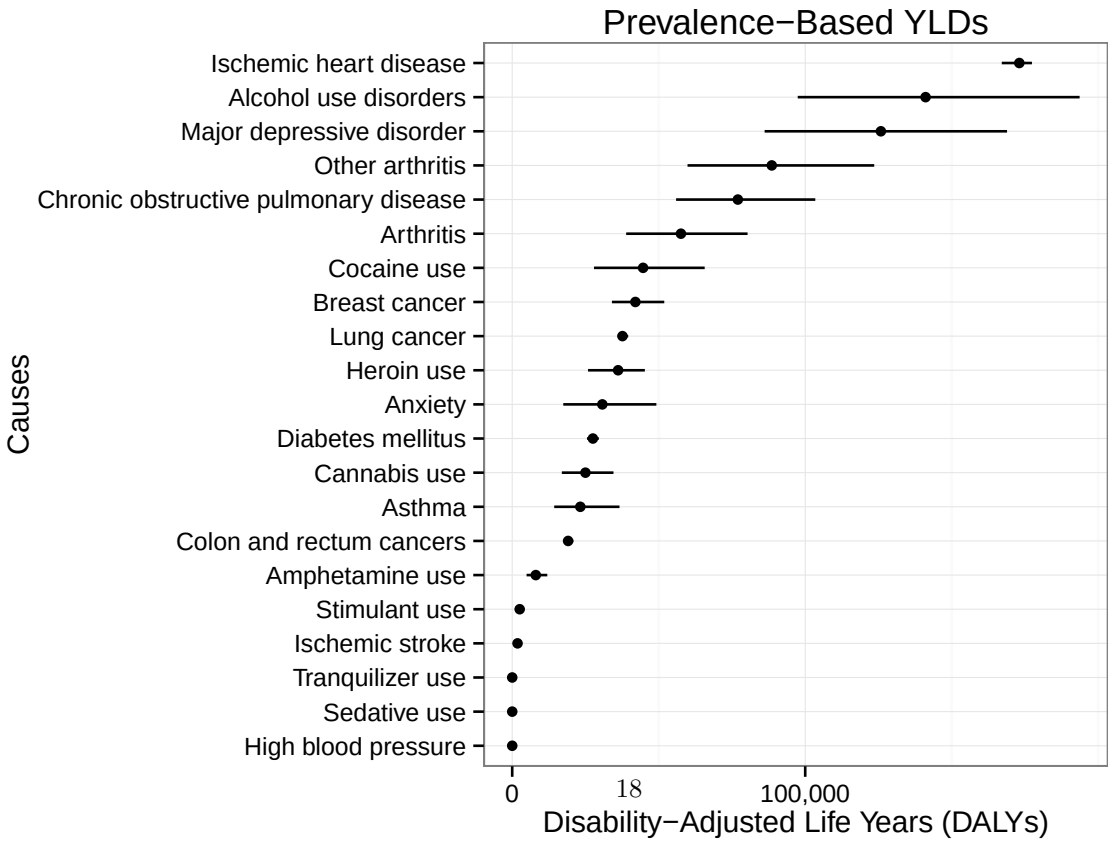

Leading Causes of DALYs in Females, NYC 2013
Causes
Ischemic heart disease
Major depressive disorder
Alcohol use disorders
Other arthritis
Breast cancer
Chronic obstructive pulmonary disease
Arthritis
Anxiety
Lung cancer
Asthma
Diabetes mellitus
Colon and rectum cancers
Cocaine use
Heroin use
Cannabis use
Amphetamine use
Ischemic stroke
Stimulant use
Tranquilizer use
Sedative use
High blood pressure
0
100,000
Disability−Adjusted Life Years (DALYs)


Leading Causes of DALYs in Females, NYC 2013
Causes
Ischemic heart disease
Major depressive disorder
Alcohol use disorders
Other arthritis
Breast cancer
Chronic obstructive pulmonary disease
Arthritis
Cocaine use
Anxiety
Lung cancer
Heroin use
Asthma
Diabetes mellitus
Colon and rectum cancers
Cannabis use
Amphetamine use
Ischemic stroke
Stimulant use
Tranquilizer use
Sedative use
High blood pressure
0
100,000
Disability−Adjusted Life Years (DALYs)
variable
yll
yld

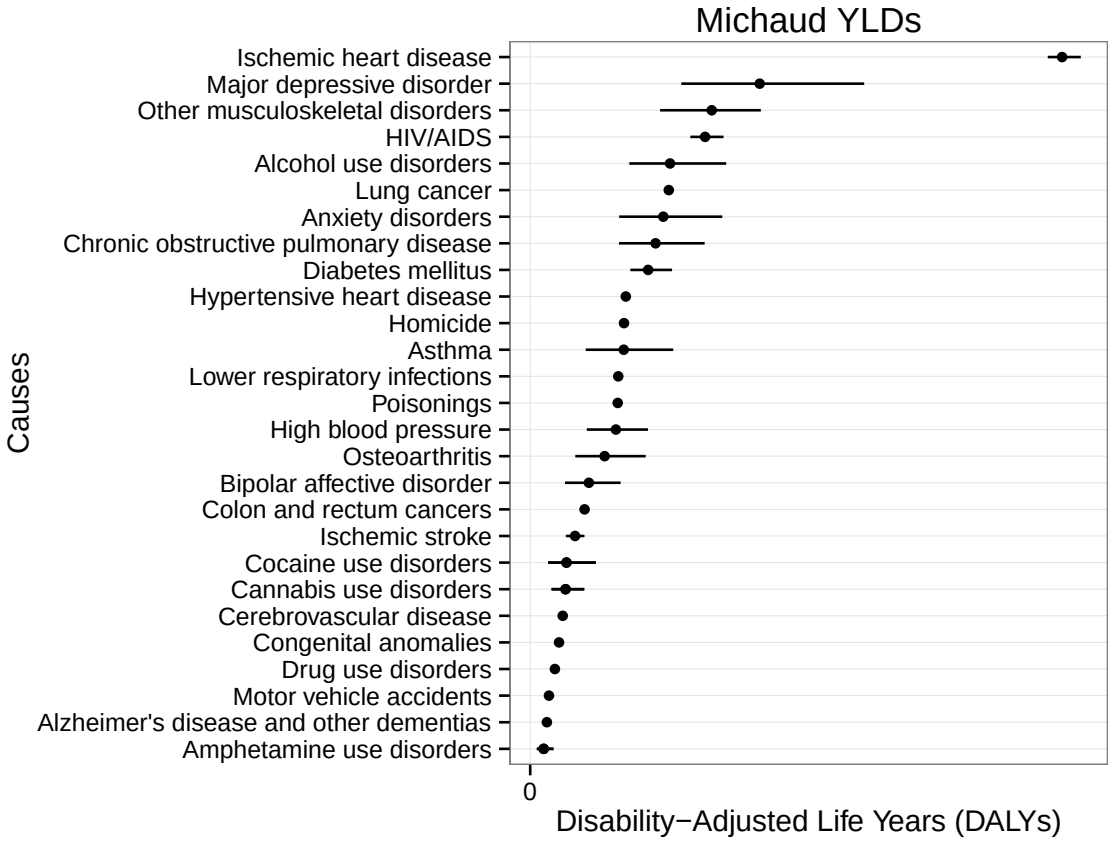
## Michaud YLDs vs. Prevalence-Based YLDs: Side-by-Side Comparison

