Analysis

Nathan Green

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The raw annual risk of death is calculated by the proportion of people in each age, sex, ethnicity group who die each year (with those who emigrate being censored, of course). Separate survivorship curve for each year of birth, as life expectancy changes over time. There is sex differences; ethnicity doesn't make much of a difference.

ETHPOP is based on ONS data in what year?

```r
library(readr)
library(purrr)
library(dplyr)
library(ggplot2)
library(scales)
library(reshape2)
library(survivorETHPOP)
```

1 ETHPOP

We want to compare between the ONS mortality statistics and ETHPOP. From here it details their method. They calculate a *central rate of mortality* as the average across 3 years.

$$m_x = \sum_{y1,y2,y3} deaths_i / \sum_{y1,y2,y3} pop_i$$

Finally, they calculate the *mortality rate* which is what we will be using to compare and is equivalent to the hazard.

$$q_x = 2m_x/(2 + m_x)$$

1.1 Individual categories hazards and survival

```r
ETHPOP_lifetable <- make_ETHPOP_lifetable()

head(ETHPOP_lifetable)
```

```
FALSE # A tibble: 6 x 13
FALSE # Groups:   ETH.group, sex, id [6]
FALSE   ETH.group   age sex   deaths  year   pop    id yr_age death_rate      mx
FALSE   <chr>     <dbl> <chr>  <dbl> <dbl> <dbl> <int> <chr>       <dbl>   <dbl>
FALSE 1 BAN           0 F       9.37  2011 4844.   101 2011_0    0.00193 0.00193
FALSE 2 BAN           0 F      11.8   2012 6219.   102 2012_0    0.00189 0.00189
FALSE 3 BAN           0 F      11.4   2013 6149.   103 2013_0    0.00185 0.00185
FALSE 4 BAN           0 F      10.9   2014 6053.   104 2014_0    0.00180 0.00180
FALSE 5 BAN           0 F      10.8   2015 6168.   105 2015_0    0.00176 0.00176
FALSE 6 BAN           0 F      10.9   2016 6330.   106 2016_0    0.00172 0.00172
FALSE # ... with 3 more variables: qx <dbl>, S <dbl>, S_qx <dbl>
```
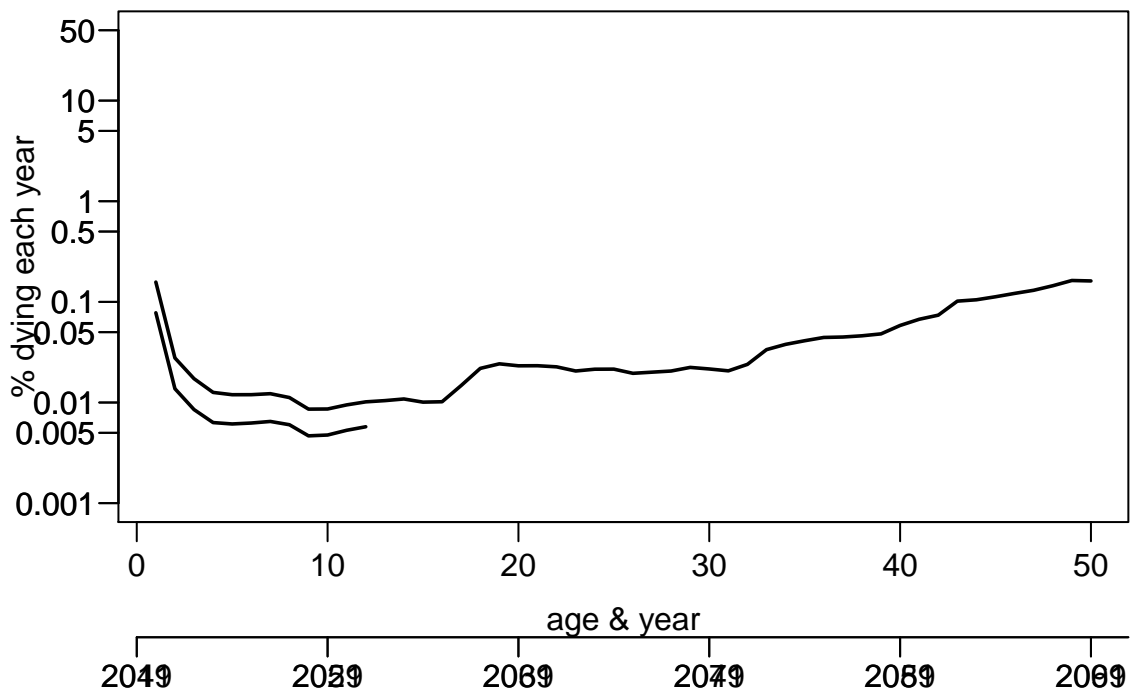
```
