DOHMH Roadmap: DALY Estimates

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Contents

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%

Code

Preliminaries

First, we load our dependencies into the R environment.

```
library("plyr")
library("dplyr")
library("reshape2")
library("magrittr")
library("ggplot2")
library("grid")
library("scales")
dir.create("results")
dir.create("data")
```

Next, we define a set of functions that we will be using for our analysis. Details on the parameters and return values for each function can be found in the comment blocks below:

```
readData <- function(url) {
    ## Reads CSV data from input URL string
    filename <- tail(unlist(strsplit(url, "/")), 1)
    filepath <- paste("data", "/", filename, sep="")
    if (!file.exists(filepath)) {
    download.file(url, filename, method="curl")
    }
    data <- read.csv(filepath, stringsAsFactors=FALSE)
    return(data)
}

assignAgeGroup <- function(ageVar) {
    ## logic for childhood, teenage, young adult, adult, and later-life age groups
    if (ageVar %in% c("Under 5 years", "5-14 years")) {
        return("00-14")
    } else if (ageVar %in% c("15-19 years", "20-24 years")) {
        return("15-24")
    } else if (ageVar %in% c("25-29 years", "30-34 years", "35-39 years", "40-44 years")) {
        return("25-44")
    } else if (ageVar %in% c("45-49 years", "50-54 years", "55-59 years", "60-64 years")) {
        return("45-64")
    } else if (ageVar %in% c("65-69 years", "70+ years")) {
        return("65+")
    } else {
        return("")
    }
}

addAgeGroup <- function(data, ageVar="age_name") {
    ## replaces age grouping in current data.frame to childhood, teenage, YA, adult, later-life
    ## Args:
    ##      data: data.frame object
    ##      ageVar: string denoting the column of ages to be replaced
    ## Returns:
    ##      data: data.frame object with new age groupings
    ageGroup <- vector(length=nrow(data))
    for (i in 1:nrow(data)) {
        ageGroup[i] <- assignAgeGroup(as.vector(data[i, ageVar]))
    }
    data$ageGroup <- ageGroup
    return(data)
}

preprocessGBD <- function(data) {
    ## extracts YLD and YLL rates from 2010 Global Burden of Disase data
    ## Args:
    ##      data: GBD dataset downloaded from the web
    ## Returns:
    ##      data: a pre-processed 2010 GBD dataset
    data %<>%
        ## filter out unnecessary variables
```

```
        select(-c(pc_mean, pc_upper, pc_lower)) %>%
        filter(year == 2010) %>%
        filter(sex %in% c("Females", "Males")) %>%
        ## extract only YLD and YLL rates
        filter(measure %in% c("yll", "yld")) %>%
        ## create long-form dataset
        melt(measure.vars=c("nm_mean", "nm_upper", "nm_lower", "rt_mean", "rt_upper", "rt_lower")) %>%
        ## create wide-form dataset with national YLD/YLL rates
        dcast(cause_name + age_name + sex ~ measure + variable, value.var="value") %>%
        ## age group manipulations
        addAgeGroup("age_name") %>%
        filter(ageGroup != "") %>%
        select(-age_name) %>%
        ## averaging YLD/YLL rates with respect to new age groupings
        group_by(cause_name, sex, ageGroup) %>%
        summarise_each(funs(mean))
    return(data)
}

getDiseaseIndex <- function(diseaseName, data) {
    ## searches disease index and returns indices of the first match
    ## Args:
    ##      diseaseName: string vector denoting diseases of interest
    ##      data: data.frame to be searched
    ## Returns:
    ##      indices of the first string match
    index <- grep(diseaseName, data$cause_name)
    pattern <- unique(data$cause_name[index])[1]
    return(which(data$cause_name == pattern))
}

subsetDataByDisease <- function(diseaseName, data) {
    ## subsets data frame from first string match
    index <- getDiseaseIndex(diseaseName, data)
    return(data[index, ])
}
```

This function contains the logic from the Michaud, 2006 study.

```
calculateMichaudYLD <- function(checkRatio, yldyllRatio, nationalYLD, nycPop, nycYLL) {
    ## calculates YLDs based on the 2006 Michaud study
    ## Args:
    ##      checkRatio: numeric. National YLD:YLL ratio to check if > 10 or < 10
    ##      yldyllRatio: numeric. National YLD:YLL ratio to evaluate
    ##      nationalYLD: numeric. National YLD rate
    ##      nycPop: numeric. NYC Population
    ##      nycYLL: numeric. NYC YLL
    ## Returns:
    ##      nycYLD: New York City YLD estimate
    nycYLDLogic <- (checkRatio >= 10 | is.na(checkRatio) | is.infinite(checkRatio) | is.na(nycYLL))
    nycYLD <- ifelse(nycYLDLogic, nationalYLD * (nycPop / 100000), yldyllRatio * nycYLL)
    return(nycYLD)
}
```

This function implements prevalence-based YLD estimates.

```
calculatePrevalenceYLD <- function(nycPrevalence) {
   ## calculates prevalence-based YLD estimates from 2010 GBD Study
    ## Args:
    ##      nycPrevalence: data.frame. NYC prevalence data with associated disability weights
    ## Returns:
    ##      nycYLD: data.frame. NYC YLD estimates.
    nycYLD <- nycPrevalence %>%
        mutate(yld = prevalence * dependence_rate * dw_estimate,
               yld_upper = prevalence * dependence_rate * dw_upper,
               yld_lower = prevalence * dependence_rate * dw_lower)
    return(nycYLD)
}

calculateYLL <- function(mortalityData) {
    ## calculates YLLs from mortality data
    nycYLL <- mortalityData %>%
        mutate(le = sle - mean_age,
               yll = mortality * (1 - exp((-0.03 * le))) / 0.03)
    return(nycYLL)
}

calculatePrevalenceDALY <- function(diseaseName, nycYLL, nycYLD) {
    ## calculates DALYs using prevalence-based YLDs from the 2010 GBD study
    ## Args:
    ##      diseaseName: chr. The disease of interest.
    ##      nycYLL: data.frame. New York City YLL estimates
    ##      nycYLD: data.frame. New York City YLD estimates
    ## Returns:
    ##      dalys: data.frame. New York City DALY estimates
        diseaseYLL <- subsetDataByDisease(diseaseName, nycYLL)
        nycYLD <- subsetDataByDisease(diseaseName, nycYLD)
        dalys <- diseaseYLL %>%
            group_by(cause_name, sex) %>%
            summarize(yll = sum(yll)) %>%
            join(nycYLD, c("cause_name", "sex"), type = "right") %>%
            ungroup() %>%
            mutate(daly = ifelse(is.na(yll), 0 + yld, yll + yld),
                   daly_upper = ifelse(is.na(yll), 0 + yld_upper, yll + yld_upper),
                   daly_lower = ifelse(is.na(yll), 0 + yld_lower, yll + yld_lower))
        return(dalys)
}

calculateDALY <- function(diseaseName, population, nycYLL, nycYLD=NULL, nationalRates=NULL) {
    ## workhorse function to calculate DALY scores for specified disease using either
    ## prevalence-based YLD estimates or the Michaud approach using national YLD/YLL rates
    diseaseYLL <- subsetDataByDisease(diseaseName, nycYLL)
    if (!is.null(nycYLD) & !is.null(nationalRates)) {
        stop("You cannot provide values to both nycYLD and nationalRates parameters.")

    } else if (!is.null(nycYLD)) {
        nycYLD <- subsetDataByDisease(diseaseName, nycYLD)
```

```
        dalys <- calculatePrevalenceDALY(diseaseName, nycYLL, nycYLD)
        return(dalys)

    } else if (!is.null(nationalRates)) {
        ## subset datasets for specified disease
        diseaseRates <- subsetDataByDisease(diseaseName, nationalRates)
        ## if disease not found in gbdData, return YLL data as DALYs
        if (nrow(diseaseRates) == 0) {
            dalys <- diseaseYLL %>%
                group_by(cause_name, sex) %>%
                summarize(yll = sum(yll),
                          daly = sum(yll))
            return(dalys)
        }
        ## compute national YLD:YLL ratio and join to NYC YLL and population data by age, sex
        dalys <- diseaseRates %>%
            ## compute national YLD:YLL ratio
            mutate(yldyll_ratio_mean = yld_nm_mean / yll_nm_mean,
                   yldyll_ratio_upper = yld_nm_upper / yll_nm_mean,
                   yldyll_ratio_lower = yld_nm_lower / yll_nm_mean) %>%
            # join tables
            join(population, by=c("ageGroup", "sex")) %>%
            join(diseaseYLL, by=c("cause_name", "ageGroup", "sex")) %>%
            ## estimate YLDs using Michaud logic
            mutate(yld = calculateMichaudYLD(yldyll_ratio_mean, yldyll_ratio_mean, yld_rt_mean, populati
                   yld_upper = calculateMichaudYLD(yldyll_ratio_mean, yldyll_ratio_upper, yld_rt_upper,
                   yld_lower = calculateMichaudYLD(yldyll_ratio_mean, yldyll_ratio_lower, yld_rt_lower,
            ## collapse age groups
            group_by(cause_name, sex) %>%
            summarise_each(funs(sum(., na.rm=TRUE)), -c(cause_name, sex, ageGroup)) %>%
            ## calculate DALY estimates with lower and upper bounds
            mutate(daly = yll + yld,
                   daly_upper = yll + yld_upper,
                   daly_lower = yll + yld_lower) %>%
            select(cause_name, sex, yll, yld, yld_upper, yld_lower, daly, daly_upper, daly_lower)
        return(dalys)
    }
}

segmentDALY <- function(dalyObj, strata) {
    ## helper function to subset DALY data
    if (strata == "total") {
        dalyObj %>% group_by(cause_name) %>% summarise_each(funs(sum), -c(sex)) %>% arrange(desc(daly))
    } else if (strata == "male") {
        dalyObj %>% filter(sex == "Male") %>% arrange(desc(daly))
    } else if (strata == "female") {
        dalyObj %>% filter(sex == "Female") %>% arrange(desc(daly))
    }
}

# Multiple plot function
#
# ggplot objects can be passed in ..., or to plotlist (as a list of ggplot objects)
# - cols:   Number of columns in layout
```

```
# - layout: A matrix specifying the layout. If present, 'cols' is ignored.
#
# If the layout is something like matrix(c(1,2,3,3), nrow=2, byrow=TRUE),
# then plot 1 will go in the upper left, 2 will go in the upper right, and
# 3 will go all the way across the bottom.
#
multiplot <- function(..., plotlist=NULL, file, cols=1, layout=NULL) {
  library(grid)

  # Make a list from the ... arguments and plotlist
  plots <- c(list(...), plotlist)

  numPlots = length(plots)

  # If layout is NULL, then use 'cols' to determine layout
  if (is.null(layout)) {
    # Make the panel
    # ncol: Number of columns of plots
    # nrow: Number of rows needed, calculated from # of cols
    layout <- matrix(seq(1, cols * ceiling(numPlots/cols)),
                     ncol = cols, nrow = ceiling(numPlots/cols))
  }

 if (numPlots==1) {
    print(plots[[1]])

  } else {
    # Set up the page
    grid.newpage()
    pushViewport(viewport(layout = grid.layout(nrow(layout), ncol(layout))))

    # Make each plot, in the correct location
    for (i in 1:numPlots) {
      # Get the i,j matrix positions of the regions that contain this subplot
      matchidx <- as.data.frame(which(layout == i, arr.ind = TRUE))

      print(plots[[i]], vp = viewport(layout.pos.row = matchidx$row,
                                      layout.pos.col = matchidx$col))
    }
  }
}

plotDALY <- function(data, title, stackedBar=FALSE) {
    ## plot function for DALY object
    if (stackedBar) {
        meltedData <- melt(data, id.vars="cause_name", measure.vars=c("yll", "yld"), value.name="daly")
        ggplot(meltedData, aes(x=reorder(cause_name, daly, FUN=sum, na.rm=TRUE), y=daly, fill=variable))
            geom_bar(stat="identity") +
            ggtitle(title) +
            ylab("Disability-Adjusted Life Years (DALYs)") + xlab("Causes") +
            scale_y_continuous(breaks=seq(0, max(data$daly_upper, na.rm=TRUE), by=100000), labels=comma)
            scale_fill_brewer() +
            coord_flip() +
            theme_bw()
```

```
    } else {
        limits <- aes(ymin=daly_lower, ymax=daly_upper)
        ggplot(data, aes(x=reorder(cause_name, daly), y=daly)) +
            geom_pointrange(limits) +
            ggtitle(title) +
            ylab("Disability-Adjusted Life Years (DALYs)") + xlab("Causes") +
            scale_y_continuous(breaks=seq(0, max(data$daly_upper, na.rm=TRUE), by=100000), labels=comma
            coord_flip() +
            theme_bw()
    }
}
```