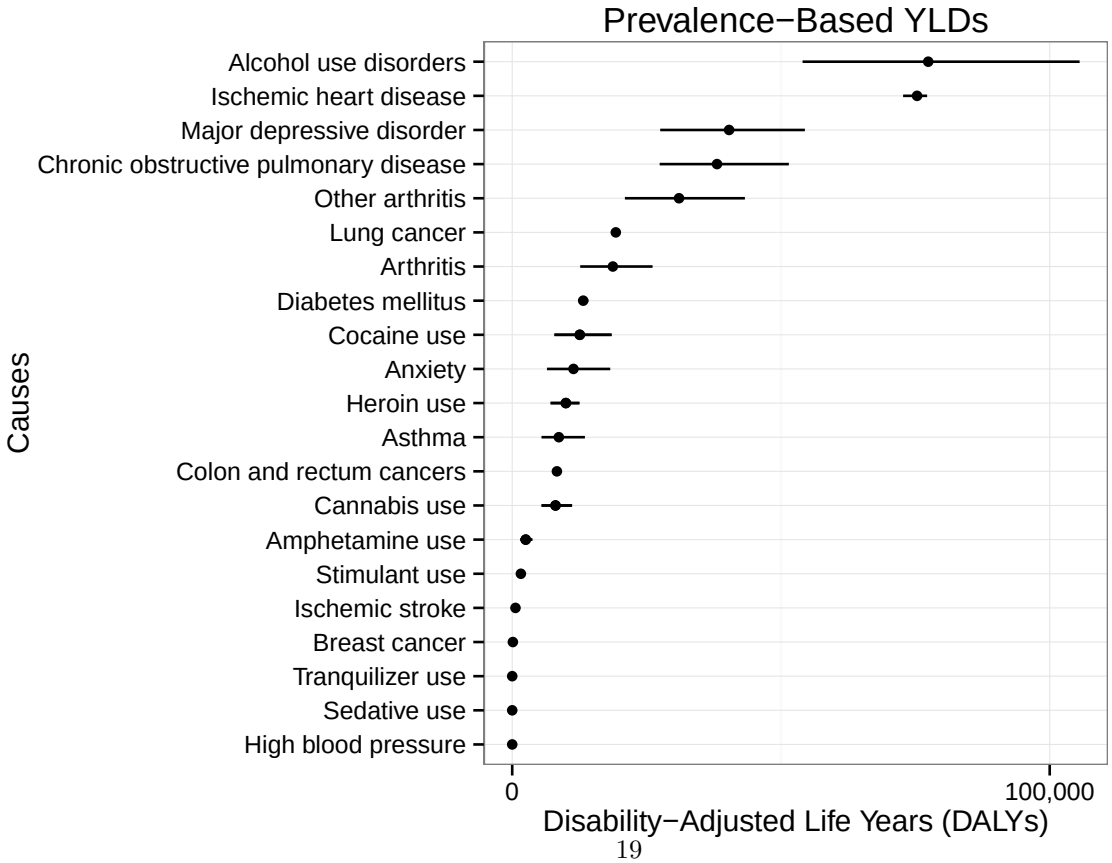
**Total**



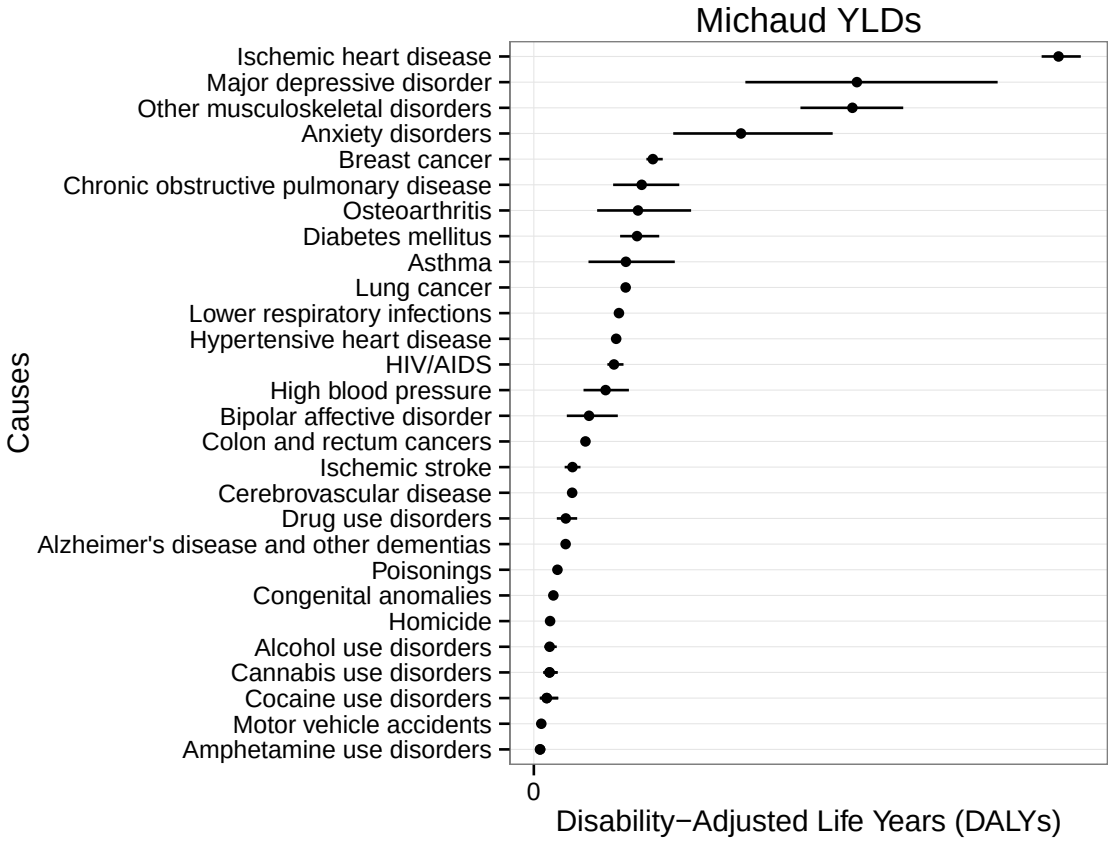



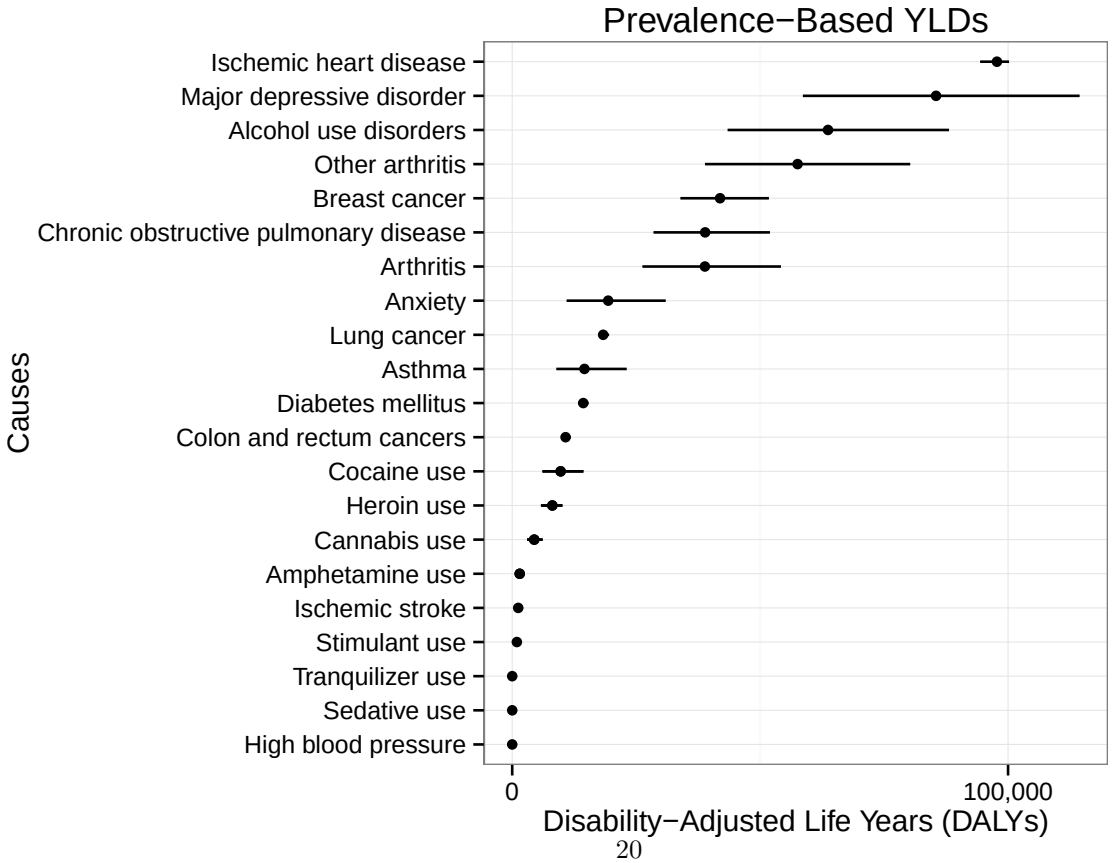
**Male**


Michaud YLDs
Ischemic heart disease
Major depressive disorder
Other musculoskeletal disorders
HIV/AIDS
Alcohol use disorders
Lung cancer
Anxiety disorders
Chronic obstructive pulmonary disease
Diabetes mellitus
Hypertensive heart disease
Homicide
Asthma
Lower respiratory infections
Poisonings
High blood pressure
Osteoarthritis
Bipolar affective disorder
Colon and rectum cancers
Ischemic stroke
Cocaine use disorders
Cannabis use disorders
Cerebrovascular disease
Congenital anomalies
Drug use disorders
Motor vehicle accidents
Alzheimer's disease and other dementias
Amphetamine use disorders
Causes
0
Disability−Adjusted Life Years (DALYs)


Prevalence−Based YLDs
Alcohol use disorders
Ischemic heart disease
Major depressive disorder
Chronic obstructive pulmonary disease
Other arthritis
Lung cancer
Arthritis
Diabetes mellitus
Cocaine use
Anxiety
Heroin use
Asthma
Colon and rectum cancers
Cannabis use
Amphetamine use
Stimulant use
Ischemic stroke
Breast cancer
Tranquilizer use
Sedative use
High blood pressure