ETHPOP_lifetable %>%
  survivor_curve(group = list(sex = "M",
                              ETH.group = "WHO",
                              year = 2011)) %>%
  haz_plot()

ETHPOP_lifetable %>%
  survivor_curve(group = list(sex = "M",
                              ETH.group = "WHO",
                              year = 2049)) %>%
  haz_plot(add = TRUE)
```
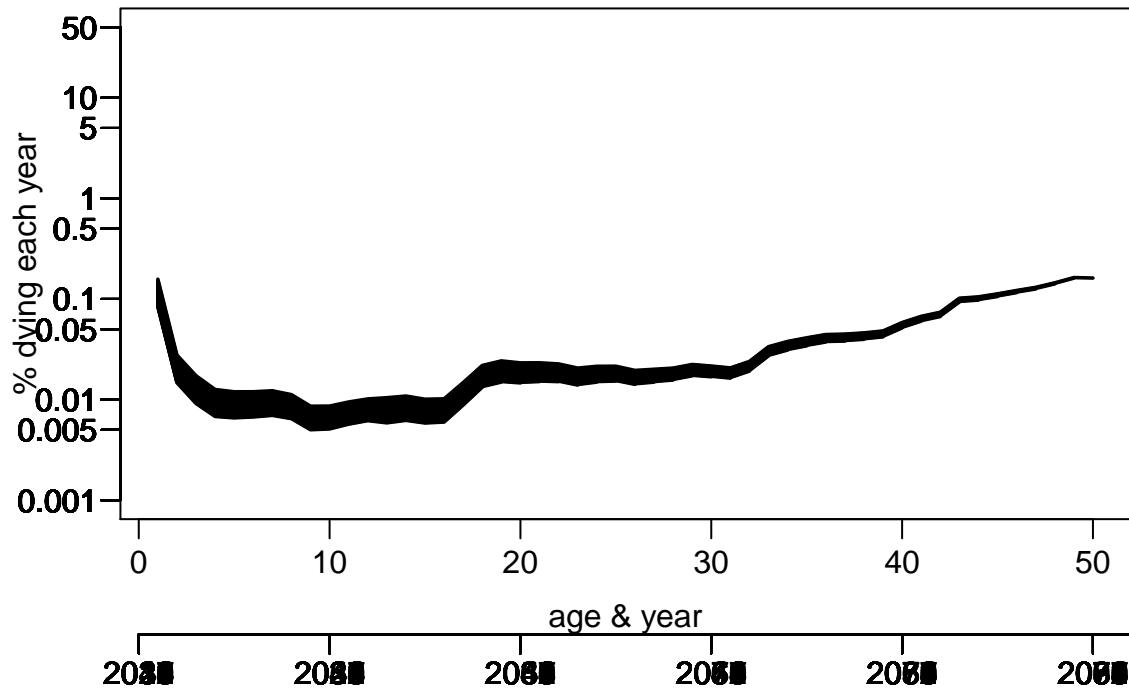
2011 WHO M


```
ETHPOP_lifetable %>%
  survivor_curve(group = list(sex = "M",
                              ETH.group = "WHO",
                              year = 2011)) %>%
  haz_plot()

for (i in 2012:2043) {
  ETHPOP_lifetable %>%
    survivor_curve(group = list(sex = "M",
                                ETH.group = "WHO",
                                year = i)) %>%
    haz_plot(add = TRUE)
}
```

2011 WHO M


```r
par(mfrow=c(1,2))
dat <- ETHPOP_lifetable %>%
  survivor_curve(group = list(sex = "M",
                              ETH.group = "BAN",