Reading in the Data

To make our analysis reproducible, we download the 2010 Global Burden of Disease data straight from the source using the `readData()` function.

```
url <- "http://ghdx.healthdata.org/sites/default/files/record-attached-files/IHME_USA_GBD_2010_RESULTS_
cause <- readData(url) %>%
    preprocessGBD()

url <- "http://ghdx.healthdata.org/sites/default/files/record-attached-files/IHME_USA_GBD_2010_RESULTS_
risk <- readData(url) %>%
    rename(cause_name = risk_name) %>%
    preprocessGBD()
```

Next, we read in the mortality, population, and prevalence data provided by NYCDOHMH.

```
mortality <- read.csv("data/2013_nyc_mortality.csv", stringsAsFactors=FALSE)
population <- read.csv("data/2013_nyc_population.csv", stringsAsFactors=FALSE)
prevalence <- read.csv("data/2013_nyc_prevalence.csv", stringsAsFactors=FALSE)
```

Data Preparation

We pre-process the national YLD/YLL rates by substituting values for `cause_name` in order to match the indices of the other datasets. This will allow us to merge datasets using `cause_name` as the key. We also write out the resulting dataset for inspection.

```
nationalRates <- rbind(cause, risk) %>%
    ungroup() %>%
    mutate(sex = ifelse(sex == "Females", "Female", "Male")) %>%
    mutate(cause_name = ifelse(cause_name == "Road injury", "Motor vehicle accidents", cause_name),
           cause_name = ifelse(cause_name == "Trachea, bronchus, and lung cancers", "Lung cancer", caus
    arrange(cause_name)
write.csv(nationalRates, "results/national_yldyll_rates.csv")
```

Next, we pre-process the NYC mortality and calculate the YLLs for each disease by age, sex, and race. For the analysis, we only use YLLs stratified by age and sex.

```
nycYLL <- calculateYLL(mortality)
write.csv(nycYLL, "results/nyc_yll_by_age_sex_race.csv")
```

```
nycYLL %<>%
    group_by(cause_name, sex, ageGroup) %>%
    summarize(yll = sum(yll))
write.csv(nycYLL, "results/nyc_yll_by_age_sex.csv")
```

We calculate YLDs for each condition using NYC prevalence data, which also contains the associated disability weights for each disease. To capture the level of uncertainty around disability weights, we include the upper and lower bounds of the resulting YLDs in the output.

```
nycYLD <- calculatePrevalenceYLD(prevalence)
write.csv(nycYLD, "results/nyc_yld_by_age_sex.csv")

nycYLD %<>%
    group_by(cause_name, sex) %>%
    summarize(yld = sum(yld, na.rm=TRUE),
              yld_upper = sum(yld_upper, na.rm=TRUE),
              yld_lower = sum(yld_lower, na.rm=TRUE))
write.csv(nycYLD, "results/nyc_yld_by_sex.csv")
```

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.

```
## create a search index
disease <- unique(c(nycYLL$cause_name, nycYLD$cause_name))
drug <- c("Amphetamine", "Heroin", "Cocaine", "Cannabis")
mental <- c("Major depressive disorder", "Anxiety", "Bipolar")
index <- unique(c(disease, drug, mental))
```

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`.

```
michaudDALY <- lapply(index, calculateDALY, population, nycYLL=nycYLL, nationalRates=nationalRates)
michaudDALY <- do.call(rbind.fill, michaudDALY)
write.csv(michaudDALY, "results/nyc_daly_michaud.csv")
```

Prevalence-Based YLD Approach

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

```
prevalenceDALY <- lapply(index, calculateDALY, population, nycYLL=nycYLL, nycYLD=nycYLD)
prevalenceDALY <- do.call(rbind.fill, prevalenceDALY)
write.csv(prevalenceDALY, "results/nyc_daly_prevalence.csv")
```

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.

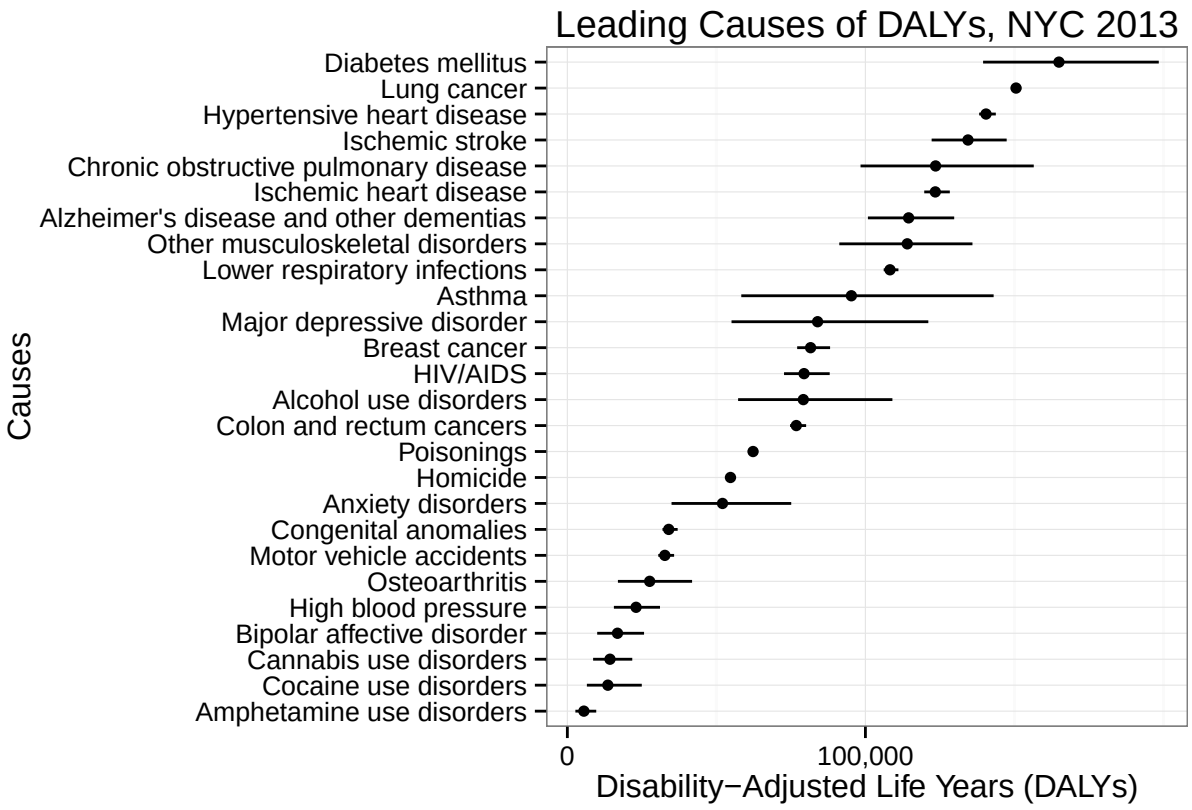
2013 NYC DALY Estimates, Total

```
michaudTotal <- segmentDALY(michaudDALY, strata="total")
michaudTotal
```

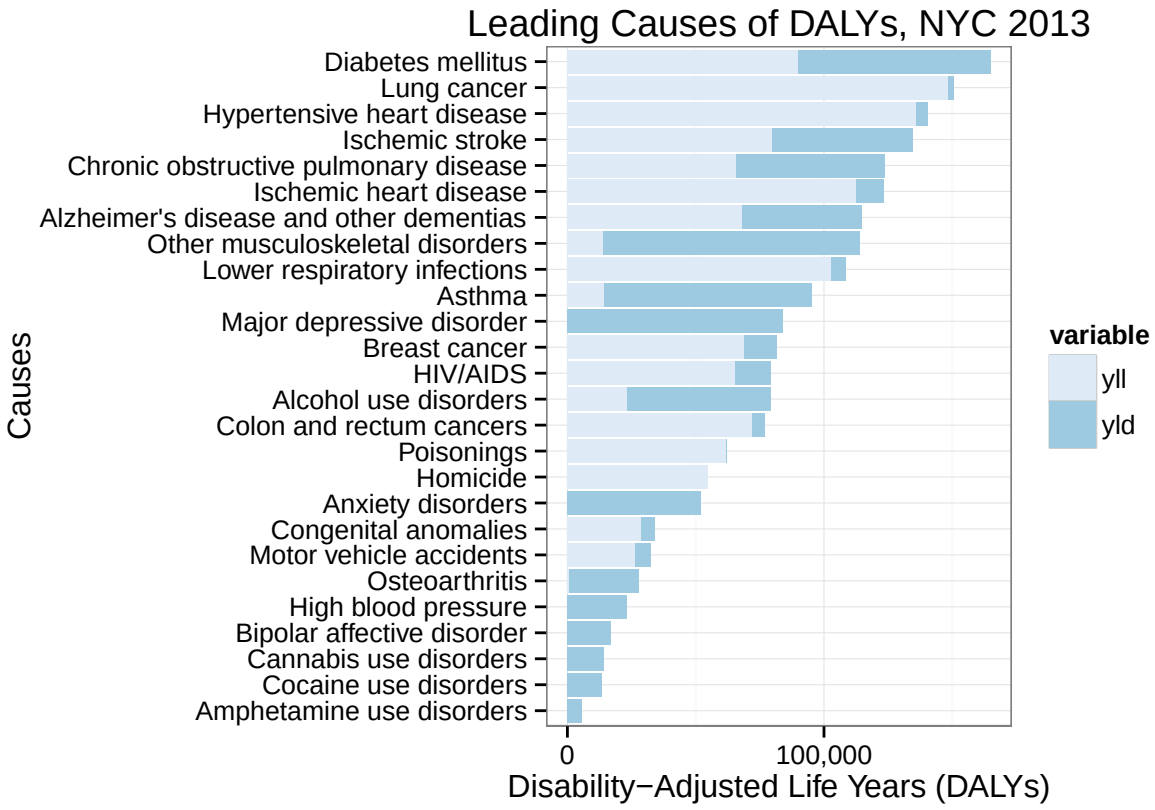
```
##                                cause_name         yll        yld
## 1                      Diabetes mellitus  89921.8593 75004.5038
## 2                            Lung cancer 148291.6356  2242.9612
## 3           Hypertensive heart disease 136003.5344  4455.7610
## 4                        Ischemic stroke  79787.1576 54618.9896
## 5  Chronic obstructive pulmonary disease  65616.6564 57924.3517
## 6                Ischemic heart disease 112699.3626 10745.5490
## 7  Alzheimer's disease and other dementias  68064.1642 46430.6034
## 8        Other musculoskeletal disorders  14183.9916 99856.4516
## 9           Lower respiratory infections 102769.2461  5474.2794
## 10                               Asthma  14317.4262 80967.8293
## 11            Major depressive disorder      0.0000 83953.4440
## 12                        Breast cancer  68867.0554 12738.7979
## 13                             HIV/AIDS  65584.2354 13821.0196
## 14                Alcohol use disorders  23367.4429 55797.8826
## 15             Colon and rectum cancers  71883.4068  4926.7991
## 16                           Poisonings  61951.4430   345.3933
## 17                             Homicide  54727.1791         NA
## 18                    Anxiety disorders      0.0000 52051.1850
## 19                Congenital anomalies  28760.0643  5247.0472
## 20              Motor vehicle accidents  26587.8134  6120.9172
## 21                        Osteoarthritis   643.1706 26968.3798
## 22                   High blood pressure      0.0000 23051.4893
## 23           Bipolar affective disorder      0.0000 16820.2498
## 24               Cannabis use disorders      0.0000 14302.9941
## 25                Cocaine use disorders      0.0000 13584.4544
## 26             Amphetamine use disorders      0.0000  5546.6613
##      yld_upper   yld_lower       daly daly_upper daly_lower
## 1  108498.2802 49557.68891 164926.363 198420.140 139479.548
## 2    3954.0205  1054.45769 150534.597 152245.656 149346.093
## 3    7743.7734  2146.86933 140459.295 143747.308 138150.404
## 4   67602.9376 42427.48230 134406.147 147390.095 122214.640
## 5   90860.6617 32740.18649 123541.008 156477.318  98356.843
## 6   15616.1724  7032.87825 123444.912 128315.535 119732.241
## 7   61713.3788 32776.61067 114494.768 129777.543 100840.775
## 8  121723.6960 77041.06298 114040.443 135907.688  91225.055
## 9    8303.9475  3354.63057 108243.525 111073.194 106123.877
## 10 128691.7057 44033.85664  95285.256 143009.132  58351.283
## 11 121099.5658 55076.00007  83953.444 121099.566  55076.000
## 12  19278.9232  8233.44871  81605.853  88145.979  77100.504
```

```
## 13  22434.1402  7110.37787  79405.255  88018.376  72694.613
## 14  85682.7067 33915.45149  79165.325 109050.150  57282.894
## 15   8225.5483  2835.32887  76810.206  80108.955  74718.736
## 16    912.0096    48.92806  62296.836  62863.453  62000.371
## 17          NA          NA  54727.179         NA         NA
## 18  75104.5772 34951.04848  52051.185  75104.577  34951.048
## 19   8241.7517  3153.12659  34007.112  37001.816  31913.191
## 20   9229.5870  3914.37900  32708.731  35817.400  30502.192
## 21  41201.1994 16315.88023  27611.550  41844.370  16959.051
## 22  31082.1570 15615.43900  23051.489  31082.157  15615.439
## 23  25727.1579 10011.62505  16820.250  25727.158  10011.625
## 24  21780.4478  8642.25054  14302.994  21780.448   8642.251
## 25  24968.4984  6553.68863  13584.454  24968.498   6553.689
## 26   9689.3818  2694.25267   5546.661   9689.382   2694.253
```

```
plotDALY(michaudTotal, "Leading Causes of DALYs, NYC 2013")
```




```
plotDALY(michaudTotal, "Leading Causes of DALYs, NYC 2013", stackedBar=TRUE)
```