Causes
0
100,000
Disability−Adjusted Life Years (DALYs)

**Female**


Michaud YLDs
Ischemic heart disease
Major depressive disorder
Other musculoskeletal disorders
Anxiety disorders
Breast cancer
Chronic obstructive pulmonary disease
Osteoarthritis
Diabetes mellitus
Asthma
Lung cancer
Lower respiratory infections
Hypertensive heart disease
HIV/AIDS
High blood pressure
Bipolar affective disorder
Colon and rectum cancers
Ischemic stroke
Cerebrovascular disease
Drug use disorders
Alzheimer's disease and other dementias
Poisonings
Congenital anomalies
Homicide
Alcohol use disorders
Cannabis use disorders
Cocaine use disorders
Motor vehicle accidents
Amphetamine use disorders
Causes
0
Disability−Adjusted Life Years (DALYs)


Prevalence−Based YLDs
Ischemic heart disease
Major depressive disorder
Alcohol use disorders
Other arthritis
Breast cancer
Chronic obstructive pulmonary disease
Arthritis
Anxiety
Lung cancer
Asthma
Diabetes mellitus
Colon and rectum cancers
Cocaine use
Heroin use
Cannabis use
Amphetamine use
Ischemic stroke
Stimulant use
Tranquilizer use
Sedative use
High blood pressure
Causes
0
100,000
Disability−Adjusted Life Years (DALYs)

