International trends in cause-specific mortality among people with and without diabetes

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https://github.com/jimb0w/CM

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1 Data cleaning

This is the protocol for an analysis of trends in cause of death (COD) in people with and without diabetes across several countries over the period spanning 2000 to 2023.

We have been provided with many different variables and some countries have restrictions on what data they can provide, so we need to harmonize and clean the data into an analysable format.

The variables we will derive are:

- Calendar year
- Sex
- Mid-point age for the age-group
- Person-years of follow-up in people with diabetes
- Person-years of follow-up in people without diabetes
- Number of deaths for each COD in people with diabetes
- Number of deaths for each COD in people without diabetes

The COD are shown in Table 1.1.

Table 1.1: Causes of death in the present analysis

Causes of death	Abbreviation	ICD-10	ICD-9
Cardiovascular diseases	CVD	I00-I99	390-434, 436-459
Ischaemic heart diseases	CHD	I20-I25	410-414, 429.2
Cerebrovascular diseases	CBD	I60-I69	430-434, 436-438
Heart failure	HFD	I50	428
Cancer	CAN	C00-C97	140-208
Diabetes	DMD	E10-E14	250
Infectious diseases	INF	A00-B99	001–033, 034.1–134, 136–139, 771.3
Influenza and pneumonia	FLU	J09-J18	480-487
Chronic lower respiratory diseases	RES	J40-J47	490-494, 496
Liver diseases	LIV1	K70-K76	570-572, 573.0, 573.3-573.9
Liver diseases (exclude alcoholic liver disease)	LIV2	K71-K76	570, 571.4-571.9, 572, 573.0, 573.3-573.9
Renal diseases	CKD	N00-N08, N17-N19, N25-N27	580-589
Dementia	AZD	F00, F01, F03, G30	290.0-290.2, 290.4, 331.0

1.1 Australia

For Australia, we have the following variables (by age, sex, and calendar year): total population size, person-years in people with diabetes, deaths in people with diabetes, and deaths in the total population. We can calculate person-years in the total population by assuming that the person-years of follow-up in a given calendar year are equal to the population size in the current year plus the population size in the next year, divided by two [this has been performed before I got the dataset–JM]. From there, person-years in people without diabetes is just person-years in the total population minus person-years in people with diabetes. Similarly, for deaths in people without diabetes, we can subtract the deaths in people with diabetes from the total deaths.

Australian data restrictions prohibit the use of any cell count <6 for the diabetes population; thus, there are many blank values (see below). I will fill them in randomly, where the number can be any number from 0 to 5 with equal probability, unless the number of deaths in the total population for the age/sex group is <5, in which case the upper bound will be the number of deaths in the total population. Further, because of this, data has been provided in both 10-year age groups and overall (i.e., the actual counts). My intuition is that the small cell counts won't drive any overall results anyway, which I check below (Figure 1.1), and that the uncertainty associated with such low numbers will be reflected in very wide confidence intervals for the younger ages.

```
cd /home/jimb0w/Documents/CM

import delimited "Consortium COD database v10.csv", clear
replace age_gp1 = "0-39" if age_gp1=="<40"
drop azd_f01_d_dm-azd_g30_d_nondm
save uncleandbase, replace

set seed 3488717
use uncleandbase, clear
keep if substr(country,1,9)=="Australia"
keep if age_gp1!="" | age_gp4!=""
drop if cal < 2005
rename sex SEX
gen sex = 0 if SEX == "F"
replace sex = 1 if SEX == "M"
replace pys_nondm = pys_totpop-pys_dm
rename (alldeath_dm alldeath_nondm alldeath_totpop) (alldeath_d_dm alldeath_d_nondm alldeath_d_pop)

. ta age_gp1
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         34       14.29       14.29
      40-49 |         34       14.29       28.57
      50-59 |         34       14.29       42.86
      60-69 |         34       14.29       57.14
      70-79 |         34       14.29       71.43
      80-89 |         34       14.29       85.71
        90+ |         34       14.29      100.00
------------+-----------------------------------
      Total |        238      100.00
. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. di "`i´"
  3. ta age_gp1 if `i´_d_dm ==.
  4. gen max_`i´ = min(`i´_d_pop,5)
  5. quietly replace `i´_d_dm = runiformint(0,max_`i´) if `i´_d_dm ==.
  6. }
alldeath
no observations
can
```