- `Diabetes mellitus` 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

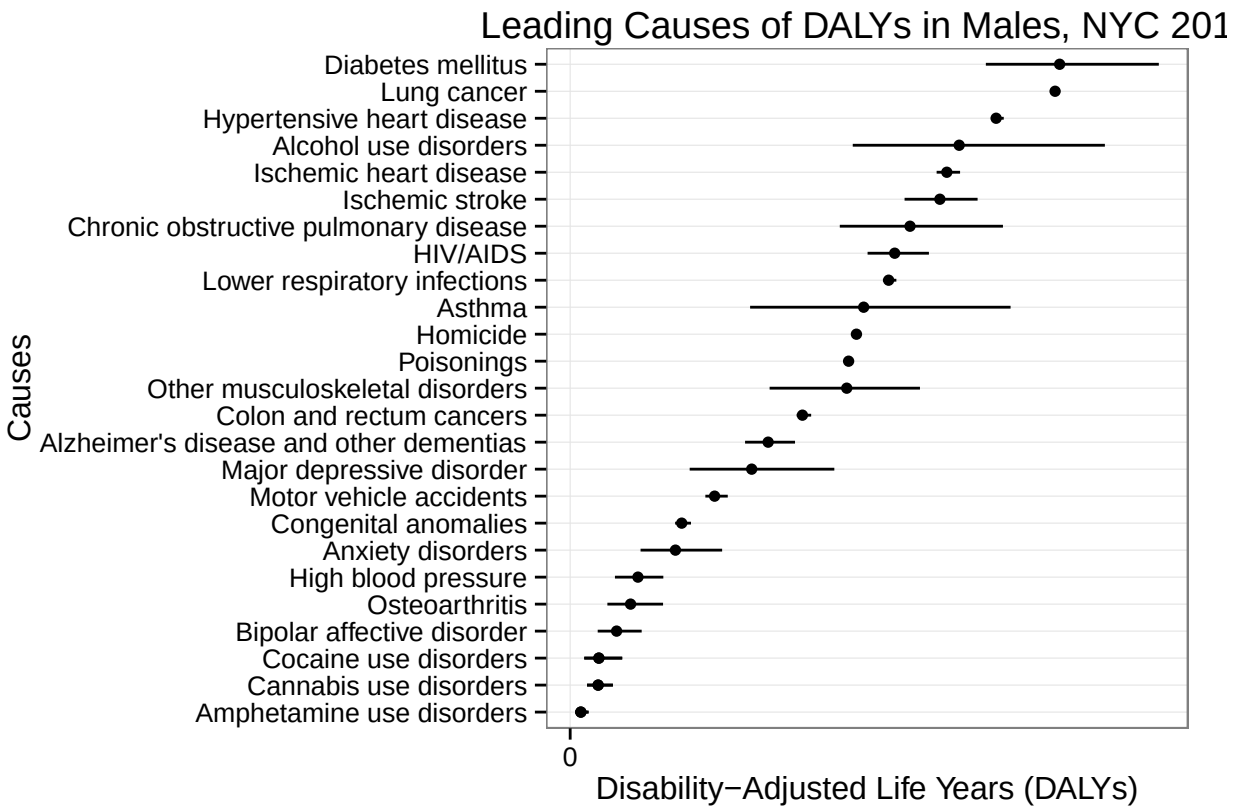
2013 NYC DALY Estimates, Male

```
michaudMale <- segmentDALY(michaudDALY, strata="male")
michaudMale
```

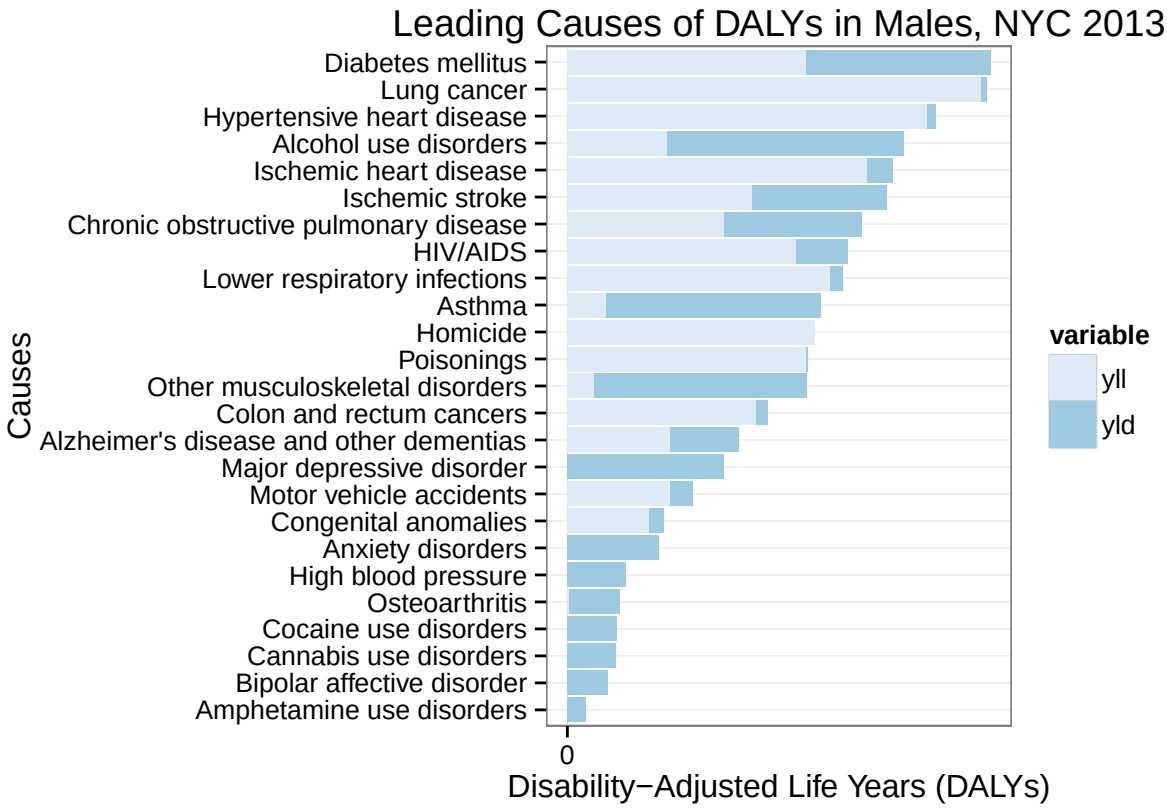
```
##                                cause_name  sex        yll        yld
## 1                       Diabetes mellitus Male 44350.2597 34179.2699
## 2                             Lung cancer Male 76727.5088  1073.4292
## 3                 Hypertensive heart disease Male 66787.3957  1551.5667
## 4                      Alcohol use disorders Male 18467.5988 43944.2346
## 5                    Ischemic heart disease Male 55740.9066  4685.5329
## 6                           Ischemic stroke Male 34381.1722 24933.7621
## 7    Chronic obstructive pulmonary disease Male 29087.5511 25436.1167
## 8                                  HIV/AIDS Male 42537.5495  9527.5167
## 9              Lower respiratory infections Male 48779.8376  2313.7384
## 10                                   Asthma Male  7320.0714 39768.0782
## 11                                  Homicide Male 45926.7164         NA
## 12                                Poisonings Male 44405.4957   264.4099
## 13         Other musculoskeletal disorders Male  4854.9161 39516.5937
## 14                 Colon and rectum cancers Male 35103.8723  2158.4156
## 15 Alzheimer's disease and other dementias Male 19116.5536 12644.7087
## 16                Major depressive disorder Male     0.0000 29121.7638
## 17                  Motor vehicle accidents Male 19023.4258  4148.8107
```

```
## 18                    Congenital anomalies Male 15210.3239  2684.3674
## 19                       Anxiety disorders Male     0.0000 16888.1881
## 20                     High blood pressure Male     0.0000 10871.5697
## 21                          Osteoarthritis Male   307.6397  9383.8038
## 22                Bipolar affective disorder Male     0.0000  7448.7748
## 23                     Cocaine use disorders Male     0.0000  4600.9626
## 24                     Cocaine use disorders Male     0.0000  4600.9626
## 25                    Cannabis use disorders Male     0.0000  4486.3505
## 26                    Cannabis use disorders Male     0.0000  4486.3505
## 27                  Amphetamine use disorders Male     0.0000  1711.4472
## 28                  Amphetamine use disorders Male     0.0000  1711.4472
##     yld_upper   yld_lower      daly daly_upper daly_lower
## 1  50092.6831 22339.66951 78529.530  94442.943 66689.9292
## 2   1835.5390   552.42866 77800.938  78563.048 77279.9374
## 3   2772.9602   726.84613 68338.962  69560.356 67514.2418
## 4  67319.8291 26869.84596 62411.833  85787.428 45337.4447
## 5   6813.3881  3052.60257 60426.439  62554.295 58793.5092
## 6  30985.2622 19269.71803 59314.934  65366.434 53650.8903
## 7  40347.4100 14170.01592 54523.668  69434.961 43257.5671
## 8  15020.5207  5179.74703 52065.066  57558.070 47717.2966
## 9   3550.9975  1397.14831 51093.576  52330.835 50176.9859
## 10 63336.0811 21549.29019 47088.150  70656.153 28869.3616
## 11         NA          NA 45926.716         NA         NA
## 12   670.9745    43.52524 44669.906  45076.470 44449.0209
## 13 51263.2757 27139.66096 44371.510  56118.192 31994.5771
## 14  3558.7848  1248.81817 37262.288  38662.657 36352.6905
## 15 16956.4678  8941.37768 31761.262  36073.021 28057.9313
## 16 42380.4459 19171.86261 29121.764  42380.446 19171.8626
## 17  6260.4445  2667.35247 23172.236  25283.870 21690.7782
## 18  4172.2215  1627.16383 17894.691  19382.545 16837.4878
## 19 24380.0577 11291.23403 16888.188  24380.058 11291.2340
## 20 14945.9569  7182.75016 10871.570  14945.957  7182.7502
## 21 14596.6142  5660.76344  9691.444  14904.254  5968.4032
## 22 11473.0601  4413.85914  7448.775  11473.060  4413.8591
## 23  8346.6274  2259.42317  4600.963   8346.627  2259.4232
## 24  8346.6274  2259.42317  4600.963   8346.627  2259.4232
## 25  6858.2744  2705.22634  4486.351   6858.274  2705.2263
## 26  6858.2744  2705.22634  4486.351   6858.274  2705.2263
## 27  2949.7666   839.42626  1711.447   2949.767   839.4263
## 28  2949.7666   839.42626  1711.447   2949.767   839.4263
```

```
plotDALY(michaudMale, "Leading Causes of DALYs in Males, NYC 2013")
```




```
plotDALY(michaudMale, "Leading Causes of DALYs in Males, NYC 2013", stackedBar=TRUE)
```