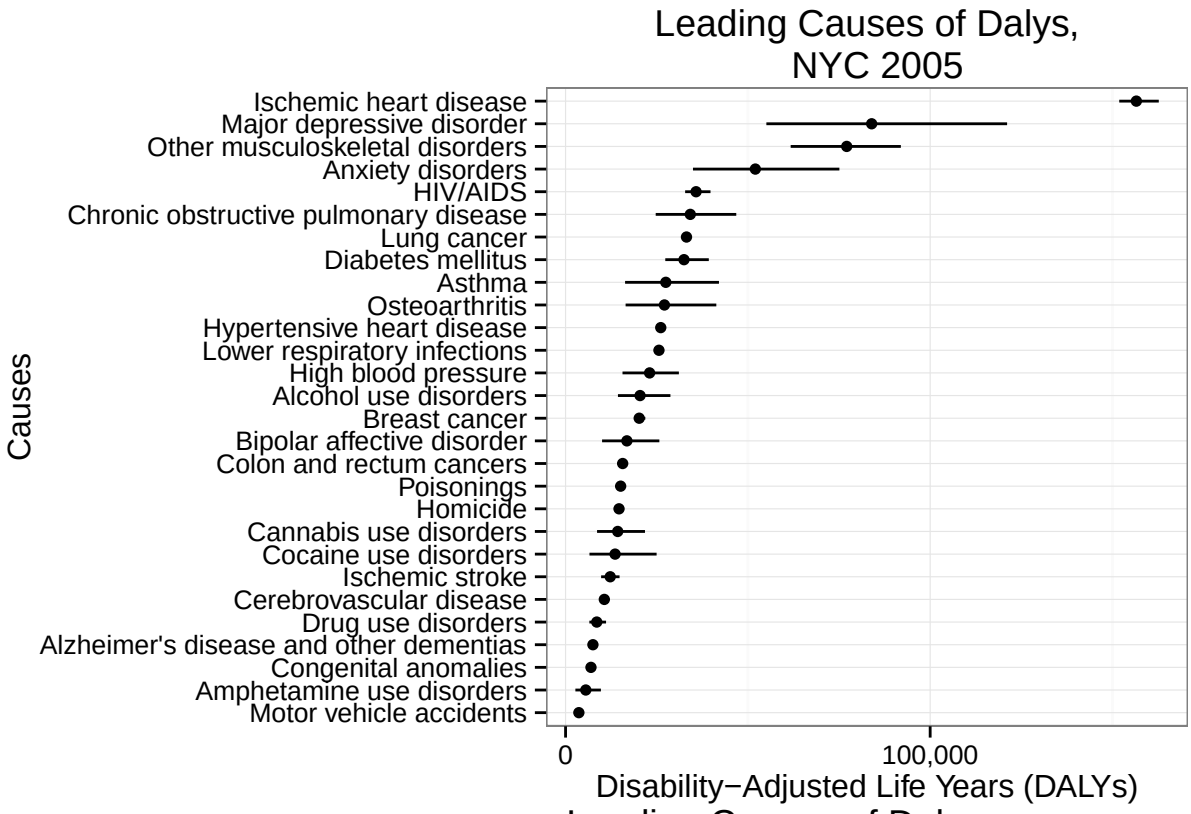
### Disease Conditions with Small Sample Sizes

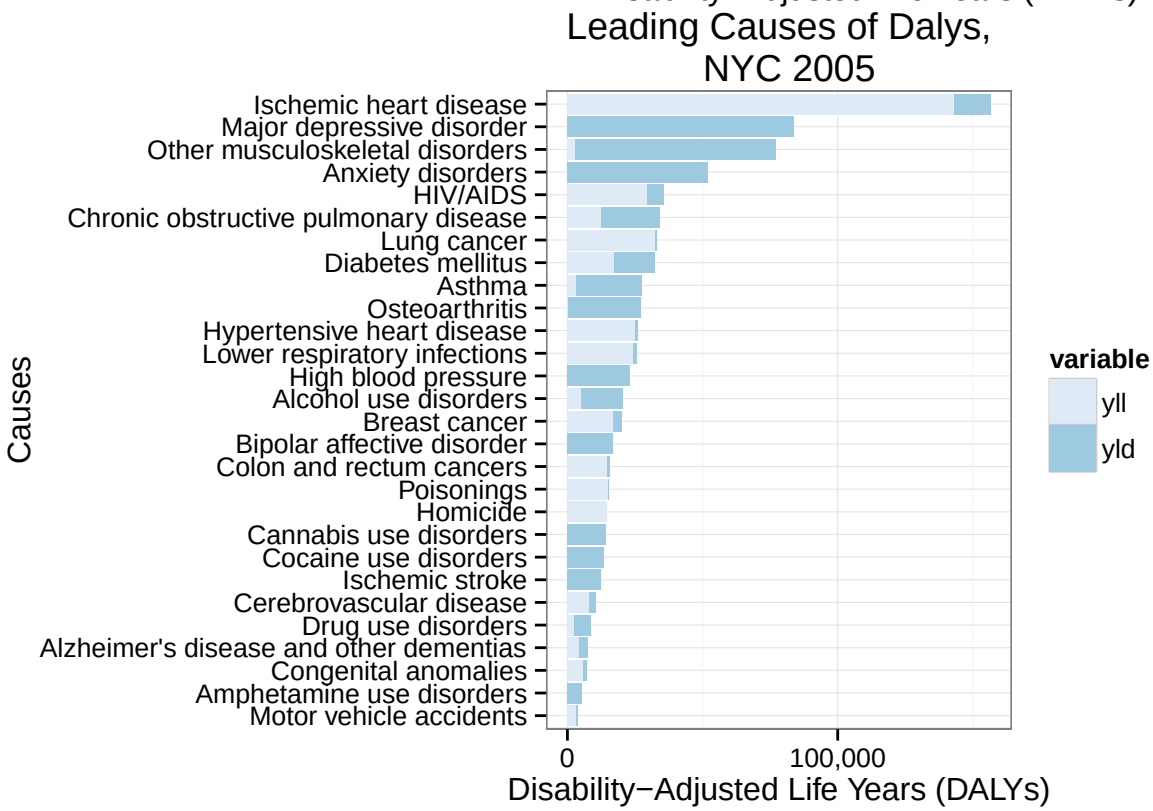
```
##                    cause_name                     sequlae    sex    age
## 25              Breast cancer                Breast cancer   Male 20-39
## 26              Breast cancer                Breast cancer   Male 40-59
## 27              Breast cancer                Breast cancer   Male   60+
## 28              Breast cancer                Breast cancer Female 20-39
## 36                Cocaine use                  Cocaine use Female   60+
## 37   Colon and rectum cancers    Colon and rectum cancers   Male 20-39
## 38   Colon and rectum cancers    Colon and rectum cancers   Male 40-59
## 39   Colon and rectum cancers    Colon and rectum cancers   Male   60+
## 40   Colon and rectum cancers    Colon and rectum cancers Female 20-39
## 41   Colon and rectum cancers    Colon and rectum cancers Female 40-59
## 42   Colon and rectum cancers    Colon and rectum cancers Female   60+
## 55                 Heroin use                   Heroin use   Male 20-39
## 56                 Heroin use                   Heroin use   Male 40-59
## 57                 Heroin use                   Heroin use   Male   60+
## 58                 Heroin use                   Heroin use Female 20-39
## 59                 Heroin use                   Heroin use Female 40-59
## 60                 Heroin use                   Heroin use Female   60+
## 67     Ischemic heart disease      Ischemic heart disease   Male 20-39
## 70     Ischemic heart disease      Ischemic heart disease Female 20-39
## 73                Lung cancer                         Lung   Male 20-39
## 74                Lung cancer                         Lung   Male 40-59
## 75                Lung cancer                         Lung   Male   60+
## 76                Lung cancer                         Lung Female 20-39
## 77                Lung cancer                         Lung Female 40-59
## 78                Lung cancer                         Lung Female   60+
## 87            Amphetamine use         Methamphetamine use   Male 20-39
## 88            Amphetamine use         Methamphetamine use   Male 40-59
## 89            Amphetamine use         Methamphetamine use   Male   60+
## 90            Amphetamine use         Methamphetamine use Female 20-39
## 91            Amphetamine use         Methamphetamine use Female 40-59
## 92            Amphetamine use         Methamphetamine use Female   60+
## 101 Major depressive disorder         moderate depression   Male   60+
## 105 Major depressive disorder moderately severe depression   Male 20-39
## 106 Major depressive disorder moderately severe depression   Male 40-59
## 107 Major depressive disorder moderately severe depression   Male   60+
## 111           Other arthritis              Other arthritis   Male 20-39
## 125 Major depressive disorder           severe depression   Male 20-39
## 126 Major depressive disorder           severe depression   Male 40-59
## 127 Major depressive disorder           severe depression   Male   60+
## 128 Major depressive disorder           severe depression Female 20-39
## 130 Major depressive disorder           severe depression Female   60+
## 139           Ischemic stroke             Ischemic stroke   Male 20-39
## 140           Ischemic stroke             Ischemic stroke   Male 40-59
## 141           Ischemic stroke             Ischemic stroke   Male   60+
## 142           Ischemic stroke             Ischemic stroke Female 20-39
```