age_gp1	Freq.	Percent	Cum.
0-39	3	100.00	100.00
Total	3	100.00	

cvd

age_gp1	Freq.	Percent	Cum.
0-39	5	100.00	100.00
Total	5	100.00	

chd

age_gp1	Freq.	Percent	Cum.
0-39	24	96.00	96.00
40-49	1	4.00	100.00
Total	25	100.00	

cbd

age_gp1	Freq.	Percent	Cum.
0-39	34	58.62	58.62
40-49	23	39.66	98.28
50-59	1	1.72	100.00
Total	58	100.00	

hfd

age_gp1	Freq.	Percent	Cum.
0-39	34	34.69	34.69
40-49	34	34.69	69.39
50-59	29	29.59	98.98
90+	1	1.02	100.00
Total	98	100.00	

res

age_gp1	Freq.	Percent	Cum.
0-39	34	48.57	48.57
40-49	33	47.14	95.71
50-59	3	4.29	100.00
Total	70	100.00	

azd

age_gp1	Freq.	Percent	Cum.
0-39	34	31.78	31.78
40-49	34	31.78	63.55
50-59	34	31.78	95.33
60-69	5	4.67	100.00
Total	107	100.00	

dmd

age_gp1	Freq.	Percent	Cum.
0-39	1	100.00	100.00
Total	1	100.00	

inf

age_gp1	Freq.	Percent	Cum.
0-39	34	58.62	58.62
40-49	20	34.48	93.10
50-59	1	1.72	94.83
90+	3	5.17	100.00

```
      Total |         58      100.00
flu
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         34       35.05       35.05
      40-49 |         34       35.05       70.10
      50-59 |         26       26.80       96.91
      60-69 |          3        3.09      100.00
------------+-----------------------------------
      Total |         97      100.00
ckd
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         34       44.16       44.16
      40-49 |         34       44.16       88.31
      50-59 |          9       11.69      100.00
------------+-----------------------------------
      Total |         77      100.00
liv1
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         34       48.57       48.57
      40-49 |         10       14.29       62.86
        90+ |         26       37.14      100.00
------------+-----------------------------------
      Total |         70      100.00
liv2
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         34       36.96       36.96
      40-49 |         29       31.52       68.48
      50-59 |          3        3.26       71.74
        90+ |         26       28.26      100.00
------------+-----------------------------------
      Total |         92      100.00
. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. di "`i´"
  3. count if `i´_d_dm > `i´_d_pop
  4. }
alldeath
  0
can
  0
cvd
  0
chd
  0
cbd
  0
hfd
  0
res
  0
azd
  0
dmd
  8
inf
  0
flu
  0
ckd
  0
liv1
  0
liv2
  0
```

```
. gen diff = dmd_d_dm-dmd_d_pop

. ta diff if diff >0

       diff |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |          5       62.50       62.50
          2 |          2       25.00       87.50
          5 |          1       12.50      100.00
------------+-----------------------------------
      Total |          8      100.00

. replace dmd_d_dm = dmd_d_pop if dmd_d_dm > dmd_d_pop
(8 real changes made)
```

We see that it is predominately younger age groups affected by missing data, which makes sense. Also, there were some age groups in which the number of deaths due to diabetes among people with diabetes was greater than that recorded for the whole population. This likely has to do with differences with how we (Australian researchers) and the Australian Institute of Health and Welfare (who supplied the total population numbers) define residence in a state, or something similar. The differences were tiny, so I have just corrected the diabetes counts to not be more than the total population counts.

We should also check that the randomly generated death counts haven't produced nonsensical results. This could happen in three ways:

1. The number of deaths in each cause of death together is greater than for all causes
2. The number of deaths in CHD, CBD, and HFD together is greater than for CVD as a whole
3. The number of deaths in liver disease (excluding alcoholic liver disease) is greater than liver disease.