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

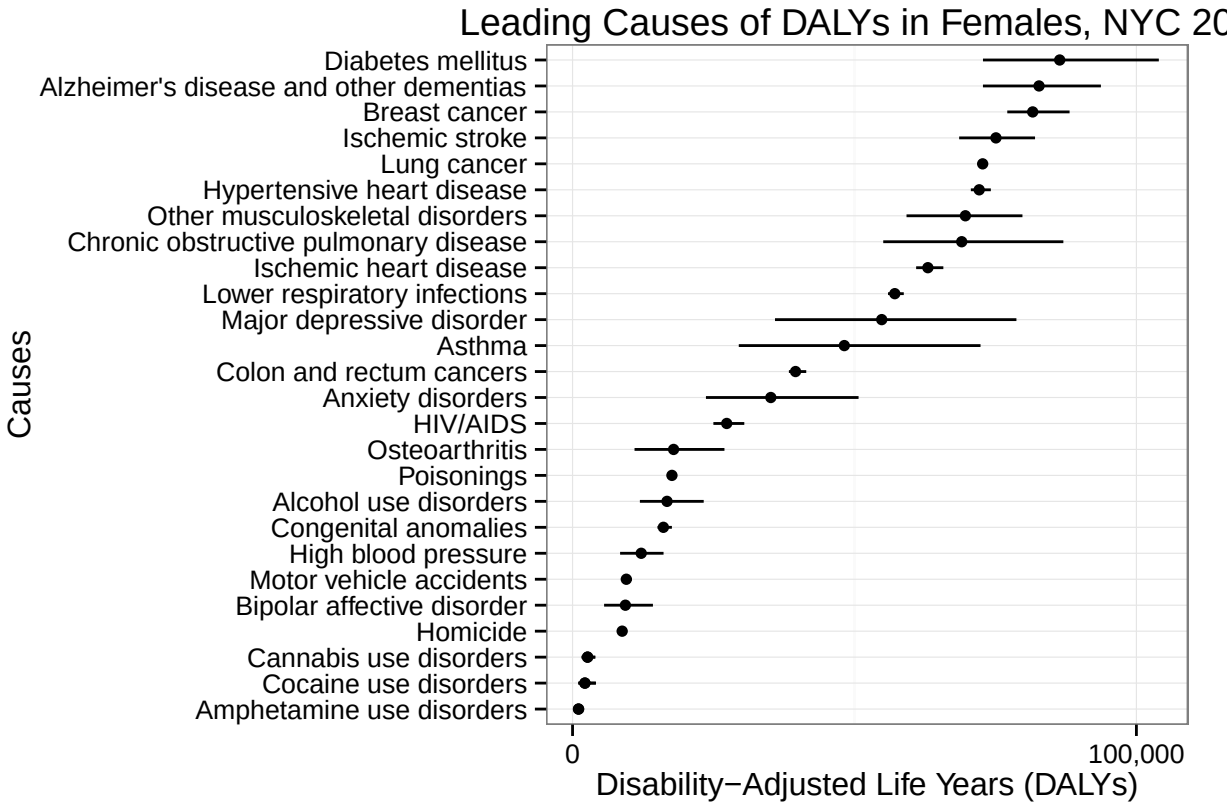
2013 NYC DALY Estimates, Female

```
michaudFemale <- segmentDALY(michaudDALY, strata="female")
michaudFemale
```

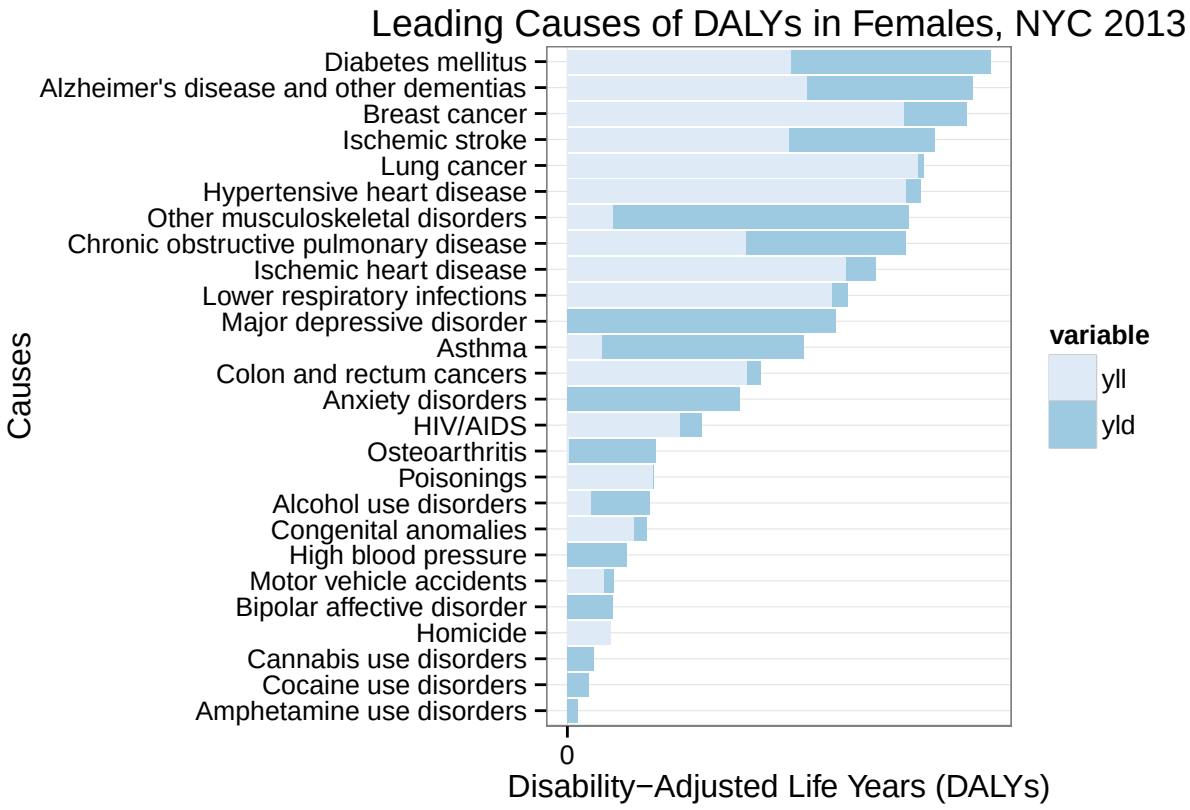
```
##                                cause_name    sex        yll         yld
## 1                          Diabetes mellitus Female 45571.5997 40825.23391
## 2  Alzheimer's disease and other dementias Female 48947.6106 33785.89475
## 3                             Breast cancer Female 68867.0554 12738.79793
## 4                           Ischemic stroke Female 45405.9854 29685.22751
## 5                              Lung cancer Female 71564.1269  1169.53195
## 6               Hypertensive heart disease Female 69216.1387  2904.19435
## 7          Other musculoskeletal disorders Female  9329.0754 60339.85786
## 8    Chronic obstructive pulmonary disease Female 36529.1052 32488.23499
## 9                    Ischemic heart disease Female 56958.4560  6060.01617
## 10            Lower respiratory infections Female 53989.4085  3160.54100
## 11               Major depressive disorder Female     0.0000 54831.68020
## 12                                  Asthma Female  6997.3548 41199.75113
## 13               Colon and rectum cancers Female 36779.5345  2768.38346
## 14                      Anxiety disorders Female     0.0000 35162.99685
## 15                                HIV/AIDS Female 23046.6859  4293.50298
## 16                           Osteoarthritis Female   335.5308 17584.57596
## 17                               Poisonings Female 17545.9474    80.98334
## 18                   Alcohol use disorders Female  4899.8441 11853.64796
## 19                    Congenital anomalies Female 13549.7404  2562.67983
## 20                     High blood pressure Female     0.0000 12179.91963
## 21                 Motor vehicle accidents Female  7564.3877  1972.10646
## 22              Bipolar affective disorder Female     0.0000  9371.47498
## 23                                Homicide Female  8800.4627          NA
## 24                   Cannabis use disorders Female     0.0000  2665.14650
## 25                   Cannabis use disorders Female     0.0000  2665.14650
## 26                    Cocaine use disorders Female     0.0000  2191.26455
## 27                    Cocaine use disorders Female     0.0000  2191.26455
## 28                Amphetamine use disorders Female     0.0000  1061.88339
## 29                Amphetamine use disorders Female     0.0000  1061.88339
##     yld_upper    yld_lower      daly daly_upper daly_lower
## 1  58405.5971 27218.019398 86396.834 103977.197 72789.6191
## 2  44756.9110 23835.232988 82733.505  93704.522 72782.8436
## 3  19278.9232  8233.448706 81605.853  88145.979 77100.5041
## 4  36617.6754 23157.764263 75091.213  82023.661 68563.7496
## 5   2118.4816   502.029026 72733.659  73682.608 72066.1559
## 6   4970.8132  1420.023201 72120.333  74186.952 70636.1619
## 7  70460.4202 49901.402016 69668.933  79789.496 59230.4774
## 8  50513.2517 18570.170568 69017.340  87042.357 55099.2758
## 9   8802.7843  3980.275681 63018.472  65761.240 60938.7317
## 10  4752.9500  1957.482259 57149.949  58742.358 55946.8907
## 11 78719.1199 35904.137465 54831.680  78719.120 35904.1375
## 12 65355.6246 22484.566452 48197.106  72352.979 29481.9213
## 13  4666.7635  1586.510706 39547.918  41446.298 38366.0452
## 14 50724.5194 23659.814445 35162.997  50724.519 23659.8144
```

```
## 15  7413.6195  1930.630841 27340.189  30460.305 24977.3167
## 16 26604.5852 10655.116785 17920.107  26940.116 10990.6476
## 17   241.0352     5.402819 17626.931  17786.983 17551.3502
## 18 18362.8776  7045.605530 16753.492  23262.722 11945.4497
## 19  4069.5302  1525.962762 16112.420  17619.271 15075.7031
## 20 16136.2000  8432.688834 12179.920  16136.200  8432.6888
## 21  2969.1424  1247.026528  9536.494  10533.530  8811.4142
## 22 14254.0978  5597.765905  9371.475  14254.098  5597.7659
## 23         NA           NA  8800.463         NA         NA
## 24  4031.9495  1615.898924  2665.147   4031.950  1615.8989
## 25  4031.9495  1615.898924  2665.147   4031.950  1615.8989
## 26  4137.6218  1017.421149  2191.265   4137.622  1017.4211
## 27  4137.6218  1017.421149  2191.265   4137.622  1017.4211
## 28  1894.9243   507.700071  1061.883   1894.924   507.7001
## 29  1894.9243   507.700071  1061.883   1894.924   507.7001
```

```
plotDALY(michaudFemale, "Leading Causes of DALYs in Females, NYC 2013")
```




```
plotDALY(michaudFemale, "Leading Causes of DALYs in Females, NYC 2013", stackedBar=TRUE)
```



- `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

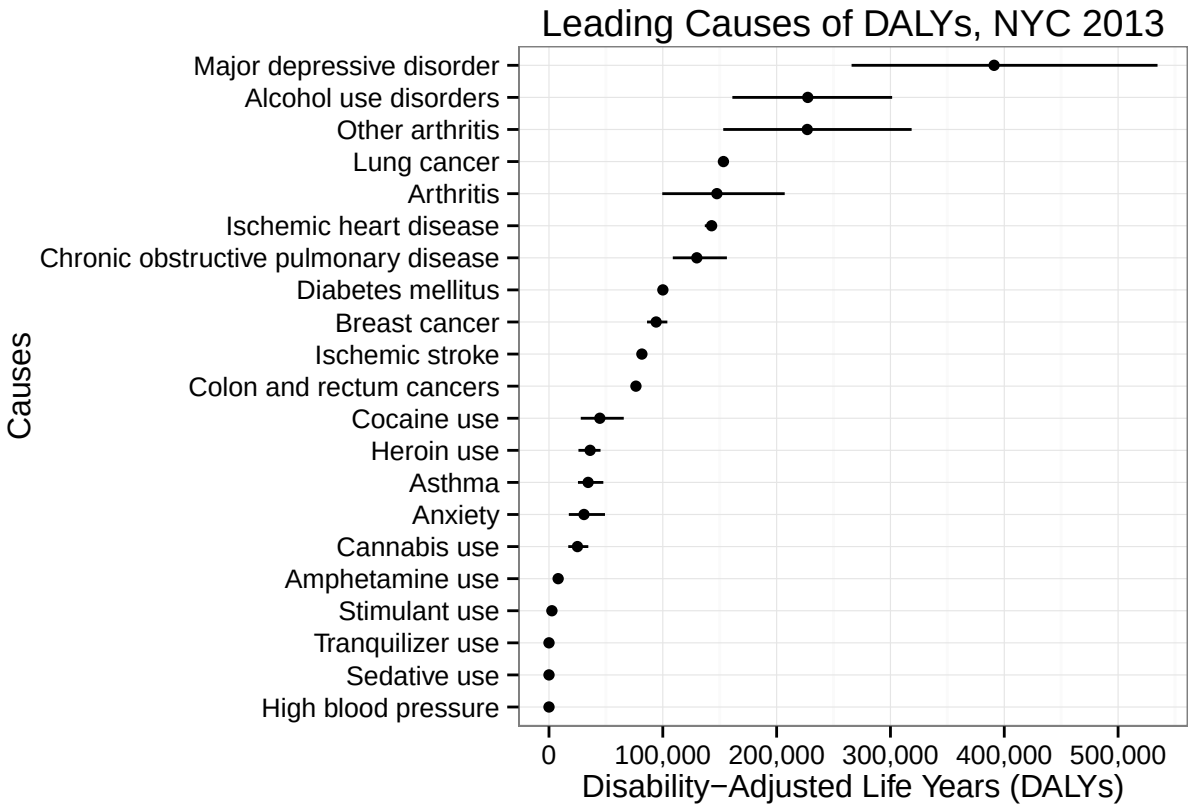
```
prevalenceTotal <- segmentDALY(prevalenceDALY, strata="total")
prevalenceTotal
```

```
##                                cause_name       yll        yld  yld_upper
## 1              Major depressive disorder        NA 391052.610 534646.723
## 2                  Alcohol use disorders  23367.44 203982.931 278110.749
## 3                        Other arthritis        NA 226917.872 318617.560
## 4                           Lung cancer 148321.18   4937.436   6902.334
## 5                             Arthritis        NA 147503.216 207110.680
## 6                 Ischemic heart disease 112699.36  30185.820  34498.080
## 7  Chronic obstructive pulmonary disease  65616.66  64252.608  90689.879
## 8                       Diabetes mellitus  89921.86  10119.135  12142.962
## 9                           Breast cancer  69366.71  24768.618  34625.517
## 10                        Ischemic stroke  79787.16   1819.986   3206.642
```