## Sensitivity Analysis

#### 2005 NYC DALY Estimates, Total

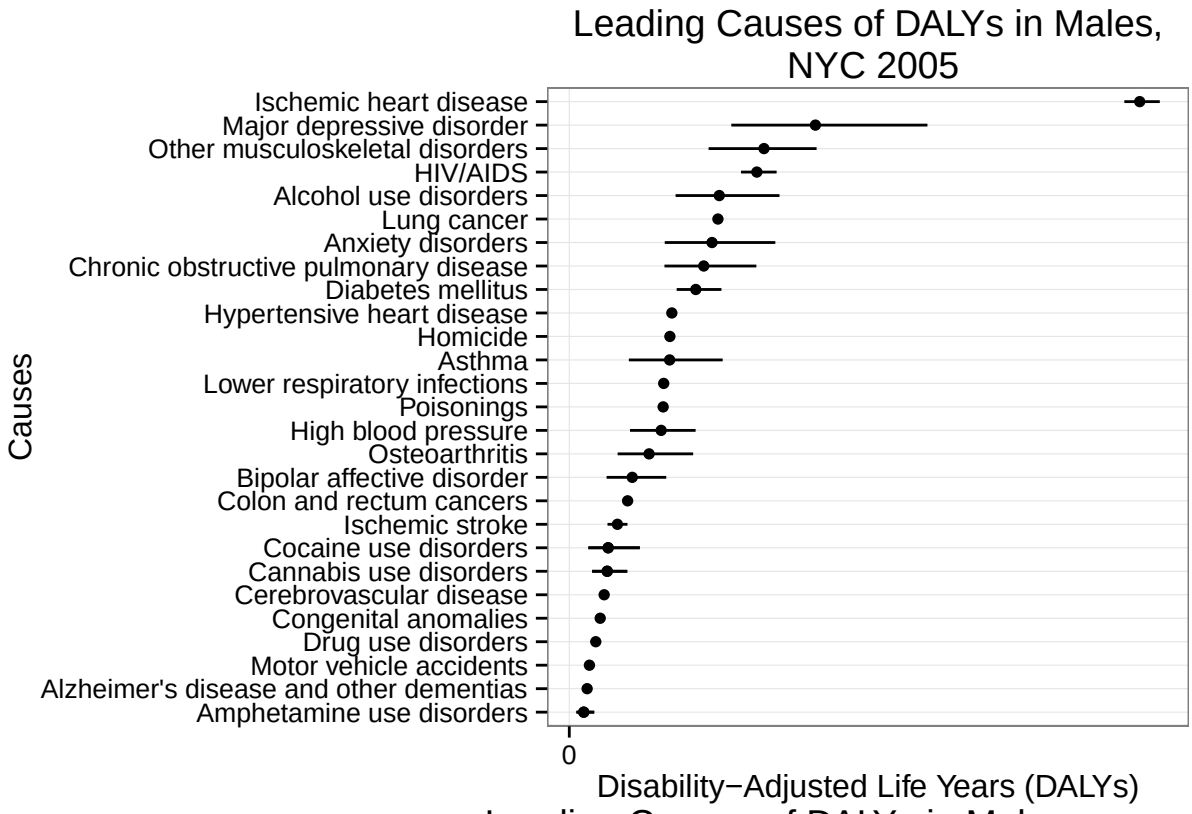
| cause_name | yll | yld | yld_upper | yld_lower | daly | daly_upper | daly_lower |
|---|---|---|---|---|---|---|---|
| Ischemic heart disease | 142893 | 13658 | 19810 | 8966 | 156550 | 162703 | 151859 |
| Major depressive disorder | 0 | 83953 | 121100 | 55076 | 83953 | 121100 | 55076 |
| Other musculoskeletal disorders | 2885 | 74223 | 89073 | 58852 | 77108 | 91957 | 61737 |
| Anxiety disorders | 0 | 52051 | 75105 | 34951 | 52051 | 75105 | 34951 |
| HIV/AIDS | 29554 | 6239 | 10198 | 3244 | 35793 | 39752 | 32798 |
| Chronic obstructive pulmonary disease | 12759 | 21453 | 34059 | 11961 | 34212 | 46818 | 24720 |
| Lung cancer | 32684 | 485 | 883 | 225 | 33169 | 33567 | 32909 |
| Diabetes mellitus | 17422 | 15059 | 21862 | 9929 | 32481 | 39284 | 27351 |
| Asthma | 3187 | 24307 | 38885 | 13140 | 27494 | 42073 | 16327 |
| Osteoarthritis | 149 | 26968 | 41201 | 16316 | 27117 | 41350 | 16465 |
| Hypertensive heart disease | 25274 | 835 | 1519 | 384 | 26108 | 26792 | 25658 |
| Lower respiratory infections | 24303 | 1312 | 1981 | 809 | 25615 | 26284 | 25112 |
| High blood pressure | 0 | 23051 | 31082 | 15615 | 23051 | 31082 | 15615 |
| Alcohol use disorders | 4921 | 15510 | 23839 | 9449 | 20431 | 28761 | 14370 |
| Breast cancer | 17147 | 3054 | 4732 | 1956 | 20201 | 21880 | 19103 |
| Bipolar affective disorder | 0 | 16820 | 25727 | 10012 | 16820 | 25727 | 10012 |
| Colon and rectum cancers | 14606 | 1055 | 1774 | 618 | 15661 | 16380 | 15224 |
| Poisonings | 15023 | 88 | 230 | 13 | 15111 | 15253 | 15036 |
| Homicide | 14663 | NA | NA | NA | 14663 | NA | NA |
| Cannabis use disorders | 0 | 14303 | 21780 | 8642 | 14303 | 21780 | 8642 |
| Cocaine use disorders | 0 | 13584 | 24968 | 6554 | 13584 | 24968 | 6554 |
| Ischemic stroke | 0 | 12250 | 14808 | 9752 | 12250 | 14808 | 9752 |
| Cerebrovascular disease | 8046 | 2585 | 3094 | 2076 | 10630 | 11139 | 10122 |
| Drug use disorders | 2326 | 6231 | 8780 | 4202 | 8557 | 11106 | 6528 |
| Alzheimer's disease and other dementias | 4452 | 3053 | 4060 | 2154 | 7505 | 8512 | 6606 |
| Congenital anomalies | 5859 | 1111 | 1741 | 672 | 6971 | 7600 | 6531 |
| Amphetamine use disorders | 0 | 5547 | 9689 | 2694 | 5547 | 9689 | 2694 |
| Motor vehicle accidents | 3135 | 512 | 775 | 325 | 3647 | 3910 | 3460 |