In the first case, we can just regenerate the random numbers until the error goes away; in the second, we can set the maximum number of deaths for the simulation of the other three causes of death as that for CVD (and because order matters, we will do this in the order of CVD, CBD, and HFD, based on their relative frequency in the overall population/ages where there is data); and for the third, we can set the maximum number of deaths for liver disease (excluding alcoholic liver disease) as that for overall liver diease.

```
. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm +
> azd_d_dm > alldeath_d_dm
  0

. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  10

. ta age_gp1 if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         10      100.00      100.00
------------+-----------------------------------
      Total |         10      100.00

. replace max_chd = min(cvd_d_dm,5)
(5 real changes made)

. replace chd_d_dm = runiformint(0,max_chd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
(7 real changes made)

. replace max_cbd = min(cvd_d_dm-chd_d_dm,5)
(11 real changes made)

. replace cbd_d_dm = runiformint(0,max_cbd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
(5 real changes made)
```

```
. replace max_hfd = min(cvd_d_dm-chd_d_dm-cbd_d_dm,5)
(57 real changes made)

. replace hfd_d_dm = runiformint(0,max_hfd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
(5 real changes made)

. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  0

. count if liv1_d_dm < liv2_d_dm
  26

. ta age_gp1 if liv1_d_dm < liv2_d_dm

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         17       65.38       65.38
      40-49 |          2        7.69       73.08
        90+ |          7       26.92      100.00
------------+-----------------------------------
      Total |         26      100.00

. replace max_liv2 = min(liv1_d_dm,5)
(54 real changes made)

. replace liv2_d_dm = runiformint(0,max_liv2) if liv1_d_dm < liv2_d_dm
(26 real changes made)

. count if liv1_d_dm < liv2_d_dm
  0

. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. quietly replace `i´_d_nondm = `i´_d_pop-`i´_d_dm
  3. }

. count if cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_
> d_nondm + ckd_d_nondm + azd_d_nondm > alldeath_d_nondm
  0


*mkdir GPH
preserve
gen agegp = 1 if age_gp1!=""
replace agegp = 2 if age_gp4!=""
collapse (sum) pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-azd_d_nondm, by(calendar agegp)
foreach i in can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
if "`i´" == "can" {
local ii = "Cancer"
}
if "`i´" == "cvd" {
local ii = "Cardiovascular disease"
}
if "`i´" == "cbd" {
local ii = "Cerebrovascular disease"
}
if "`i´" == "res" {
local ii = "Chronic lower respiratory disease"
}
if "`i´" == "chd" {
local ii = "Coronary heart disease"
}
if "`i´" == "azd" {
local ii = "Dementia"
}
if "`i´" == "dmd" {
local ii = "Diabetes"
}
if "`i´" == "hfd" {
local ii = "Heart failure"
}
if "`i´" == "inf" {
local ii = "Infectious diseases"
}
if "`i´" == "flu" {
```