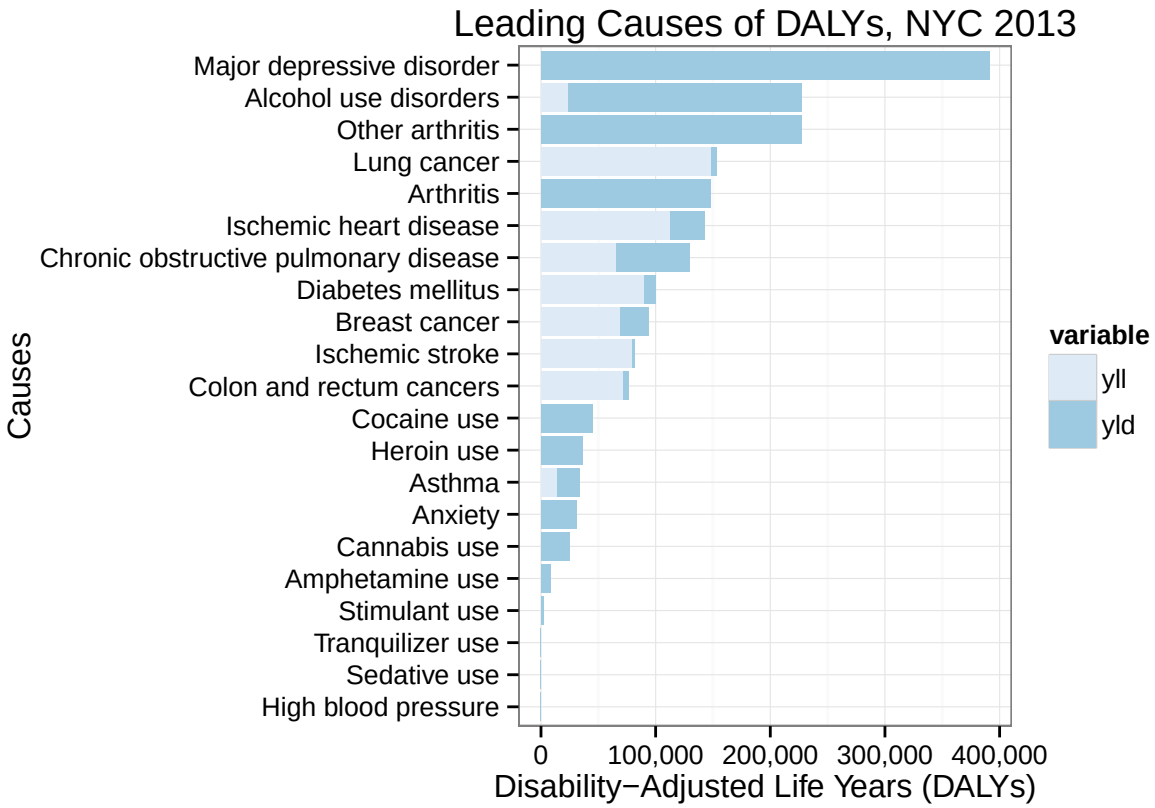
```
## 11              Colon and rectum cancers  71913.23   4471.446   6250.899
## 12                           Cocaine use        NA  44665.457  65691.483
## 13                            Heroin use        NA  36138.504  45271.793
## 14                                Asthma  14317.43  20058.084  33430.140
## 15                               Anxiety        NA  30752.130  49203.408
## 16                           Cannabis use        NA  24990.840  34561.800
## 17                        Amphetamine use        NA   8049.876  11972.195
## 18                          Stimulant use        NA   2548.660   3790.500
## 19                   High blood pressure        NA      0.000      0.000
## 20                          Sedative use        NA      0.000      0.000
## 21                       Tranquilizer use        NA      0.000      0.000
##     yld_lower       daly daly_upper daly_lower
## 1  265843.756 391052.610  534646.72 265843.756
## 2  137741.051 227350.374  301478.19 161108.494
## 3  153091.852 226917.872  318617.56 153091.852
## 4    3342.006 153258.618  155223.52 151663.188
## 5   99514.156 147503.216  207110.68  99514.156
## 6   24196.570 142885.183  147197.44 136895.933
## 7   43169.721 129869.264  156306.54 108786.377
## 8    8095.308 100040.994  102064.82  98017.167
## 9   16765.153  94135.331  103992.23  86131.866
## 10    953.326  81607.144   82993.80  80740.484
## 11   3026.591  76384.673   78164.13  74939.818
## 12  27915.910  44665.457   65691.48  27915.910
## 13  25877.650  36138.504   45271.79  25877.650
## 14  11143.380  34375.510   47747.57  25460.806
## 15  17426.207  30752.130   49203.41  17426.207
## 16  16939.080  24990.840   34561.80  16939.080
## 17   4902.899   8049.876   11972.19   4902.899
## 18   1552.300   2548.660    3790.50   1552.300
## 19      0.000      0.000       0.00      0.000
## 20      0.000      0.000       0.00      0.000
## 21      0.000      0.000       0.00      0.000
```

- `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`.

```
plotDALY(prevalenceTotal, "Leading Causes of DALYs, NYC 2013")
```




```
plotDALY(prevalenceTotal, "Leading Causes of DALYs, NYC 2013", stackedBar=TRUE)
```



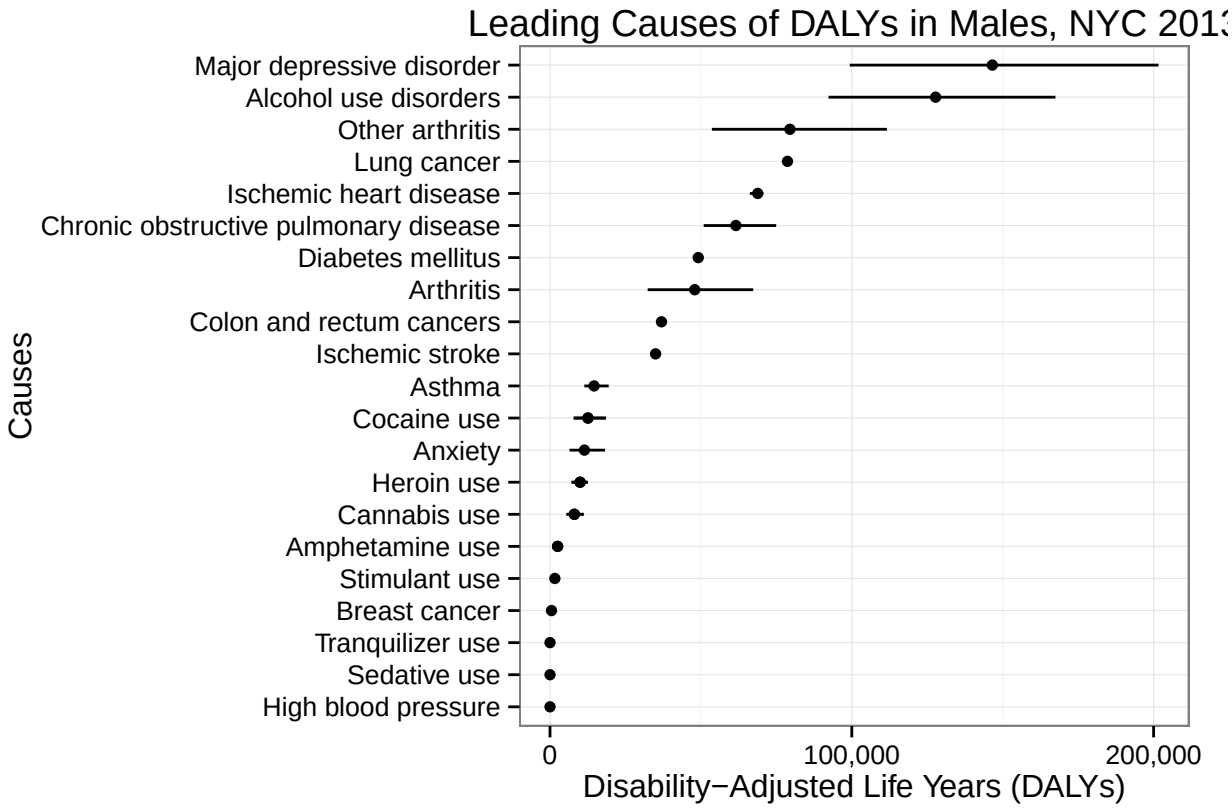
2013 NYC DALY Estimates, Male

```
prevalenceMale <- segmentDALY(prevalenceDALY, strata="male")
prevalenceMale
```