                              year = 2011)) %>%
  haz_plot() %>%
  surv_plot()
```
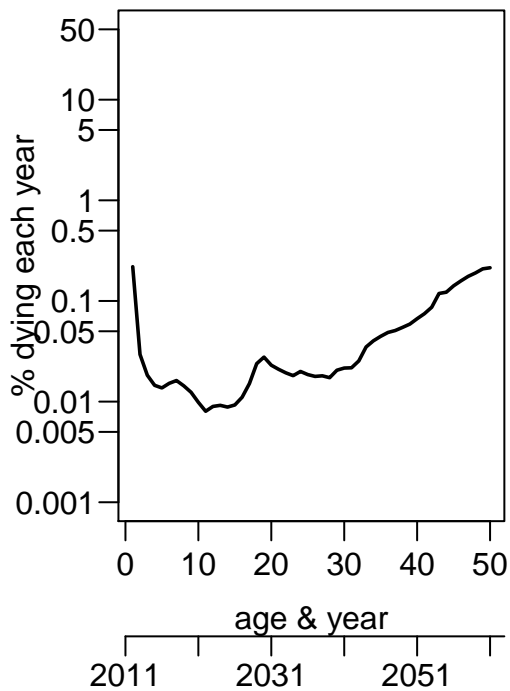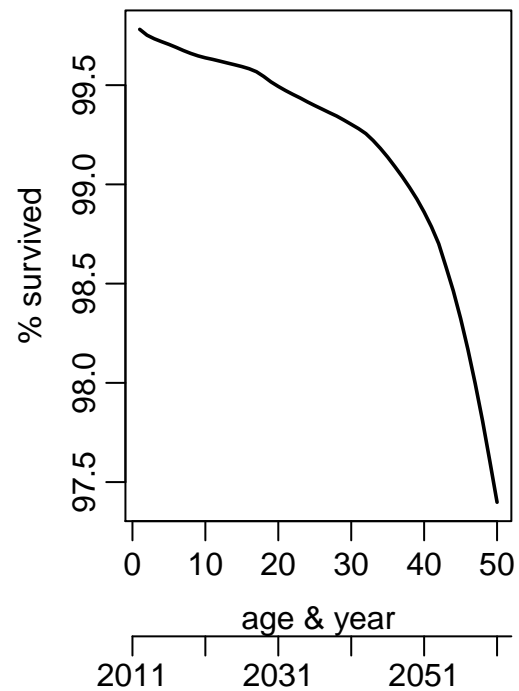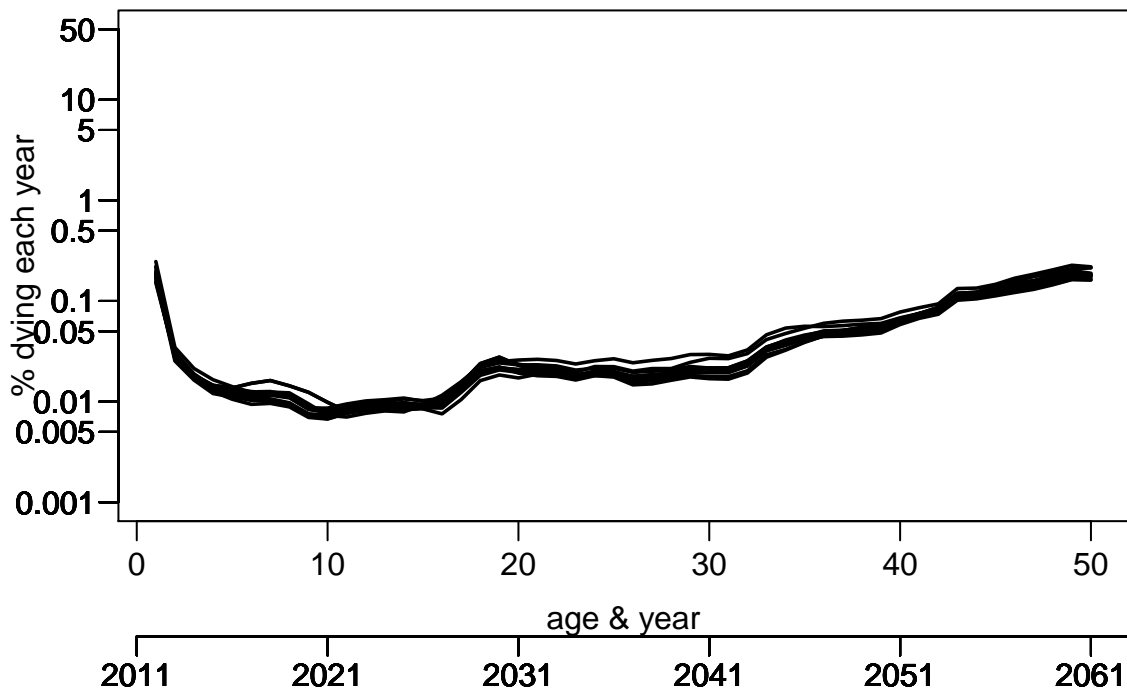
2011 BAN M   2011 BAN M

1.1.1 Ethnic groups

```r
ethnic_grps <- c("BAN", "BLA", "BLC", "CHI", "IND", "MIX",
                 "OAS", "OBL", "OTH", "PAK", "WBI", "WHO")

ETHPOP_lifetable %>%
  survivor_curve(group = list(sex = "M",
                              ETH.group = "BAN",
                              year = 2011)) %>%
  haz_plot()

for (i in ethnic_grps) {
  ETHPOP_lifetable %>%
    survivor_curve(group = list(sex = "M",
                                ETH.group = i,
                                year = 2011)) %>%
    haz_plot(add = TRUE)
}
```
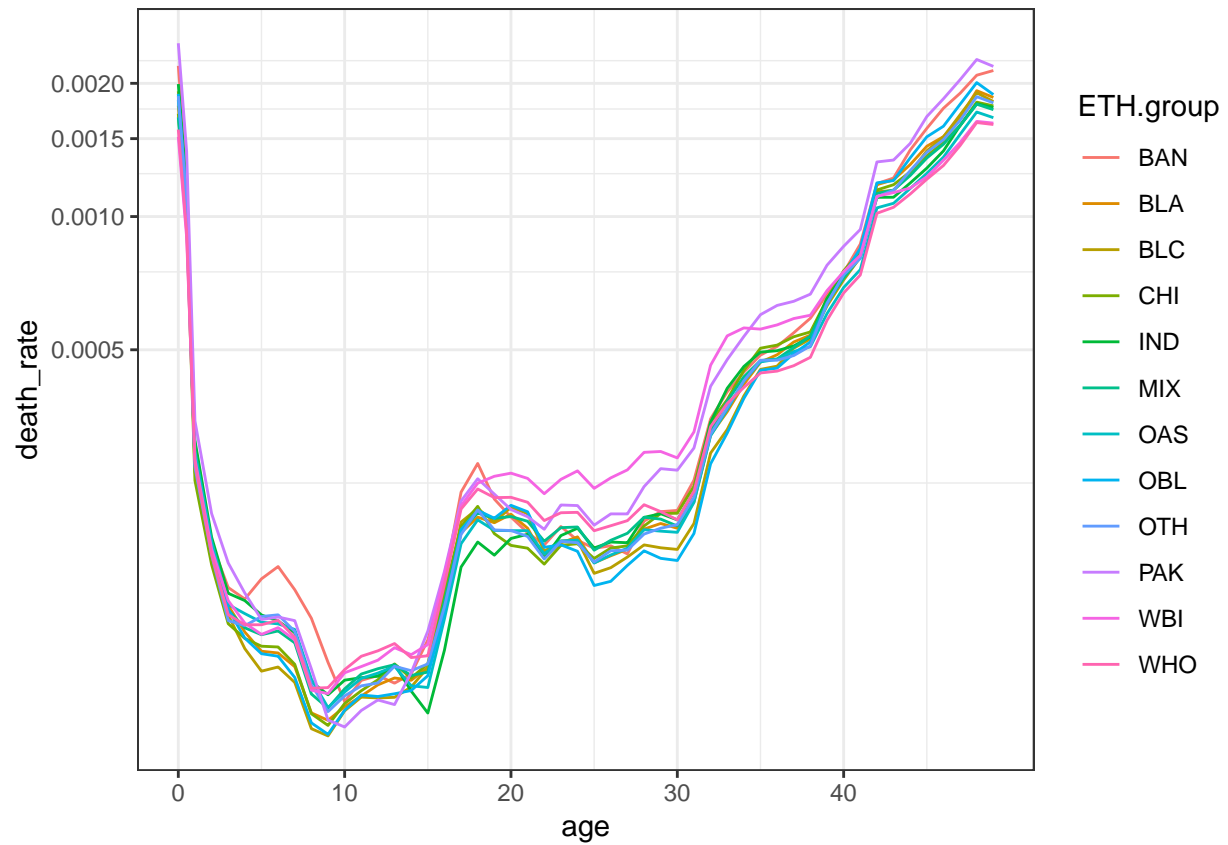
2011 BAN M


```
baseyr_2011 <- ETHPOP_lifetable$id[ETHPOP_lifetable$yr_age == "2011_0"][1]

ETHPOP_lifetable_2011M <- ETHPOP_lifetable %>%
  filter(id == baseyr_2011,