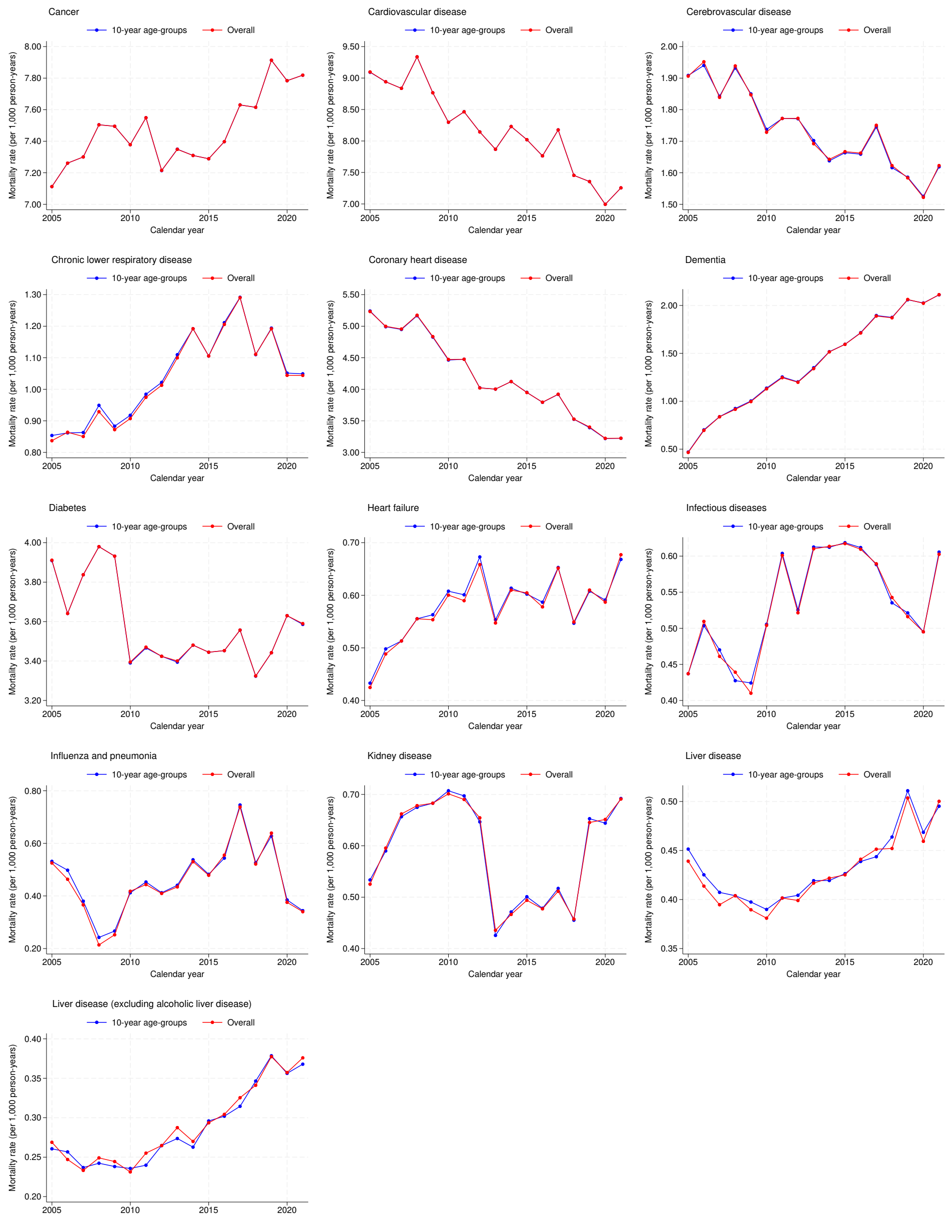
```
local ii = "Influenza and pneumonia"
}
if "`i´" == "ckd" {
local ii = "Kidney disease"
}
if "`i´" == "liv1" {
local ii = "Liver disease"
}
if "`i´" == "liv2" {
local ii = "Liver disease (excluding alcoholic liver disease)"
}
gen dm_`i´ = 1000*`i´_d_dm/pys_dm
twoway ///
(connected dm_`i´ cal if agegp == 1, col(blue)) ///
(connected dm_`i´ cal if agegp == 2, col(red)) ///
, graphregion(color(white)) ///
ytitle(Mortality rate (per 1,000 person-years)) ///
xtitle(Calendar year) ///
legend(order( ///
1 "10-year age-groups" ///
2 "Overall" ///
) cols(3) position(12) region(lcolor(none) color(none))) ///
ylabel(,angle(0) format(%9.2f)) ///
title("`ii´", placement(west) size(medium) col(black))
graph save GPH/dm_`i´_chk1, replace
}
restore

graph combine ///
GPH/dm_can_chk1.gph ///
GPH/dm_cvd_chk1.gph ///
GPH/dm_cbd_chk1.gph ///
GPH/dm_res_chk1.gph ///
GPH/dm_chd_chk1.gph ///
GPH/dm_azd_chk1.gph ///
GPH/dm_dmd_chk1.gph ///
GPH/dm_hfd_chk1.gph ///
GPH/dm_inf_chk1.gph ///
GPH/dm_flu_chk1.gph ///
GPH/dm_ckd_chk1.gph ///
GPH/dm_liv1_chk1.gph ///
GPH/dm_liv2_chk1.gph ///
, graphregion(color(white)) cols(3) altshrink xsize(3.5)
> tes.)
```

So, from Figure 1.1 we see that there doesn't appear to be any systematic issue introduced using random numbers. I will assume the mid-point of the age interval for people with diabetes aged <40 is 35, for people without diabetes aged <40 is 20, and for both people with and without diabetes aged 90+ is 95.

```
keep if age_gp1!=""
replace country = substr(country,1,9)
gen age_dm = substr(age_gp1,1,2)
replace age_dm = "30" if age_dm == "0-"
destring age_dm, replace
replace age_dm = age_dm+5
gen age_nondm = substr(age_gp1,1,2)
replace age_nondm = "15" if age_nondm == "0-"
destring age_nondm, replace
replace age_nondm = age_nondm+5
keep country calendar sex alldeath_d_dm alldeath_d_nondm age_dm age_nondm pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-
save Australia, replace
```

Figure 1.1: Crude mortality rate by age-grouping method, by cause of death. Australia. People with diabetes.