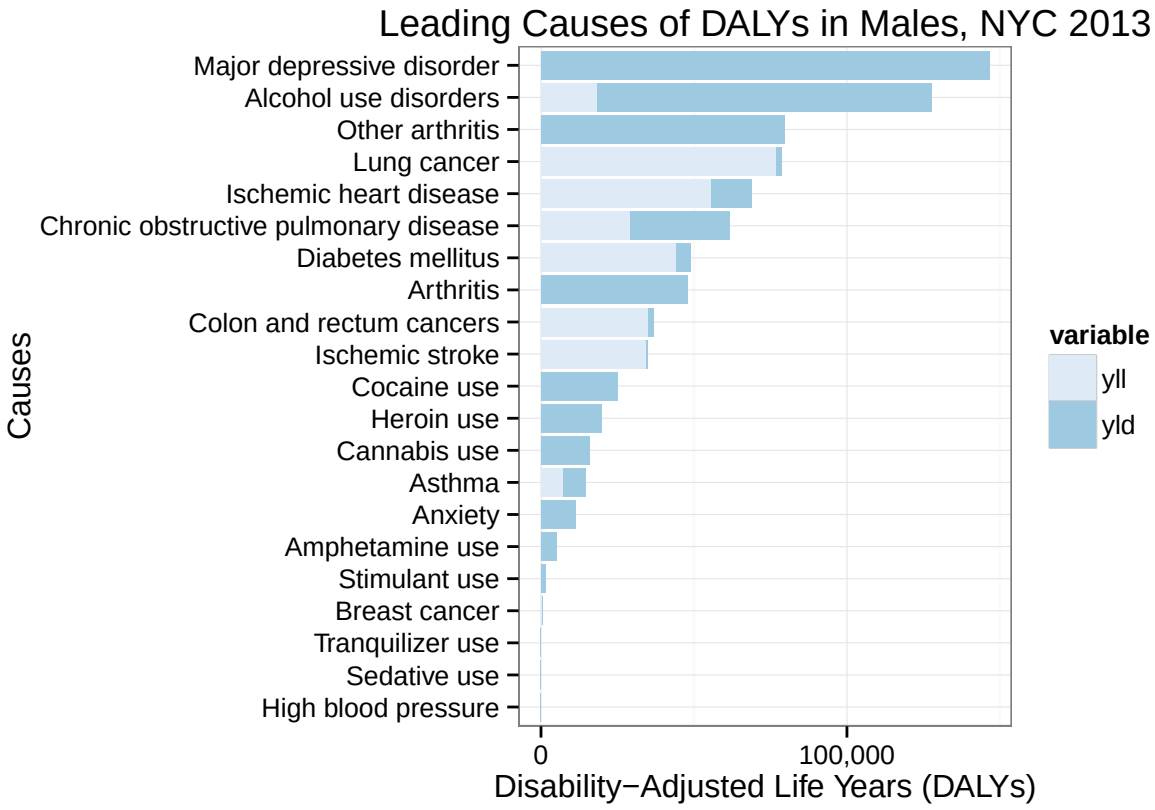
```
##                                cause_name  sex        yll        yld
## 1              Major depressive disorder Male         NA 146547.662
## 2                  Alcohol use disorders Male 18467.5988 109295.729
## 3                        Other arthritis Male         NA  79497.292
## 4                            Lung cancer Male 76757.0552   1925.994
## 5                 Ischemic heart disease Male 55740.9066  13079.052
## 6  Chronic obstructive pulmonary disease Male 29087.5511  32495.040
## 7                       Diabetes mellitus Male 44350.2597   4769.880
## 8                                Arthritis Male         NA  47958.372
## 9               Colon and rectum cancers Male 35103.8723   1835.148
## 10                       Ischemic stroke Male 34381.1722    607.635
## 11                                Asthma Male  7320.0714   7268.832
## 12                            Cocaine use Male         NA  12568.070
## 13                            Cocaine use Male         NA  12568.070
## 14                                Anxiety Male         NA  11398.980
## 15                             Heroin use Male         NA   9979.689
## 16                             Heroin use Male         NA   9979.689
## 17                            Cannabis use Male         NA   8053.920
## 18                            Cannabis use Male         NA   8053.920
## 19                         Amphetamine use Male         NA   2514.454
## 20                         Amphetamine use Male         NA   2514.454
## 21                           Stimulant use Male         NA   1609.680
## 22                           Breast cancer Male   499.6573      0.000
## 23                    High blood pressure Male         NA      0.000
## 24                           Sedative use Male         NA      0.000
## 25                         Tranquilizer use Male         NA      0.000
##     yld_upper yld_lower        daly  daly_upper daly_lower
## 1  201639.650 99306.914 146547.6620 201639.6500 99306.9140
## 2  149014.023 73802.786 127763.3281 167481.6215 92270.3850
## 3  111622.910 53633.447  79497.2920 111622.9100 53633.4470
## 4    2692.461  1303.649  78683.0492  79449.5162 78060.7042
## 5   14947.488 10484.002  68819.9586  70688.3946 66224.9086
## 6   45865.395 21832.605  61582.5911  74952.9461 50920.1561
## 7    5723.856  3815.904  49120.1397  50074.1157 48166.1637
## 8   67338.810 32355.477  47958.3720  67338.8100 32355.4770
## 9    2565.462  1242.158  36939.0203  37669.3343 36346.0303
## 10   1070.595   318.285  34988.8072  35451.7672 34699.4572
## 11  12114.720  4038.240  14588.9034  19434.7914 11358.3114
## 12  18484.422  7855.044  12568.0700  18484.4221  7855.0437
## 13  18484.422  7855.044  12568.0700  18484.4221  7855.0437
## 14  18238.368  6459.422  11398.9800  18238.3680  6459.4220
## 15  12501.857  7146.143   9979.6893  12501.8572  7146.1425
## 16  12501.857  7146.143   9979.6893  12501.8572  7146.1425
## 17  11138.400  5459.040   8053.9200  11138.4000  5459.0400
## 18  11138.400  5459.040   8053.9200  11138.4000  5459.0400
## 19   3739.628  1531.466   2514.4543   3739.6275  1531.4665
## 20   3739.628  1531.466   2514.4543   3739.6275  1531.4665
## 21   2394.000   980.400   1609.6800   2394.0000   980.4000
## 22      0.000     0.000    499.6573    499.6573   499.6573
```

```
## 23      0.000      0.000      0.0000      0.0000      0.0000
## 24      0.000      0.000      0.0000      0.0000      0.0000
## 25      0.000      0.000      0.0000      0.0000      0.0000
```

```
plotDALY(prevalenceMale, "Leading Causes of DALYs in Males, NYC 2013")
```




```
plotDALY(prevalenceMale, "Leading Causes of DALYs in Males, NYC 2013", stackedBar=TRUE)
```



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

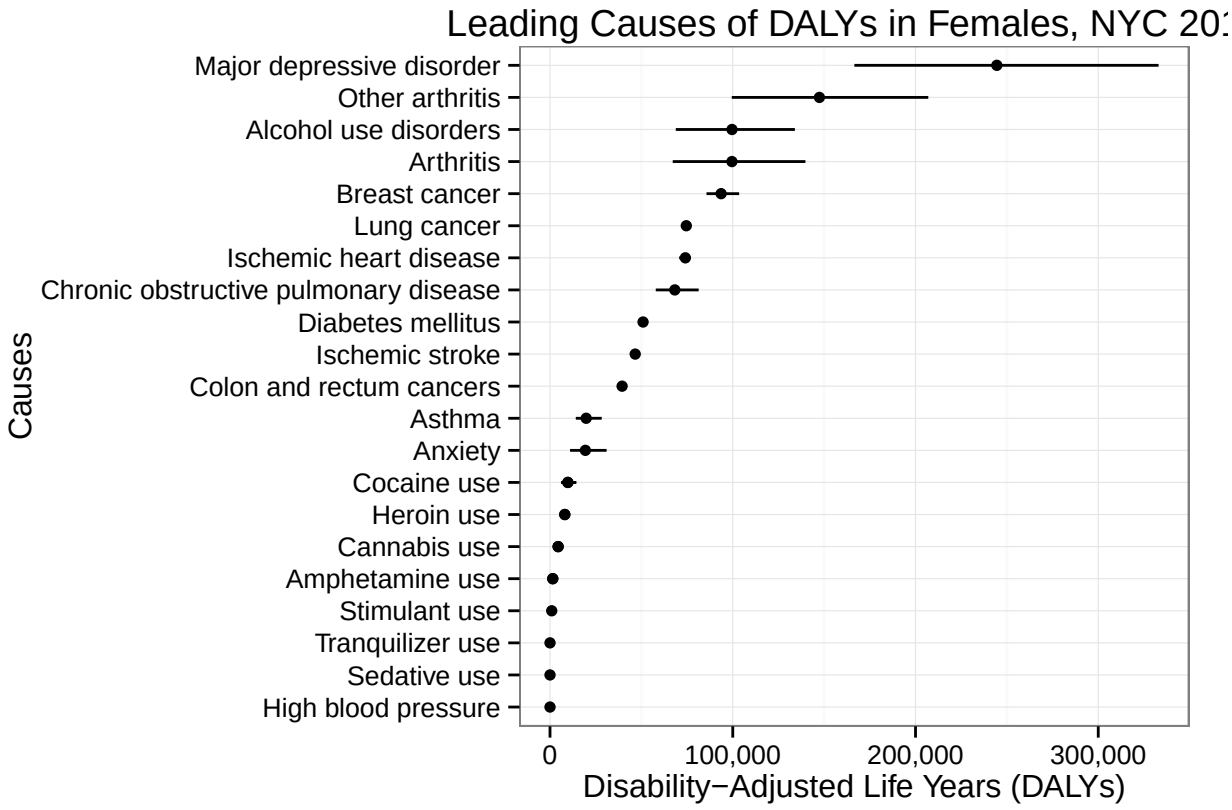
2013 NYC DALY Estimates, Female

```
prevalenceFemale <- segmentDALY(prevalenceDALY, strata="female")
prevalenceFemale
```

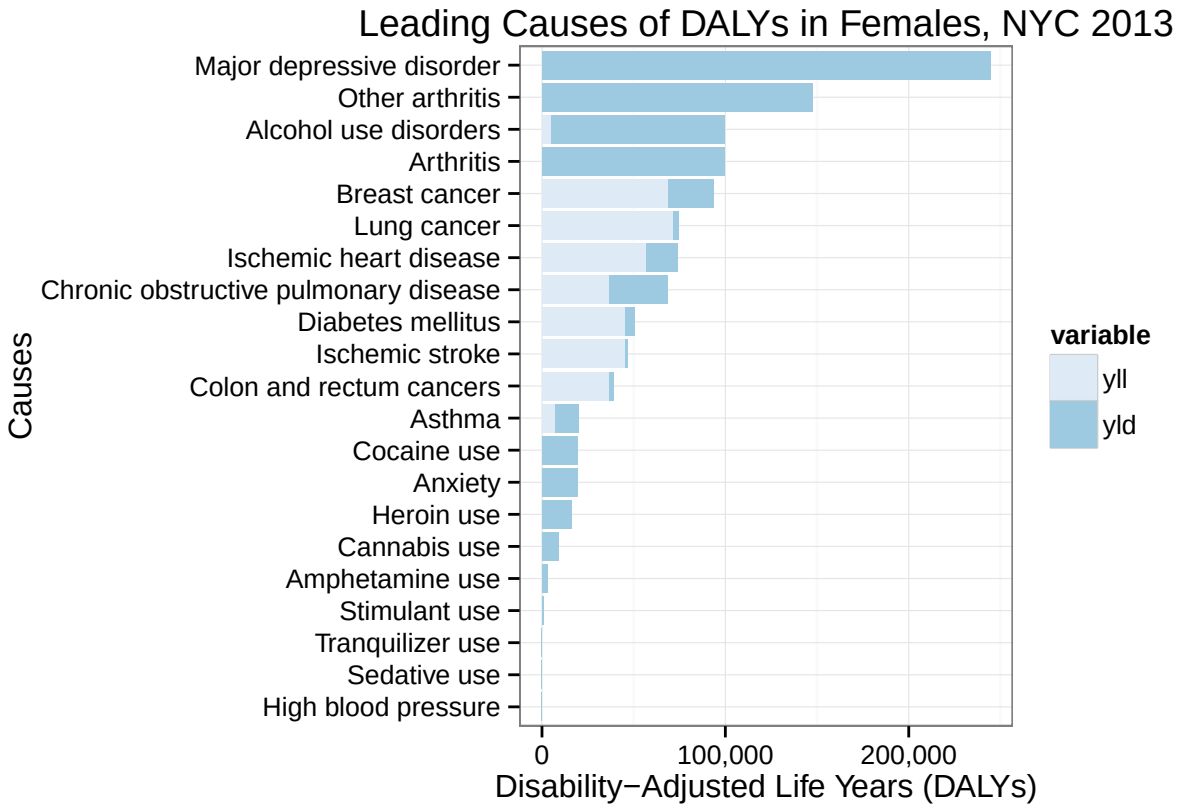
```
##                                cause_name    sex       yll        yld
## 1              Major depressive disorder Female        NA 244504.948
## 2                       Other arthritis Female        NA 147420.580
## 3                  Alcohol use disorders Female  4899.844  94687.202
## 4                             Arthritis Female        NA  99544.844
## 5                         Breast cancer Female 68867.055  24768.618
## 6                          Lung cancer Female 71564.127   3011.442
## 7                Ischemic heart disease Female 56958.456  17106.768
## 8  Chronic obstructive pulmonary disease Female 36529.105  31757.568
## 9                      Diabetes mellitus Female 45571.600   5349.255
## 10                       Ischemic stroke Female 45405.985   1212.351
## 11             Colon and rectum cancers Female 36809.355   2636.298
## 12                               Asthma Female  6997.355  12789.252
## 13                              Anxiety Female        NA  19353.150
## 14                          Cocaine use Female        NA   9764.658
## 15                          Cocaine use Female        NA   9764.658
## 16                           Heroin use Female        NA   8089.563
## 17                           Heroin use Female        NA   8089.563
## 18                          Cannabis use Female        NA   4441.500
## 19                          Cannabis use Female        NA   4441.500
```

```
## 20                      Amphetamine use Female        NA   1510.483
## 21                      Amphetamine use Female        NA   1510.483
## 22                        Stimulant use Female        NA    938.980
## 23                  High blood pressure Female        NA      0.000
## 24                         Sedative use Female        NA      0.000
## 25                      Tranquilizer use Female        NA      0.000
##     yld_upper   yld_lower       daly daly_upper  daly_lower
## 1  333007.073 166536.8420 244504.948  333007.07 166536.8420
## 2  206994.650  99458.4050 147420.580  206994.65  99458.4050
## 3  129096.726  63938.2652  99587.046  133996.57  68838.1093
## 4  139771.870  67158.6790  99544.844  139771.87  67158.6790
## 5   34625.517  16765.1530  93635.673  103492.57  85632.2084
## 6    4209.873   2038.3570  74575.569   75774.00  73602.4839
## 7   19550.592  13712.5680  74065.224   76509.05  70671.0240
## 8   44824.484  21337.1160  68286.673   81353.59  57866.2212
## 9    6419.106   4279.4040  50920.855   51990.71  49851.0037
## 10   2136.047    635.0410  46618.336   47542.03  46041.0264
## 11   3685.437   1784.4330  39445.653   40494.79  38593.7875
## 12  21315.420   7105.1400  19786.607   28312.77  14102.4948
## 13  30965.040  10966.7850  19353.150   30965.04  10966.7850
## 14  14361.319   6102.9115   9764.658   14361.32   6102.9115
## 15  14361.319   6102.9115   9764.658   14361.32   6102.9115
## 16  10134.039   5792.6824   8089.563   10134.04   5792.6824
## 17  10134.039   5792.6824   8089.563   10134.04   5792.6824
## 18   6142.500   3010.5000   4441.500    6142.50   3010.5000
## 19   6142.500   3010.5000   4441.500    6142.50   3010.5000
## 20   2246.470    919.9828   1510.483    2246.47    919.9828
## 21   2246.470    919.9828   1510.483    2246.47    919.9828
## 22   1396.500    571.9000    938.980    1396.50    571.9000
## 23      0.000      0.0000      0.000       0.00      0.0000
## 24      0.000      0.0000      0.000       0.00      0.0000
## 25      0.000      0.0000      0.000       0.00      0.0000
```

```
plotDALY(prevalenceFemale, "Leading Causes of DALYs in Females, NYC 2013")
```