         sex == "M")

ETHPOP_lifetable_2011F <- ETHPOP_lifetable %>%
  filter(id == baseyr_2011,
         sex == "F")
```
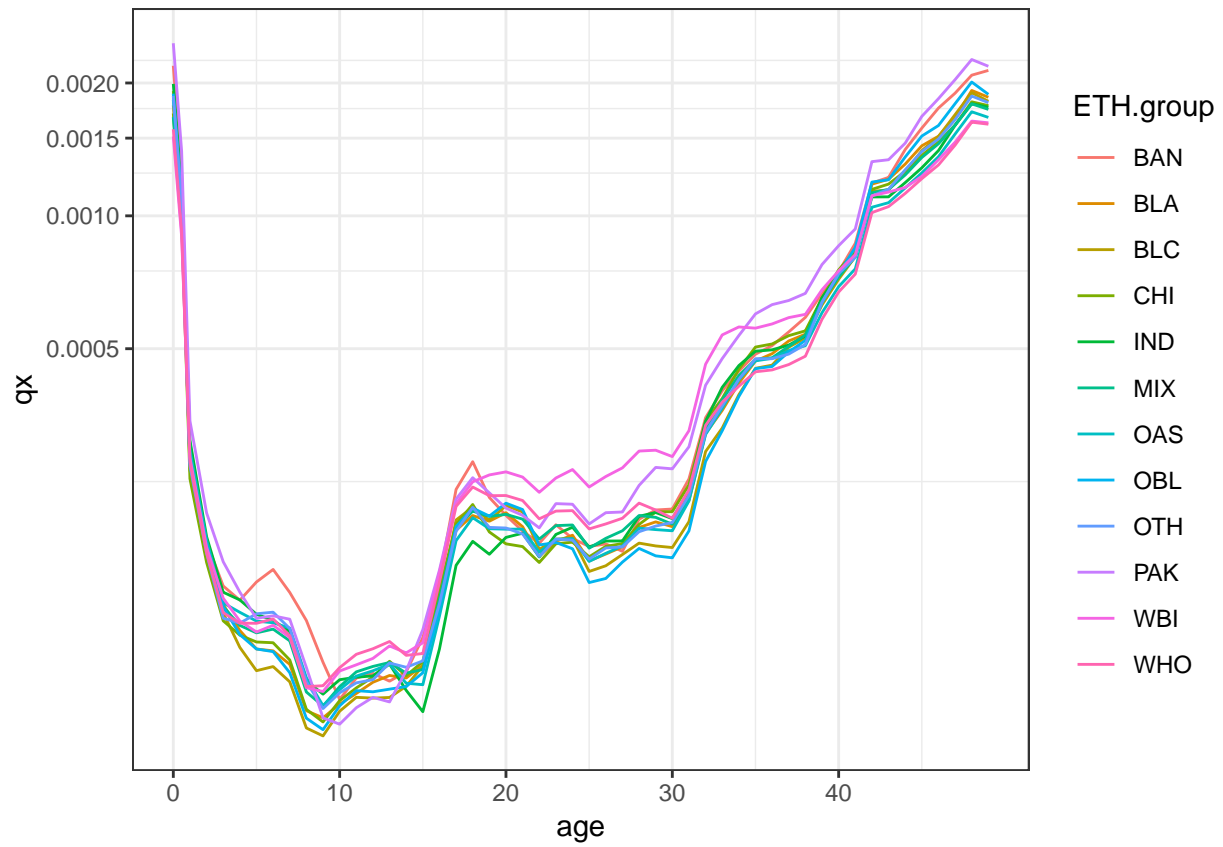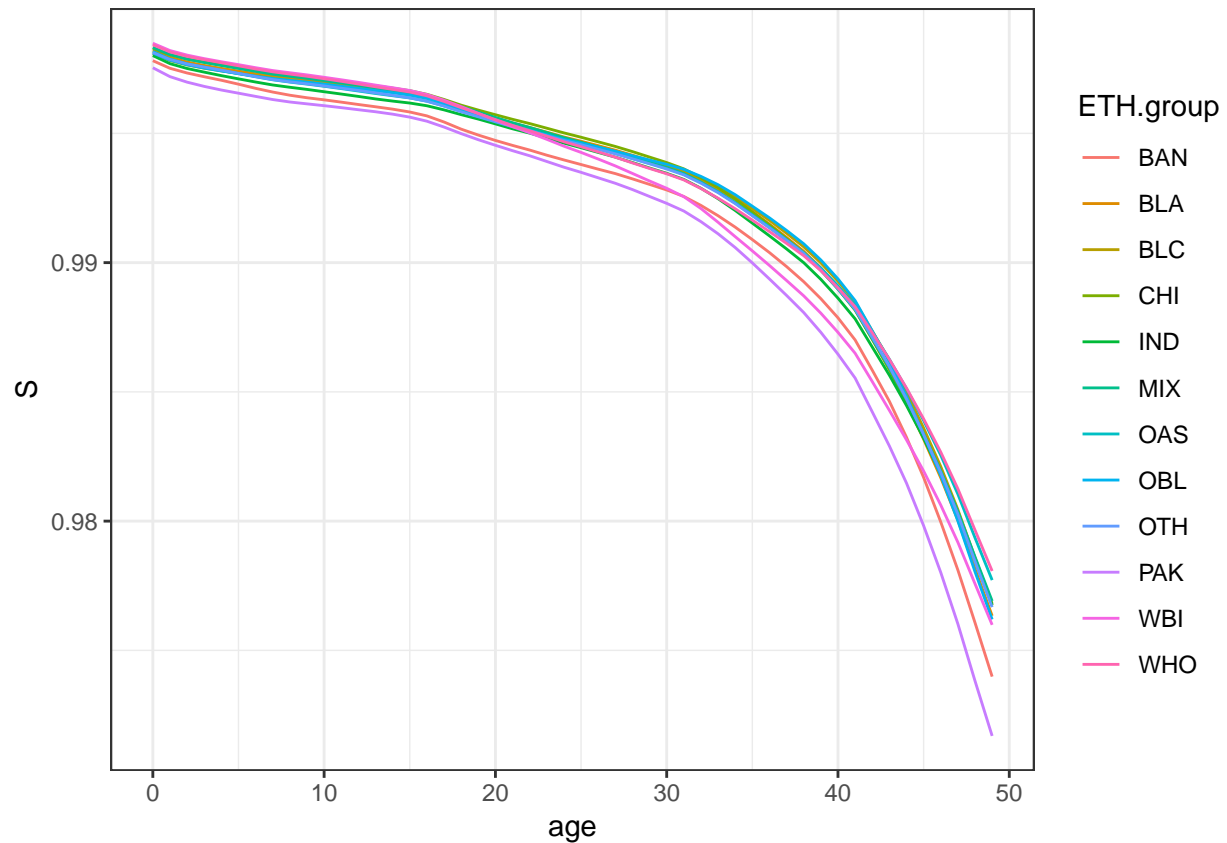
```
## ggplot

ggplot(ETHPOP_lifetable_2011M, aes(x = age, y = death_rate, colour = ETH.group)) +
  geom_line() +
  # scale_y_continuous(trans='log2') +
  coord_trans(y = "log10") +
  theme_bw()
```

```r
ggplot(ETHPOP_lifetable_2011M, aes(x = age, y = qx, colour = ETH.group)) +
  geom_line() +
  # scale_y_continuous(trans='log2') +
  coord_trans(y = "log10") +
  theme_bw()
```

```
ggplot(ETHPOP_lifetable_2011M, aes(x = age, y = S, colour = ETH.group)) +
  geom_line() +
  theme_bw()
```
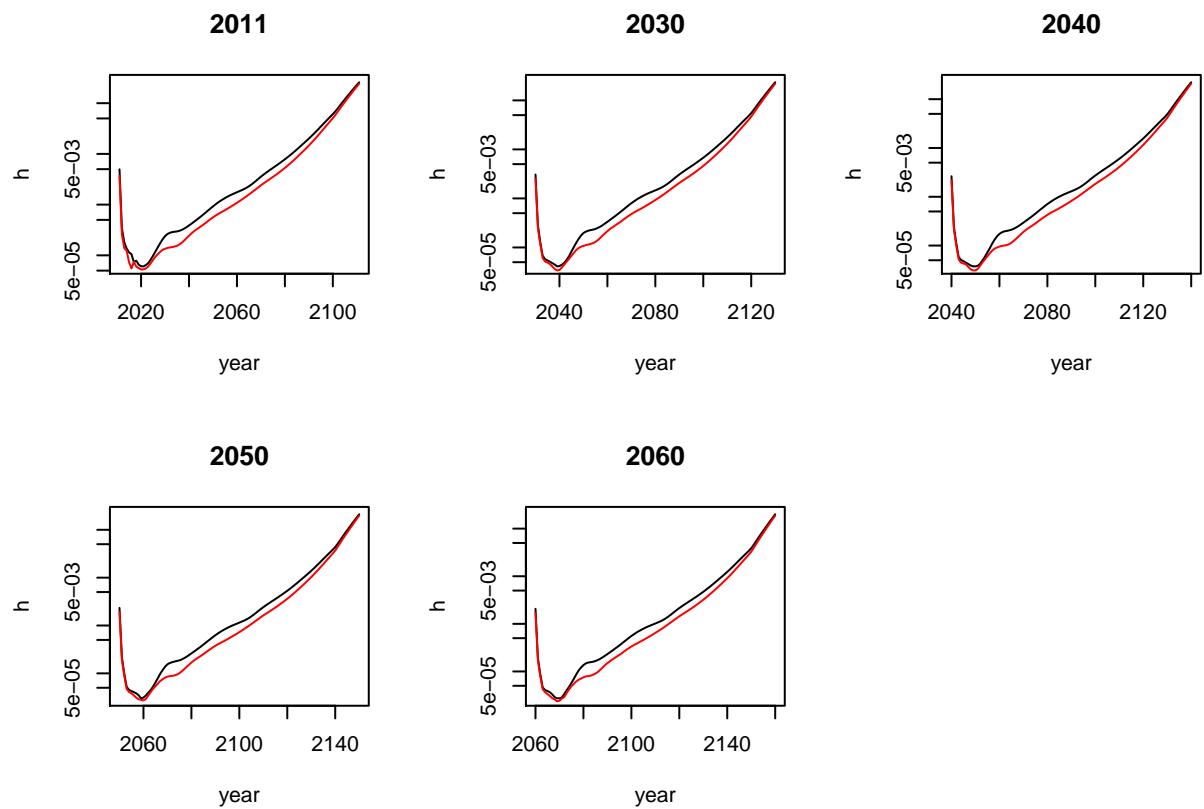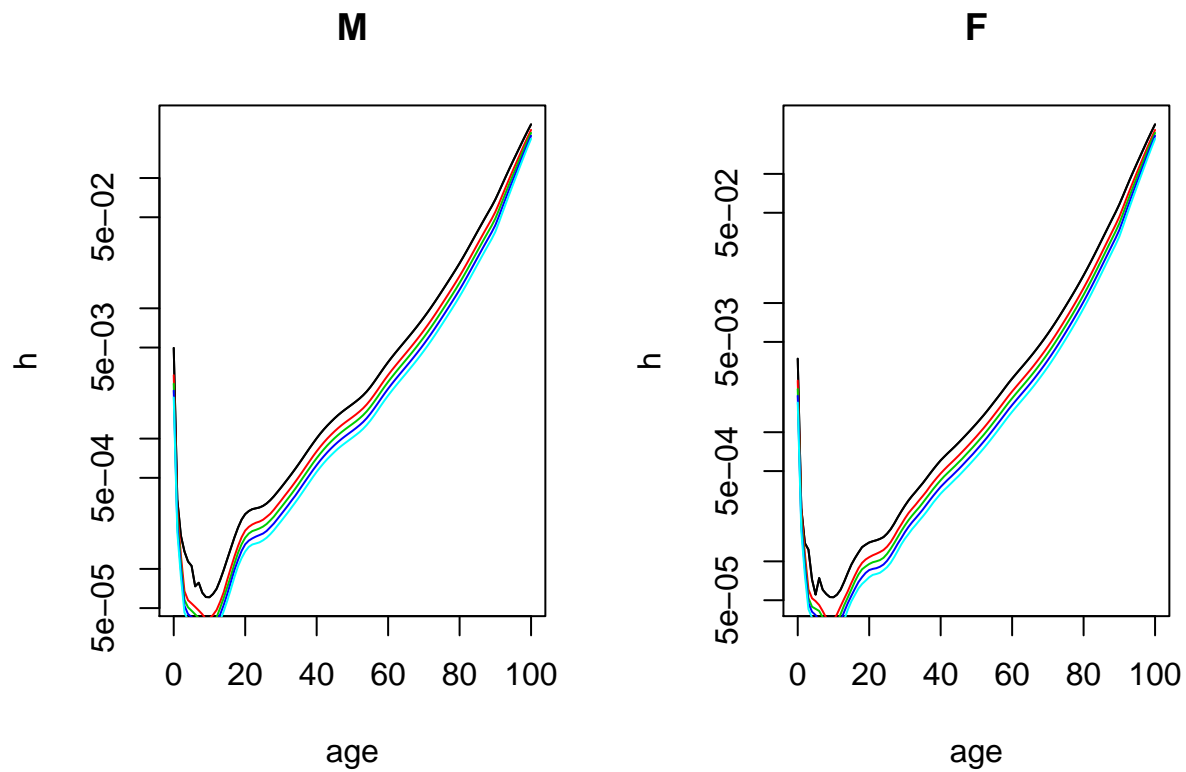
2 ONS lifetables

```r
lifetables <- read_lifetables()

par(mfrow= c(2,3))
for (i in seq_along(lifetables)) {
  plot(x = lifetables[[i]]$year[lifetables[[i]]$sex == "M"],