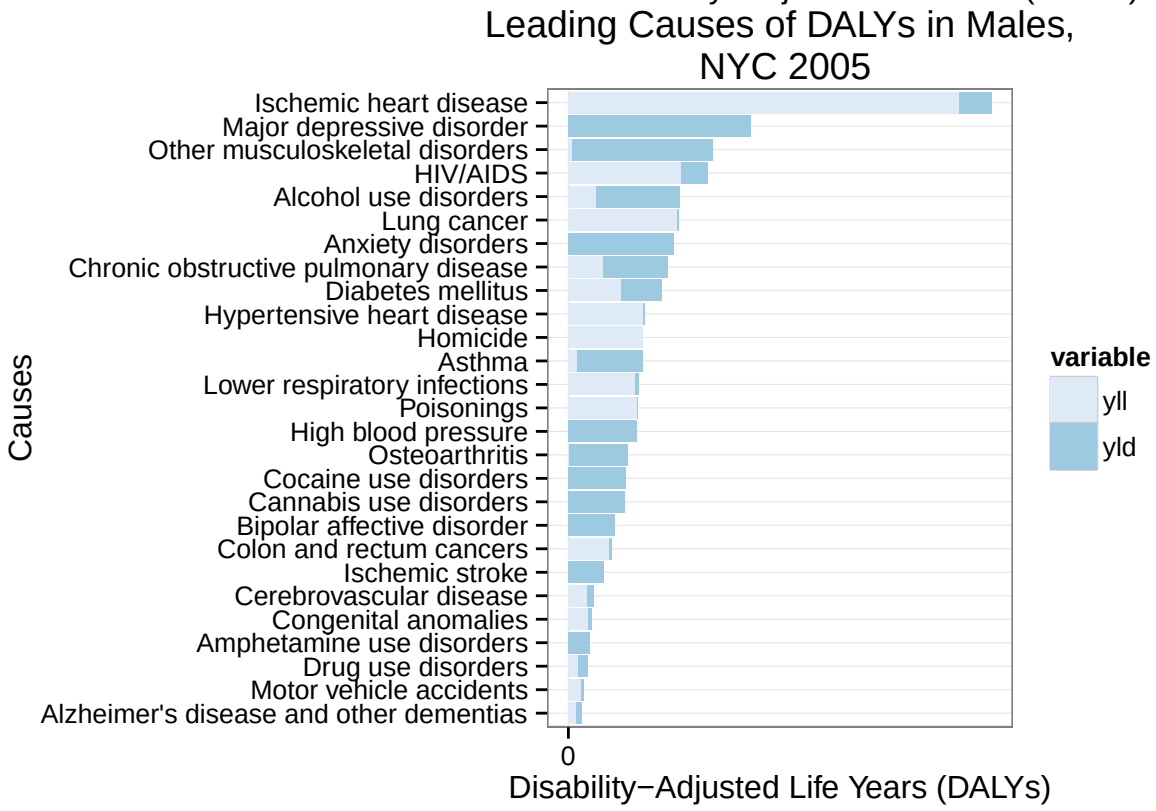



**2005 NYC DALY Estimates, Male**

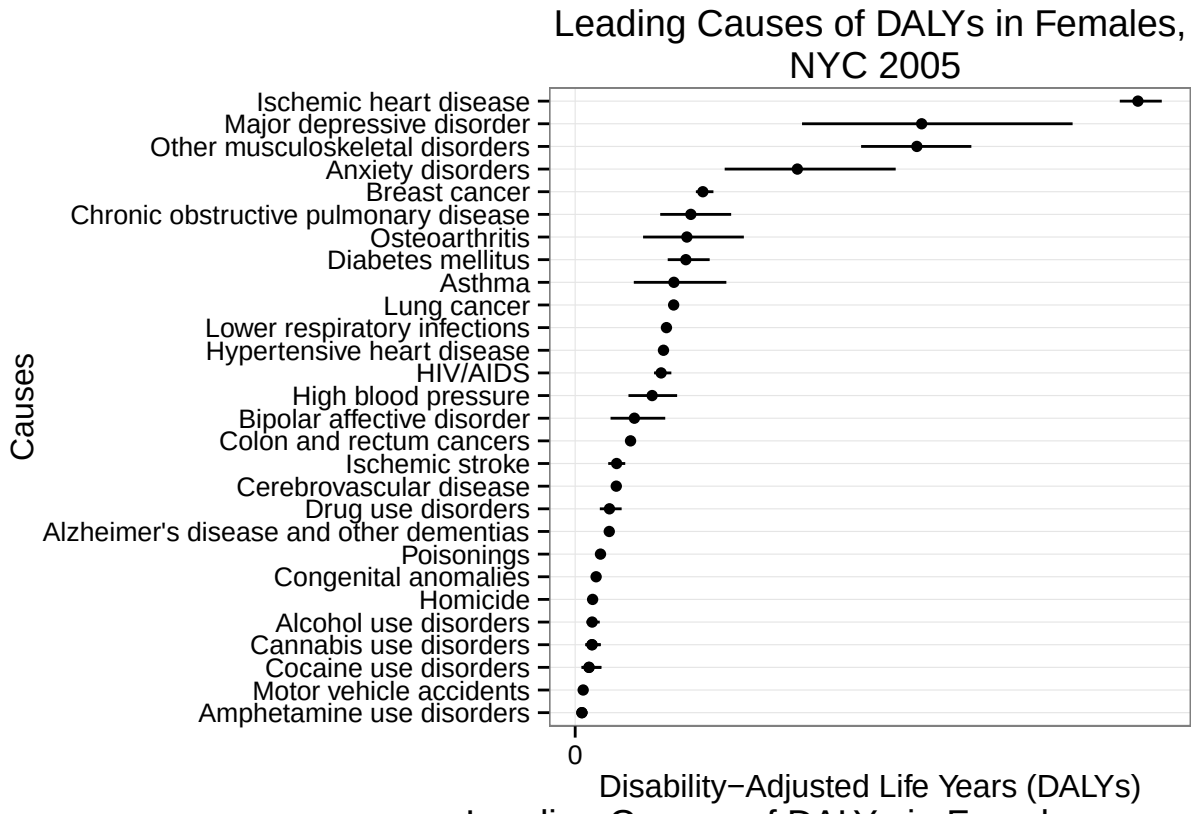
| cause_name | sex | yll | yld | yld_upper | yld_lower | daly | daly_upper | daly_lo |
|---|---|---|---|---|---|---|---|---|
| Ischemic heart disease | Male | 62241 | 5253 | 7628 | 3433 | 67494 | 69869 | 65 |
| Major depressive disorder | Male | 0 | 29122 | 42380 | 19172 | 29122 | 42380 | 19 |
| Other musculoskeletal disorders | Male | 604 | 22433 | 28657 | 15884 | 23036 | 29261 | 16 |
| HIV/AIDS | Male | 17948 | 4244 | 6583 | 2371 | 22192 | 24532 | 20 |
| Alcohol use disorders | Male | 4438 | 13308 | 20434 | 8139 | 17747 | 24873 | 12 |
| Lung cancer | Male | 17348 | 238 | 411 | 121 | 17586 | 17759 | 17 |
| Anxiety disorders | Male | 0 | 16888 | 24380 | 11291 | 16888 | 24380 | 11 |
| Chronic obstructive pulmonary disease | Male | 5605 | 10302 | 16528 | 5655 | 15907 | 22133 | 11 |
| Diabetes mellitus | Male | 8440 | 6526 | 9561 | 4265 | 14967 | 18002 | 12 |
| Hypertensive heart disease | Male | 11866 | 268 | 491 | 120 | 12134 | 12357 | 11 |
| Homicide | Male | 11903 | NA | NA | NA | 11903 | NA | |
| Asthma | Male | 1409 | 10463 | 16739 | 5641 | 11871 | 18148 | 7 |
| Lower respiratory infections | Male | 10657 | 513 | 786 | 311 | 11170 | 11443 | 10 |
| Poisonings | Male | 11035 | 70 | 176 | 12 | 11105 | 11210 | 11 |
| High blood pressure | Male | 0 | 10872 | 14946 | 7183 | 10872 | 14946 | 7 |
| Osteoarthritis | Male | 59 | 9384 | 14597 | 5661 | 9443 | 14656 | 5 |
| Bipolar affective disorder | Male | 0 | 7449 | 11473 | 4414 | 7449 | 11473 | 4 |
| Colon and rectum cancers | Male | 6478 | 421 | 680 | 250 | 6899 | 7158 | 6 |
| Ischemic stroke | Male | 0 | 5693 | 6885 | 4521 | 5693 | 6885 | 4 |
| Cocaine use disorders | Male | 0 | 4601 | 8347 | 2259 | 4601 | 8347 | 2 |
| Cocaine use disorders | Male | 0 | 4601 | 8347 | 2259 | 4601 | 8347 | 2 |
| Cannabis use disorders | Male | 0 | 4486 | 6858 | 2705 | 4486 | 6858 | 2 |
| Cannabis use disorders | Male | 0 | 4486 | 6858 | 2705 | 4486 | 6858 | 2 |
| Cerebrovascular disease | Male | 3085 | 1042 | 1250 | 834 | 4126 | 4334 | 3 |
| Congenital anomalies | Male | 3108 | 550 | 855 | 333 | 3658 | 3963 | 3 |
| Drug use disorders | Male | 1620 | 1512 | 2134 | 1006 | 3132 | 3755 | 2 |
| Motor vehicle accidents | Male | 2060 | 323 | 489 | 206 | 2383 | 2549 | 2 |
| Alzheimer's disease and other dementias | Male | 1280 | 832 | 1114 | 589 | 2112 | 2395 | 1 |
| Amphetamine use disorders | Male | 0 | 1711 | 2950 | 839 | 1711 | 2950 | |
| Amphetamine use disorders | Male | 0 | 1711 | 2950 | 839 | 1711 | 2950 | |