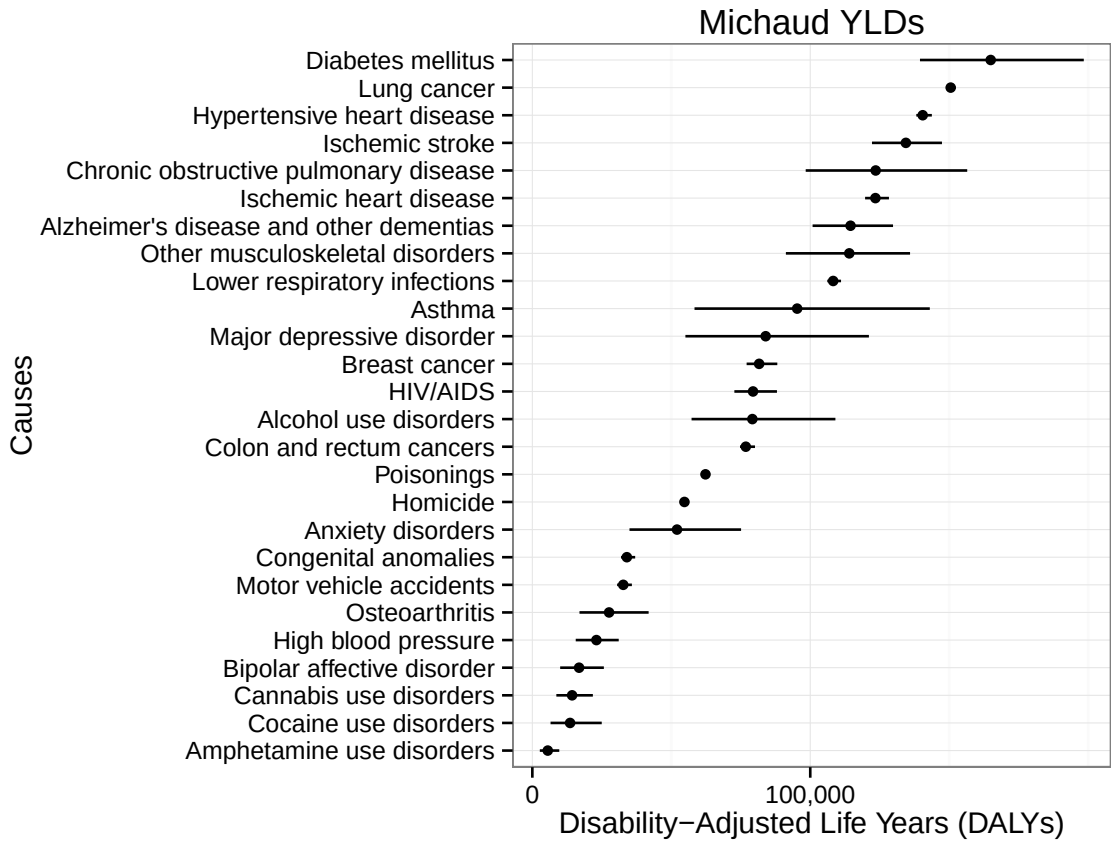

```
plotDALY(prevalenceFemale, "Leading Causes of DALYs in Females, NYC 2013", stackedBar=TRUE)
```

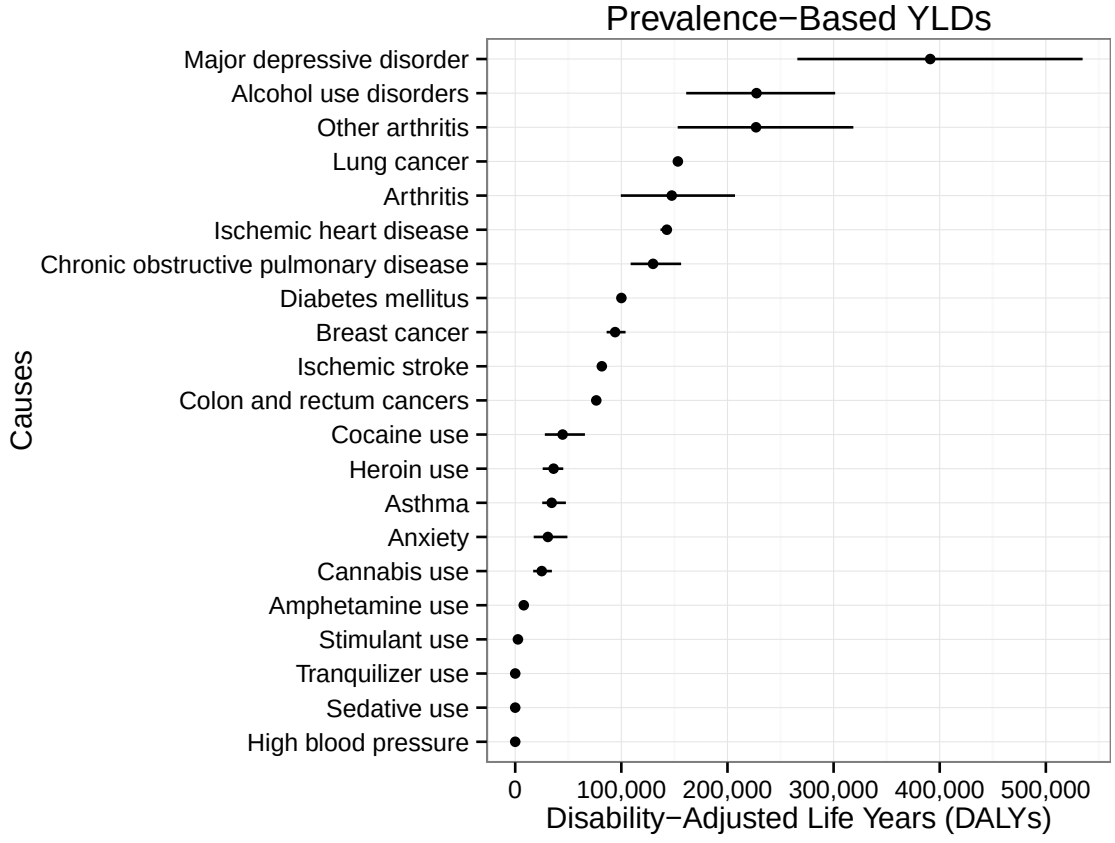


Michaud YLDs vs. Prevalence-Based YLDs: Side-by-Side Comparison

Total

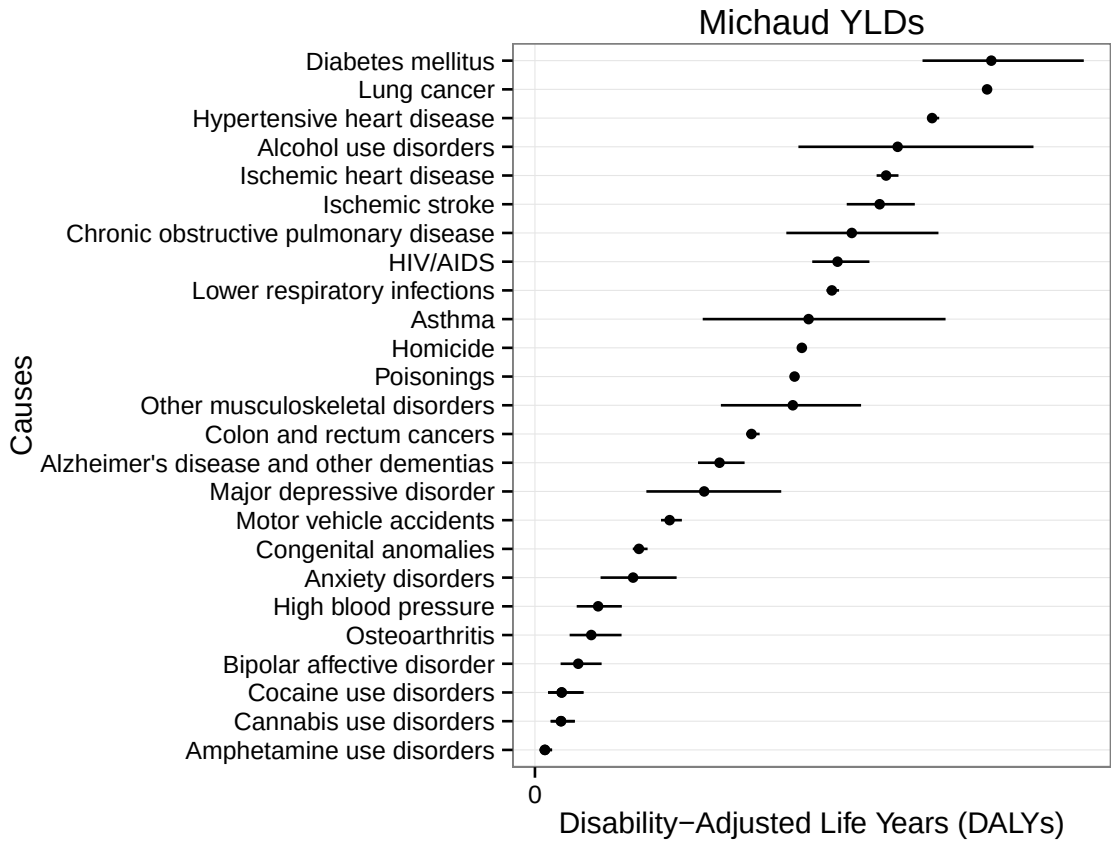
```
multiplot(plotDALY(michaudTotal, "Michaud YLDs"), plotDALY(prevalenceTotal, "Prevalence-Based YLDs"))
```

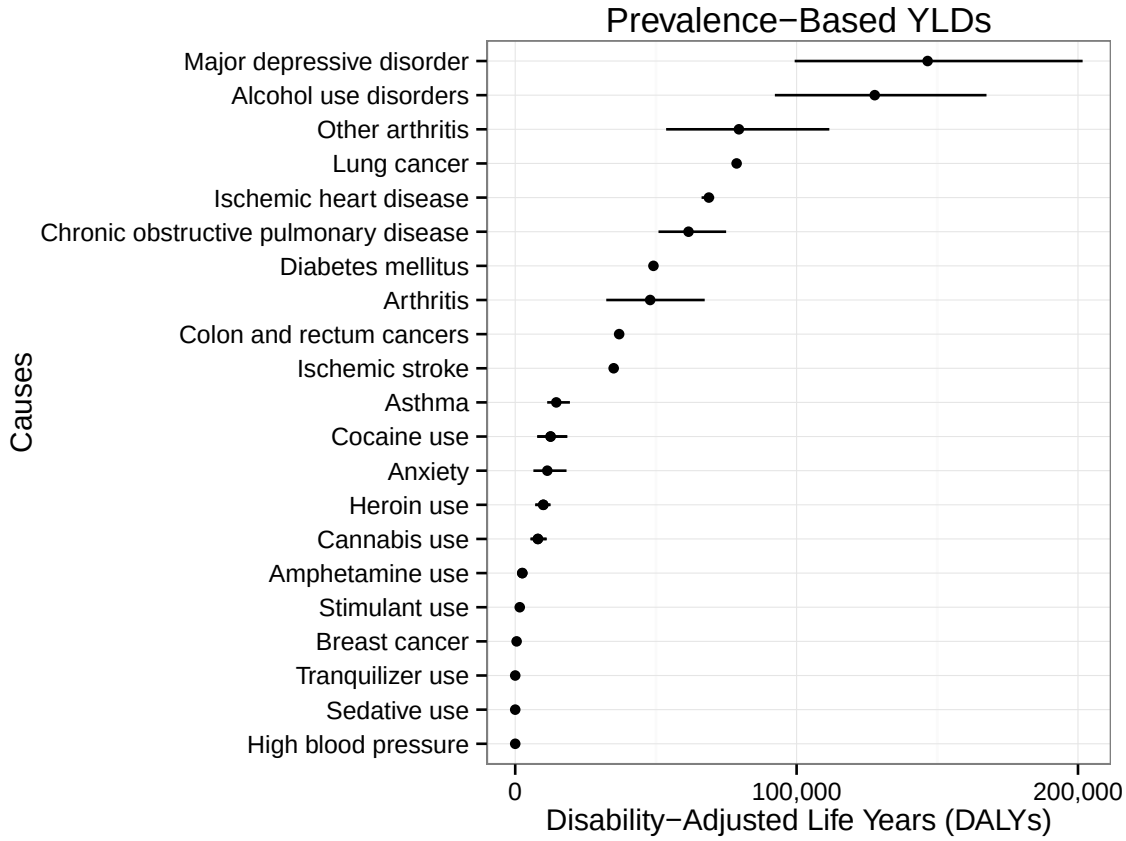

Michaud YLDs
Diabetes mellitus
Lung cancer
Hypertensive heart disease
Ischemic stroke
Chronic obstructive pulmonary disease
Ischemic heart disease
Alzheimer's disease and other dementias
Other musculoskeletal disorders
Lower respiratory infections
Asthma
Major depressive disorder
Breast cancer
HIV/AIDS
Alcohol use disorders
Colon and rectum cancers
Poisonings
Homicide
Anxiety disorders
Congenital anomalies
Motor vehicle accidents
Osteoarthritis
High blood pressure
Bipolar affective disorder
Cannabis use disorders
Cocaine use disorders
Amphetamine use disorders
Causes
0
100,000
Disability−Adjusted Life Years (DALYs)