1.2 Canada (Alberta)

For Canada (Alberta), we have the following variables (by age, sex, and calendar year): total population size, prevalence of diabetes, incidence of diabetes, deaths in people with diabetes, and deaths in the total population. We can calculate person-years in the total population by assuming that the person-years of follow-up in a given calendar year are equal to the population size in the current year plus the population size in the next year, divided by two [this has been performed before I got the dataset–JM]. We can calculate person-years in people with diabetes, in a given calendar year, by adding the number of people with prevalent diabetes to half the number of people with incident diabetes and subtracting half the number of all-cause deaths [again, performed before I got the dataset–JM]. From there, person-years in people without diabetes is just person-years in the total population minus person-years in people with diabetes. Similarly, for deaths in people without diabetes, we can subtract the deaths in people with diabetes from the total deaths.

Alberta data restrictions prohibit the use of any cell count between 1 and 9 for people with diabetes and in the total population; thus, there are many blank values (see below). I will fill them in randomly, where the number can be any number from 1 to 9 with equal probability, unless the number of deaths in the total population for the age/sex group is <9 (after being randomly generated), in which case the upper bound will be the number of deaths in the total population.

Sense checks will be as for Australia, above.

```
set seed 17812854
use uncleandbase, clear
keep if substr(country,1,9)=="Canada (A"
rename sex SEX
gen sex = 0 if SEX == "F"
replace sex = 1 if SEX == "M"
replace pys_nondm = pys_totpop-pys_dm
rename (alldeath_dm alldeath_nondm alldeath_totpop) (alldeath_d_dm alldeath_d_nondm alldeath_d_pop)
```

```
. ta age_gp1

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         32       14.29       14.29
      40-49 |         32       14.29       28.57
      50-59 |         32       14.29       42.86
      60-69 |         32       14.29       57.14
      70-79 |         32       14.29       71.43
      80-89 |         32       14.29       85.71
        90+ |         32       14.29      100.00
------------+-----------------------------------
      Total |        224      100.00
. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. di "`i´"
  3. ta age_gp1 if `i´_d_pop ==.
  4. gen min_`i´ = max(`i´_d_dm,1) if `i´_d_dm!=.
  5. replace min_`i´ = 1 if `i´_d_dm==.
  6. replace `i´_d_dm=0 if `i´_d_pop==0
  7. quietly replace `i´_d_pop = runiformint(min_`i´,9) if `i´_d_pop==.
  8. ta age_gp1 if `i´_d_dm ==.
  9. gen max_`i´ = min(`i´_d_pop,9)
 10. quietly replace `i´_d_dm = runiformint(1,max_`i´) if `i´_d_dm ==.
 11. }
alldeath
no observations
(0 real changes made)
(0 real changes made)
no observations
can
no observations
```

```
(12 missing values generated)
(12 real changes made)
(0 real changes made)
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          6       50.00       50.00
      40-49 |          6       50.00      100.00
------------+-----------------------------------
      Total |         12      100.00
cvd
no observations
(14 missing values generated)
(14 real changes made)
(0 real changes made)
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          7       50.00       50.00
      40-49 |          7       50.00      100.00
------------+-----------------------------------
      Total |         14      100.00
chd
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          2       50.00       50.00
      40-49 |          2       50.00      100.00
------------+-----------------------------------
      Total |          4      100.00
(24 missing values generated)
(24 real changes made)
(0 real changes made)
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         12       50.00       50.00
      40-49 |         12       50.00      100.00
------------+-----------------------------------
      Total |         24      100.00
cbd
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         11       50.00       50.00
      40-49 |         11       50.00      100.00
------------+-----------------------------------
      Total |         22      100.00
(62 missing values generated)
(62 real changes made)
(0 real changes made)
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         12       19.35       19.35
      40-49 |         23       37.10       56.45
      50-59 |         23       37.10       93.55
      60-69 |          4        6.45      100.00
------------+-----------------------------------
      Total |         62      100.00
hfd
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         12       17.65       17.65
      40-49 |         10       14.71       32.35
      50-59 |         25       36.76       69.12
      60-69 |         21       30.88      100.00
------------+-----------------------------------
      Total |         68      100.00
(61 missing values generated)
(61 real changes made)
(0 real changes made)
```