**2005 NYC DALY Estimates, Female**

| cause_name | sex | yll | yld | yld_upper | yld_lower | daly | daly_upper | daly_ |
|---|---|---|---|---|---|---|---|---|
| Ischemic heart disease | Female | 80652 | 8404 | 12182 | 5533 | 89056 | 92834 | |
| Major depressive disorder | Female | 0 | 54832 | 78719 | 35904 | 54832 | 78719 | |
| Other musculoskeletal disorders | Female | 2281 | 51790 | 60415 | 42969 | 54071 | 62696 | |
| Anxiety disorders | Female | 0 | 35163 | 50725 | 23660 | 35163 | 50725 | |
| Breast cancer | Female | 17147 | 3054 | 4732 | 1956 | 20201 | 21880 | |
| Chronic obstructive pulmonary disease | Female | 7154 | 11151 | 17530 | 6307 | 18305 | 24685 | |
| Osteoarthritis | Female | 90 | 17585 | 26605 | 10655 | 17674 | 26694 | |
| Diabetes mellitus | Female | 8982 | 8533 | 12301 | 5665 | 17514 | 21282 | |
| Asthma | Female | 1779 | 13844 | 22146 | 7499 | 15623 | 23925 | |
| Lung cancer | Female | 15336 | 247 | 472 | 104 | 15583 | 15808 | |
| Lower respiratory infections | Female | 13646 | 799 | 1196 | 498 | 14445 | 14841 | |
| Hypertensive heart disease | Female | 13407 | 567 | 1028 | 264 | 13974 | 14436 | |
| HIV/AIDS | Female | 11606 | 1995 | 3615 | 873 | 13601 | 15221 | |
| High blood pressure | Female | 0 | 12180 | 16136 | 8433 | 12180 | 16136 | |
| Bipolar affective disorder | Female | 0 | 9371 | 14254 | 5598 | 9371 | 14254 | |
| Colon and rectum cancers | Female | 8128 | 634 | 1095 | 368 | 8762 | 9223 | |
| Ischemic stroke | Female | 0 | 6556 | 7923 | 5231 | 6556 | 7923 | |
| Cerebrovascular disease | Female | 4961 | 1543 | 1844 | 1242 | 6504 | 6805 | |
| Drug use disorders | Female | 706 | 4719 | 6645 | 3197 | 5424 | 7351 | |
| Alzheimer's disease and other dementias | Female | 3172 | 2221 | 2946 | 1565 | 5393 | 6118 | |
| Poisonings | Female | 3988 | 18 | 54 | 1 | 4006 | 4042 | |
| Congenital anomalies | Female | 2751 | 562 | 886 | 339 | 3313 | 3637 | |
| Homicide | Female | 2760 | NA | NA | NA | 2760 | NA | |
| Alcohol use disorders | Female | 483 | 2202 | 3405 | 1310 | 2685 | 3888 | |
| Cannabis use disorders | Female | 0 | 2665 | 4032 | 1616 | 2665 | 4032 | |
| Cannabis use disorders | Female | 0 | 2665 | 4032 | 1616 | 2665 | 4032 | |
| Cocaine use disorders | Female | 0 | 2191 | 4138 | 1017 | 2191 | 4138 | |
| Cocaine use disorders | Female | 0 | 2191 | 4138 | 1017 | 2191 | 4138 | |
| Motor vehicle accidents | Female | 1074 | 189 | 287 | 119 | 1264 | 1361 | |
| Amphetamine use disorders | Female | 0 | 1062 | 1895 | 508 | 1062 | 1895 | |
| Amphetamine use disorders | Female | 0 | 1062 | 1895 | 508 | 1062 | 1895 | |