Prevalence−Based YLDs
Major depressive disorder
Alcohol use disorders
Other arthritis
Lung cancer
Arthritis
Ischemic heart disease
Chronic obstructive pulmonary disease
Diabetes mellitus
Breast cancer
Ischemic stroke
Colon and rectum cancers
Cocaine use
Heroin use
Asthma
Anxiety
Cannabis use
Amphetamine use
Stimulant use
Tranquilizer use
Sedative use
High blood pressure
Causes
0
100,000
200,000
300,000
400,000
500,000
Disability−Adjusted Life Years (DALYs)

Male

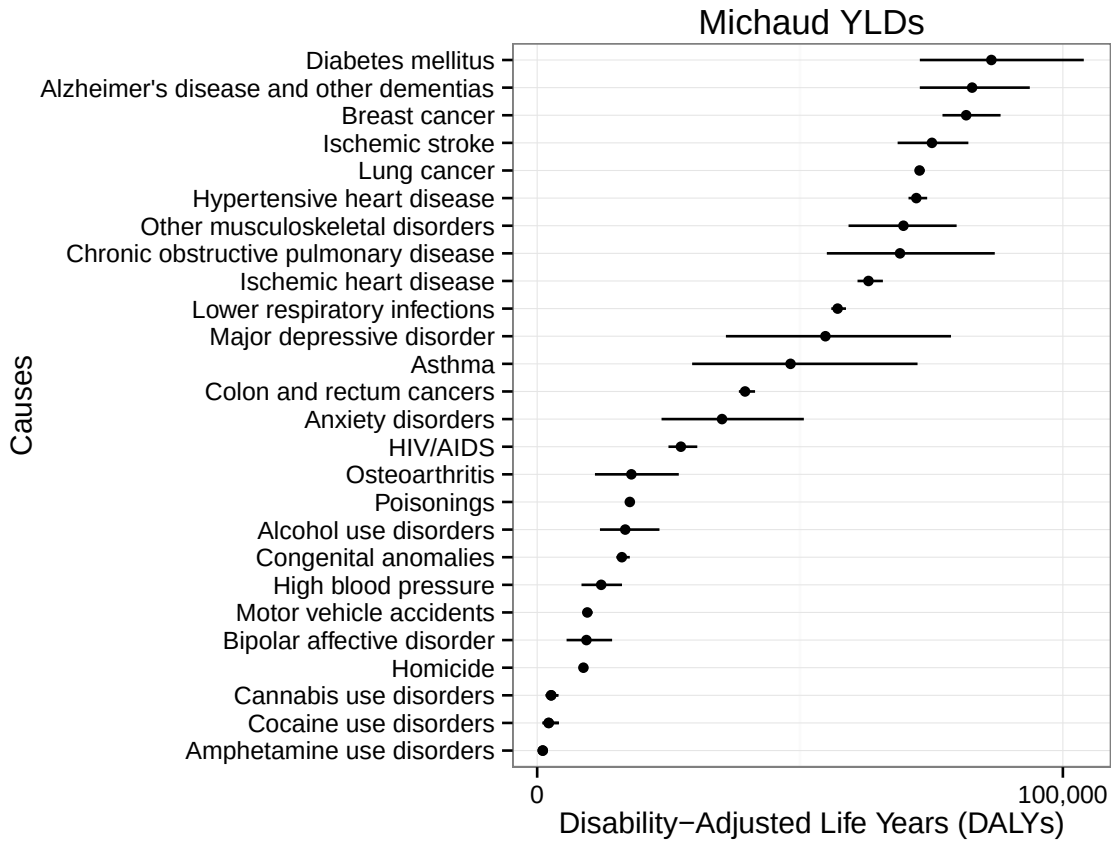
```
multiplot(plotDALY(michaudMale, "Michaud YLDs"), plotDALY(prevalenceMale, "Prevalence-Based YLDs"))
```

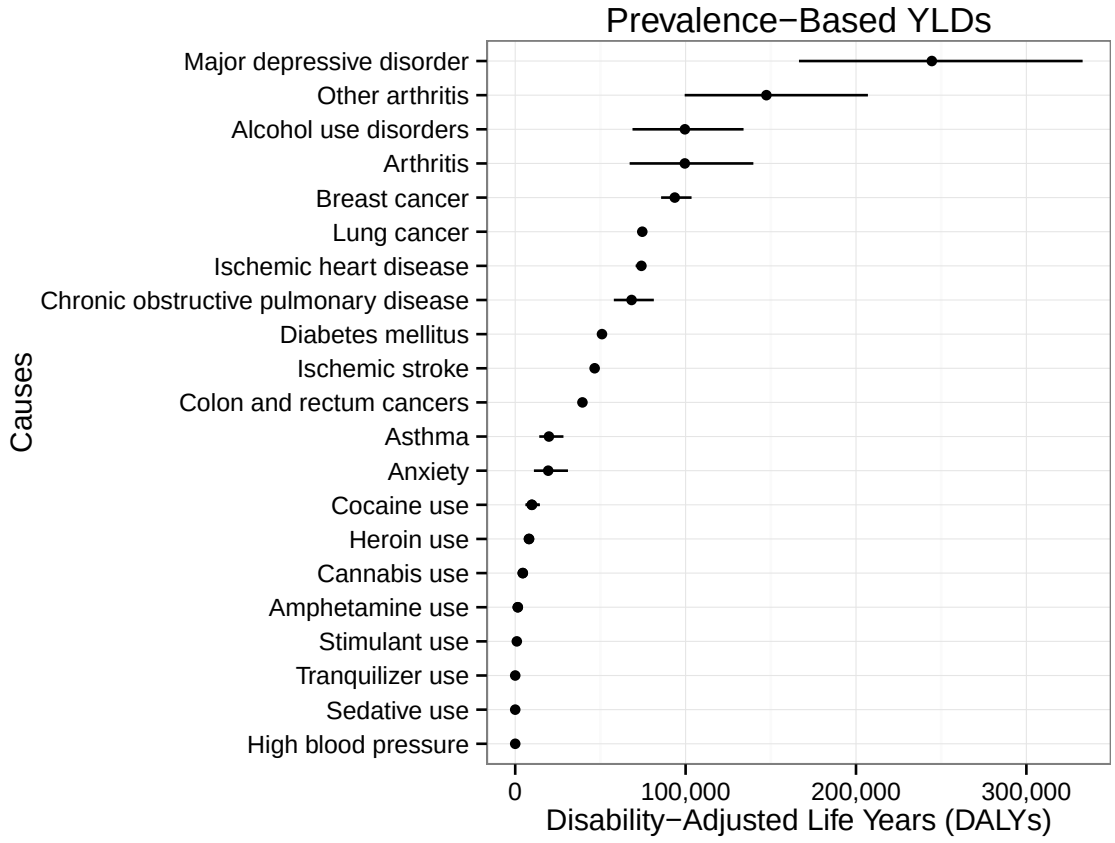

Michaud YLDs
Diabetes mellitus
Lung cancer
Hypertensive heart disease
Alcohol use disorders
Ischemic heart disease
Ischemic stroke
Chronic obstructive pulmonary disease
HIV/AIDS
Lower respiratory infections
Asthma
Homicide
Poisonings
Other musculoskeletal disorders
Colon and rectum cancers
Alzheimer's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


Prevalence−Based YLDs
Major depressive disorder
Alcohol use disorders
Other arthritis
Lung cancer
Ischemic heart disease
Chronic obstructive pulmonary disease
Diabetes mellitus
Arthritis
Colon and rectum cancers
Ischemic stroke
Asthma
Cocaine use
Anxiety
Heroin use
Cannabis use
Amphetamine use
Stimulant use
Breast cancer
Tranquilizer use
Sedative use
High blood pressure
Causes
0
100,000
200,000
Disability−Adjusted Life Years (DALYs)

Female

```
multiplot(plotDALY(michaudFemale, "Michaud YLDs"), plotDALY(prevalenceFemale, "Prevalence-Based YLDs"))
```


Michaud YLDs
Diabetes mellitus
Alzheimer's disease and other dementias
Breast cancer
Ischemic stroke
Lung cancer
Hypertensive heart disease
Other musculoskeletal disorders
Chronic obstructive pulmonary disease
Ischemic heart disease
Lower respiratory infections
Major depressive disorder
Asthma
Colon and rectum cancers
Anxiety disorders
HIV/AIDS
Osteoarthritis
Poisonings
Alcohol use disorders
Congenital anomalies
High blood pressure
Motor vehicle accidents
Bipolar affective disorder
Homicide
Cannabis use disorders
Cocaine use disorders
Amphetamine use disorders
Causes
0
100,000
Disability−Adjusted Life Years (DALYs)


Prevalence−Based YLDs
Major depressive disorder
Other arthritis
Alcohol use disorders
Arthritis
Breast cancer
Lung cancer
Ischemic heart disease
Chronic obstructive pulmonary disease
Diabetes mellitus
Ischemic stroke
Colon and rectum cancers
Asthma
Anxiety
Cocaine use
Heroin use
Cannabis use
Amphetamine use
Stimulant use
Tranquilizer use
Sedative use
High blood pressure
Causes
0
100,000
200,000
300,000
Disability−Adjusted Life Years (DALYs)

Disease Conditions with Small Sample Sizes

```
prevalence[prevalence$small_sample == "yes", c("cause_name", "sequlae", "sex", "age")]
```

```
##                    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
```

Discussion

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.

References

Jiang, Yongwen, and Jana Earl Hesser. "Using Disability-Adjusted Life Years to Assess the Burden of Disease and Injury in Rhode Island." Public Health Reports 127, no. 3 (2012): 293–303.

Lozano, Rafael, Mohsen Naghavi, Kyle Foreman, Stephen Lim, Kenji Shibuya, Victor Aboyans, Jerry Abraham, et al. "Global and Regional Mortality from 235 Causes of Death for 20 Age Groups in 1990 and 2010: A Systematic Analysis for the Global Burden of Disease Study 2010." The Lancet 380, no. 9859 (December 15, 2012): 2095–2128. doi:10.1016/S0140-6736(12)61728-0.

Michaud, Catherine M, Matthew T McKenna, Stephen Begg, Niels Tomijima, Meghna Majmudar, Maria T Bulzacchelli, Shahul Ebrahim, et al. "The Burden of Disease and Injury in the United States 1996." Population Health Metrics 4 (October 18, 2006): 11. doi:10.1186/1478-7954-4-11.

Schroeder, S Andrew. "Incidence, Prevalence, and Hybrid Approaches to Calculating Disability-Adjusted Life Years." Population Health Metrics 10 (September 12, 2012): 19. doi:10.1186/1478-7954-10-19.

U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, and Center for Behavioral Health Statistics and Quality. "Results from the 2012 NSDUH: Summary of National Findings, SAMHSA, CBHSQ." Accessed April 18, 2015. http://archive.samhsa.gov/data/NSDUH/2012SummNatFindDetTables/NationalFindings/NSDUHresults2012.htm. Üstün, T. B., J. L. Ayuso-Mateos, S. Chatterji, C. Mathers, and C. J. L. Murray. "Global Burden of Depressive Disorders in the Year 2000." The British Journal of Psychiatry 184, no. 5 (May 1, 2004): 386–92. doi:10.1192/bjp.184.5.386.