age_gp1	Freq.	Percent	Cum.
0-39	1	1.64	1.64
40-49	3	4.92	6.56
50-59	23	37.70	44.26
60-69	26	42.62	86.89
70-79	3	4.92	91.80
90+	5	8.20	100.00
Total	61	100.00	

res

age_gp1	Freq.	Percent	Cum.
0-39	29	50.00	50.00
40-49	29	50.00	100.00
Total	58	100.00	

(50 missing values generated)
(50 real changes made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	5	10.00	10.00
40-49	18	36.00	46.00
50-59	23	46.00	92.00
90+	4	8.00	100.00
Total	50	100.00	

azd

age_gp1	Freq.	Percent	Cum.
0-39	3	17.65	17.65
40-49	3	17.65	35.29
50-59	8	47.06	82.35
60-69	3	17.65	100.00
Total	17	100.00	

(25 missing values generated)
(25 real changes made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
50-59	10	40.00	40.00
60-69	12	48.00	88.00
70-79	1	4.00	92.00
90+	2	8.00	100.00
Total	25	100.00	

dmd

age_gp1	Freq.	Percent	Cum.
0-39	13	48.15	48.15
40-49	13	48.15	96.30
50-59	1	3.70	100.00
Total	27	100.00	

(37 missing values generated)
(37 real changes made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	17	45.95	45.95
40-49	18	48.65	94.59
50-59	2	5.41	100.00
Total	37	100.00	

inf

age_gp1	Freq.	Percent	Cum.
0-39	14	45.16	45.16
40-49	14	45.16	90.32
50-59	3	9.68	100.00
Total	31	100.00	

(104 missing values generated)
(104 real changes made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	13	12.50	12.50
40-49	26	25.00	37.50
50-59	28	26.92	64.42
60-69	11	10.58	75.00
70-79	4	3.85	78.85
80-89	3	2.88	81.73
90+	19	18.27	100.00
Total	104	100.00	

flu

age_gp1	Freq.	Percent	Cum.
0-39	24	45.28	45.28
40-49	24	45.28	90.57
50-59	5	9.43	100.00
Total	53	100.00	

(95 missing values generated)
(95 real changes made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	14	14.74	14.74
40-49	22	23.16	37.89
50-59	28	29.47	67.37
60-69	22	23.16	90.53
70-79	7	7.37	97.89
90+	2	2.11	100.00
Total	95	100.00	

ckd

age_gp1	Freq.	Percent	Cum.
0-39	26	27.37	27.37
40-49	27	28.42	55.79
50-59	31	32.63	88.42
60-69	11	11.58	100.00
Total	95	100.00	

(96 missing values generated)
(96 real changes made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	10	10.42	10.42
40-49	15	15.62	26.04
50-59	27	28.12	54.17
60-69	24	25.00	79.17
70-79	4	4.17	83.33
90+	16	16.67	100.00
Total	96	100.00	