Leading Causes of DALYs in Females, NYC 2005
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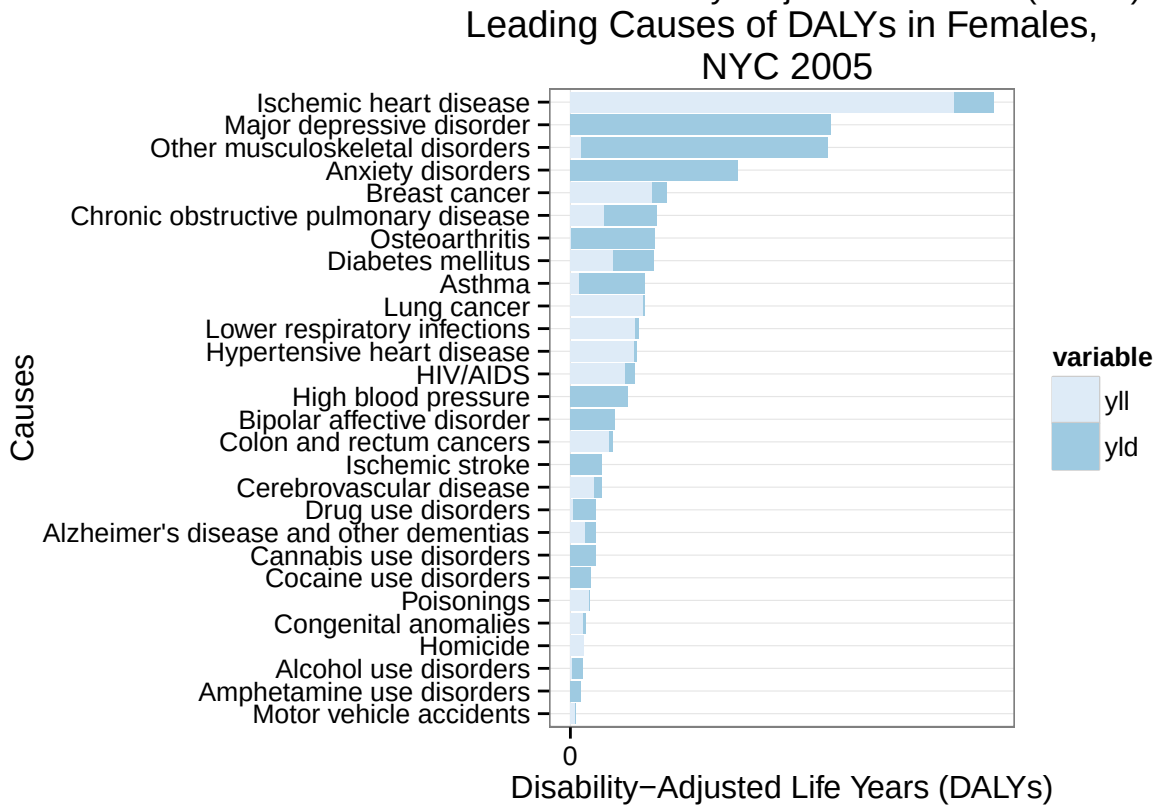
Major depressive disorder
Other musculoskeletal disorders
Anxiety disorders
Breast cancer
Chronic obstructive pulmonary disease
Osteoarthritis
Diabetes mellitus
Asthma
Lung cancer
Lower respiratory infections
Hypertensive heart disease
HIV/AIDS
High blood pressure
Bipolar affective disorder
Colon and rectum cancers
Ischemic stroke
Cerebrovascular disease
Drug use disorders
Alzheimer's disease and other dementias
Poisonings
Congenital anomalies
Homicide
Alcohol use disorders
Cannabis use disorders
Cocaine use disorders
Motor vehicle accidents
Amphetamine use disorders
Causes
0
Disability−Adjusted Life Years (DALYs)


Leading Causes of DALYs in Females, NYC 2005
Ischemic heart disease
Major depressive disorder
Other musculoskeletal disorders
Anxiety disorders
Breast cancer
Chronic obstructive pulmonary disease
Osteoarthritis
Diabetes mellitus
Asthma
Lung cancer
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Cerebrovascular disease
Drug use disorders
Alzheimer's disease and other dementias
Cannabis use disorders
Cocaine use disorders
Poisonings
Congenital anomalies
Homicide
Alcohol use disorders
Amphetamine use disorders
Motor vehicle accidents
Causes
0
Disability−Adjusted Life Years (DALYs)
variable
yll
yld

# Discussion

## Limitations

There are key limitations to this analysis. First and foremost, the magnitude of the DALY scores should be interpreted and reported with caution. Due to the small sample size of NYC prevalence estimates and the uncertainty around disability weights and national YLL/YLD rates for some conditions, DALY estimates can assume a wide range of values, changing how one condition ranks against the others (for example, `alcohol use disorders` and `diabetes mellitus`). For this reason, DALY magnitudes obtained via Michaud approach and the Prevalence-based YLDs cannot be directly compared.

Moreover, the accuracy of DALY estimations suffers from potential biases introduced in the data collection and computation processes. For example, comorbidities with respect to chronic diseases means that DALY estimates based on Vital Statistics mortality counts are overestimating the contribution of YLLs. Summation of prevalence YLDs across all causes can result in overestimation of the total average severity-weighted health state prevalence because of comorbidity between conditions (Mathers, 2006). Over-reporting of some conditions due to misclassification (e.g. where symptoms such as joint pain are labeled as osteoarthritis or occasional wheezing as asthma), under-reporting of undiagnosed conditions (e.g. most mental health problems), and lack of information on condition severity (resulting in high prevalences due to inclusion of very minor conditions or minor symptoms) may also contribute to biased DALY estimates.

In order to convey the uncertainty around our estimates, we visualize the range of values that NYC DALY estimates can take for each condition.

## Sensitivity Analysis

NYC DALY rankings and magnitudes using the Michaud approach are fairly consistent using both 2005 and 2013 NYC mortality counts. Moreover, the Michaud approach implemented in this analysis replicated the 2005 NYC DALY estimates from the previous NYC DOHMH study, producing comparable rankings. However, since age-weighting is no longer used due to ethical concerns, the 2013 NYC DALYs are slightly larger in magnitude. Recommendations for future work include running simulations to test the stability of DALY rankings for an even wider range of assumptions.

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