       y = lifetables[[i]]$qx[lifetables[[i]]$sex == "M"], log = "y", type = "l",
       main = lifetables[[i]]$year[1], ylab = "h", xlab = "year")
  lines(x = lifetables[[i]]$year[lifetables[[i]]$sex == "F"],
        y = lifetables[[i]]$qx[lifetables[[i]]$sex == "F"], log = "y", type = "l", col = "red")
}

par(mfrow= c(1,2))
```

```r
for (j in c("M","F")) {
  plot(x = lifetables[[1]]$age[lifetables[[1]]$sex == j],
       y = lifetables[[1]]$qx[lifetables[[1]]$sex == j], log = "y", type = "l",
       main = j, ylab = "h", xlab = "age")
  for (i in seq_along(lifetables)) {
    lines(x = lifetables[[i]]$age[lifetables[[i]]$sex == j],
          y = lifetables[[i]]$qx[lifetables[[i]]$sex == j], log = "y", type = "l", col = i)
  }
}
```

M **F**


```
## ggplot

ONS_lifetables <-
  do.call(rbind, lifetables) %>%
  cbind(id = rep(c(2011, 2030, 2040, 2050, 2060), each = 101))

ggplot(ONS_lifetables, aes(x = age, y = qx, colour = interaction(sex, id))) +
  geom_line() +
  # scale_y_continuous(trans='log2') +
  coord_trans(y = "log10") +
  theme_bw()
```
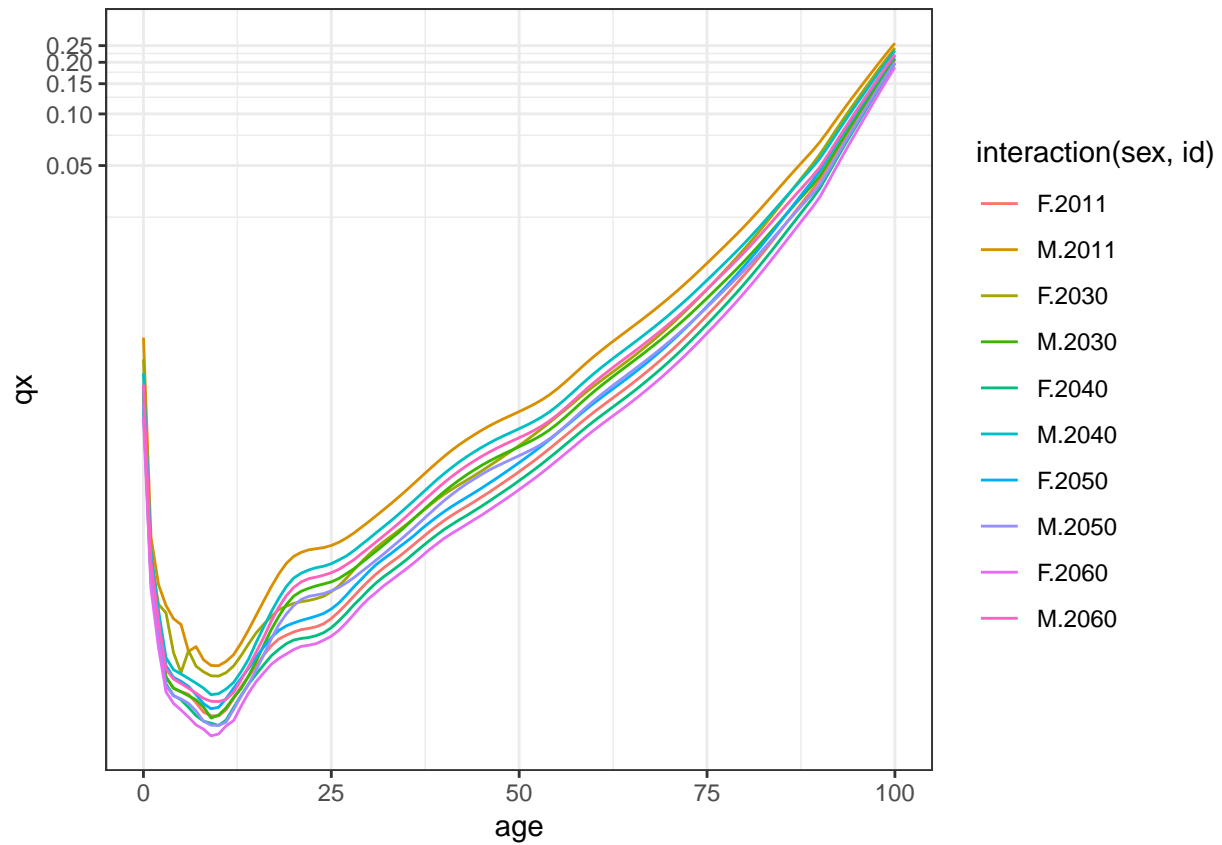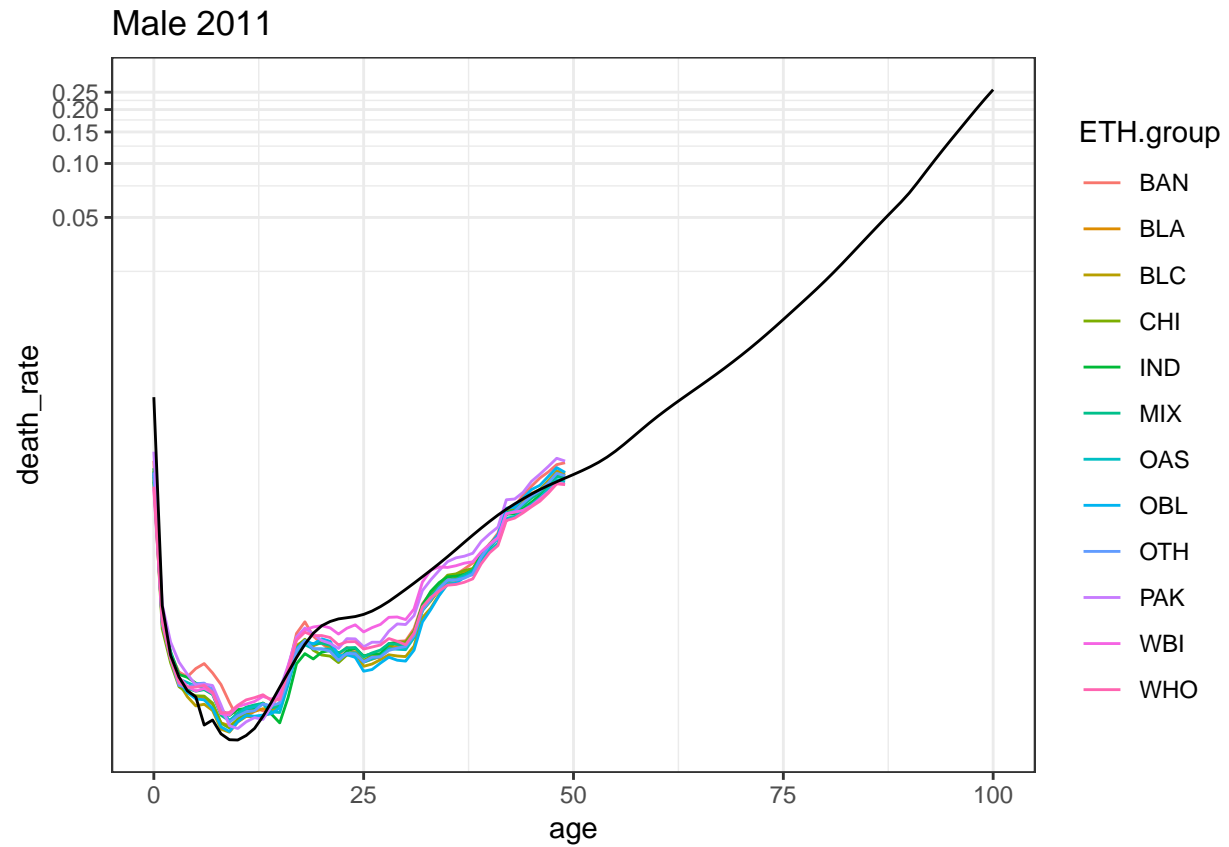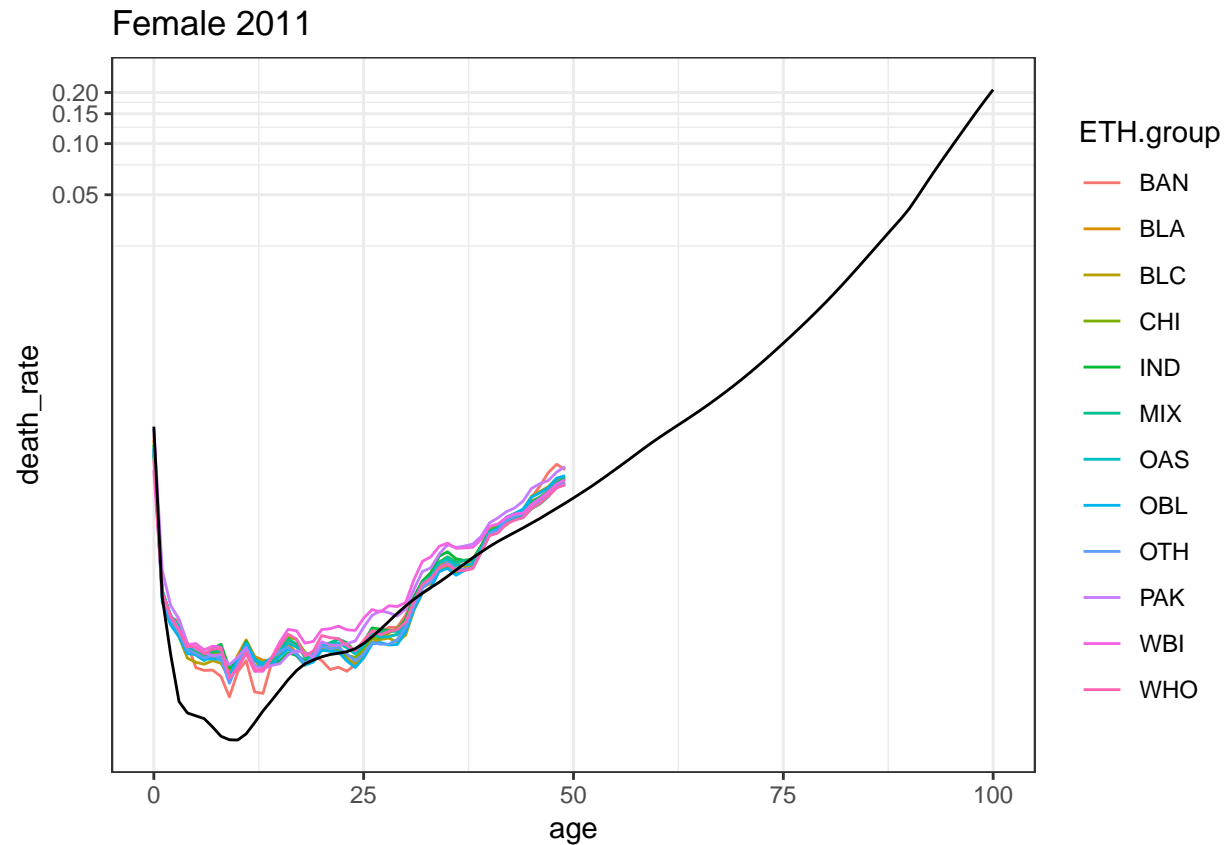
3   Comparison with ONS and ETHPOP

```r
ggplot(ETHPOP_lifetable_2011M, aes(x = age, y = death_rate, colour = ETH.group)) +
  geom_line() +
  coord_trans(y = "log10") +
  ggtitle("Male 2011") +
  theme_bw() +
  geom_line(aes(age, qx, colour = "ONS"),
            data = ONS_lifetables[ONS_lifetables$id == 2011 & ONS_lifetables$sex == "M", ],
            colour = "black")
```
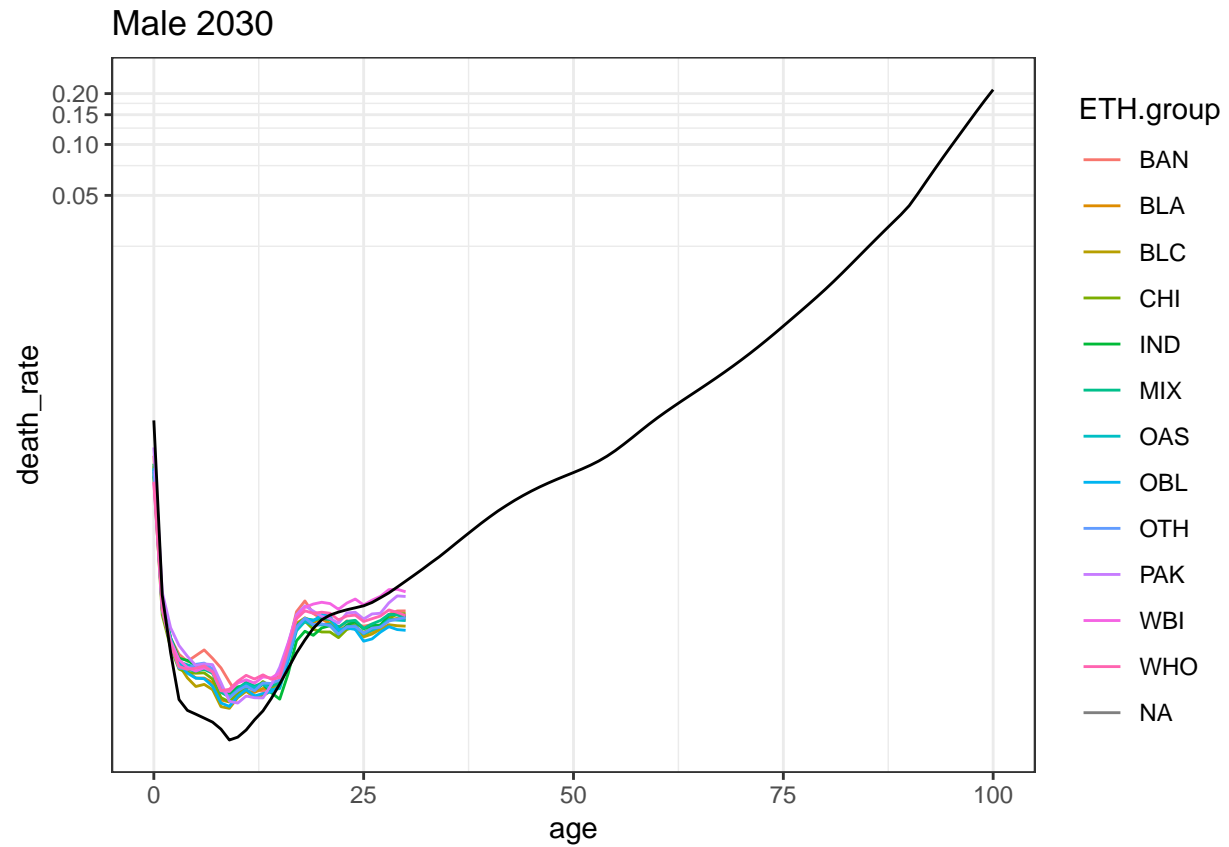
Male 2011

```
ggplot(ETHPOP_lifetable_2011F, aes(x = age, y = death_rate, colour = ETH.group)) +
  geom_line() +
  ggtitle("Female 2011") +
  coord_trans(y = "log10") +
  theme_bw() +
  geom_line(aes(age, qx, colour = "ONS"),
            data = ONS_lifetables[ONS_lifetables$id == 2011 & ONS_lifetables$sex == "F", ],
            colour = "black")
```
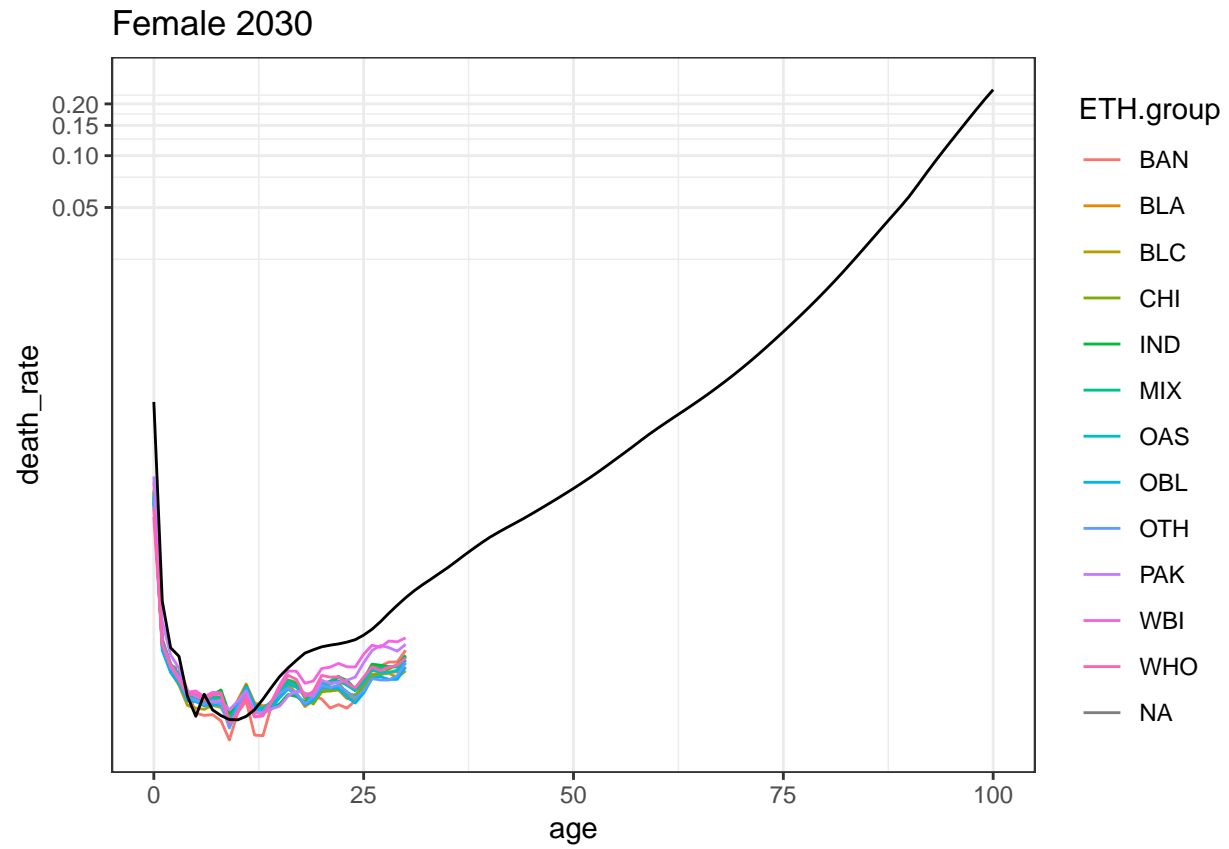
Female 2011


```
baseyr_2030 <- ETHPOP_lifetable$id[ETHPOP_lifetable$yr_age == "2030_0"][1]

ETHPOP_lifetable[ETHPOP_lifetable$id == baseyr_2030 & ETHPOP_lifetable$sex == "M", ] %>%
  ggplot(aes(x = age, y = death_rate, colour = ETH.group)) +
  geom_line() +
  coord_trans(y = "log10") +
  ggtitle("Male 2030") +
  theme_bw() +
  geom_line(aes(age, qx, colour = "ONS"),
            data = ONS_lifetables[ONS_lifetables$id == 2030 & ONS_lifetables$sex == "M", ],
            colour = "black")
```

```
ETHPOP_lifetable[ETHPOP_lifetable$id == baseyr_2030 & ETHPOP_lifetable$sex == "F", ] %>%
  ggplot(aes(x = age, y = death_rate, colour = ETH.group)) +
  geom_line() +
  ggtitle("Female 2030") +
  coord_trans(y = "log10") +
  theme_bw() +
  geom_line(aes(age, qx, colour = "ONS"),
            data = ONS_lifetables[ONS_lifetables$id == 2030 & ONS_lifetables$sex == "F", ],
            colour = "black")
```

Female 2030

4 Extrapolation of ETHPOP