liv1

```
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |         16       48.48       48.48
       80-89 |          1        3.03       51.52
         90+ |         16       48.48      100.00
-------------+-----------------------------------
       Total |         33      100.00
(113 missing values generated)
(113 real changes made)
(0 real changes made)
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |         19       16.81       16.81
       40-49 |         28       24.78       41.59
       50-59 |         10        8.85       50.44
       60-69 |          3        2.65       53.10
       70-79 |          7        6.19       59.29
       80-89 |         24       21.24       80.53
         90+ |         22       19.47      100.00
-------------+-----------------------------------
       Total |        113      100.00
liv2
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |         28       33.33       33.33
       40-49 |         26       30.95       64.29
       50-59 |          2        2.38       66.67
       60-69 |          1        1.19       67.86
       80-89 |          4        4.76       72.62
         90+ |         23       27.38      100.00
-------------+-----------------------------------
       Total |         84      100.00
(126 missing values generated)
(126 real changes made)
(0 real changes made)
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |         11        8.73        8.73
       40-49 |         22       17.46       26.19
       50-59 |         26       20.63       46.83
       60-69 |          9        7.14       53.97
       70-79 |         11        8.73       62.70
       80-89 |         25       19.84       82.54
         90+ |         22       17.46      100.00
-------------+-----------------------------------
       Total |        126      100.00
. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. di "`i´"
  3. count if `i´_d_dm > `i´_d_pop
  4. }
alldeath
  0
can
  0
cvd
  0
chd
  0
cbd
  0
hfd
  0
res
  0
azd
  0
dmd
```

```
  0
inf
  0
flu
  0
ckd
  0
liv1
  0
liv2
  0
. count if cvd_d_pop + can_d_pop + dmd_d_pop + inf_d_pop + flu_d_pop + res_d_pop + liv1_d_pop + ckd_d_pop + azd_d_pop > a
  0
. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm > alldeath_d
  2
. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. quietly replace `i´_d_dm = runiformint(1,max_`i´) if (cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_d
  3. }
. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm > alldeath_d
  0
. count if chd_d_pop + cbd_d_pop + hfd_d_pop > cvd_d_pop
  0
. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  23
. ta age_gp1 if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         12       52.17       52.17
      40-49 |          8       34.78       86.96
      50-59 |          3       13.04      100.00
------------+-----------------------------------
      Total |         23      100.00
. replace max_chd = min(cvd_d_dm,9)
(35 real changes made)
. replace chd_d_dm = runiformint(1,max_chd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm & inrange(chd_d_dm,1,9)
(16 real changes made)
. replace max_cbd = min(cvd_d_dm-chd_d_dm,9)
(59 real changes made)
. replace cbd_d_dm = runiformint(0,max_cbd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm & inrange(cbd_d_dm,1,9)
(15 real changes made)
. replace max_hfd = min(cvd_d_dm-chd_d_dm-cbd_d_dm,9)
(107 real changes made)
. replace hfd_d_dm = runiformint(0,max_hfd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm & inrange(hfd_d_dm,1,9)
(2 real changes made)
. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  0
. count if liv1_d_pop < liv2_d_pop
  23
. ta age_gp1 if liv1_d_pop < liv2_d_pop

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         11       47.83       47.83
        90+ |         12       52.17      100.00
------------+-----------------------------------
      Total |         23      100.00
. replace max_liv2 = min(liv1_d_pop,9)
(79 real changes made)
. replace liv2_d_pop = runiformint(1,max_liv2) if liv1_d_pop < liv2_d_pop & inrange(liv2_d_pop,1,9)
(23 real changes made)
. count if liv1_d_pop < liv2_d_pop
  0
```

```
. count if liv1_d_dm < liv2_d_dm
  36

. ta age_gp1 if liv1_d_dm < liv2_d_dm

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          2        5.56        5.56
      40-49 |          4       11.11       16.67
      50-59 |          7       19.44       36.11
      60-69 |          2        5.56       41.67
      70-79 |          2        5.56       47.22
      80-89 |          8       22.22       69.44
        90+ |         11       30.56      100.00
------------+-----------------------------------
      Total |         36      100.00

. replace max_liv2 = min(liv1_d_dm,liv2_d_pop,9)
(124 real changes made)

. replace liv2_d_dm = runiformint(1,max_liv2) if ((liv1_d_dm < liv2_d_dm) | liv2_d_dm > liv2_d_pop & liv2_d_dm!=.) & inra
(38 real changes made)

. count if liv1_d_dm < liv2_d_dm
  0

. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. quietly replace `i´_d_nondm = `i´_d_pop-`i´_d_dm
  3. }

. count if cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_d_nondm + ckd_d_nondm
  0


keep if age_gp1!=""
replace country = "Canada1"
gen age_dm = substr(age_gp1,1,2)
replace age_dm = "30" if age_dm == "0-"
destring age_dm, replace
replace age_dm = age_dm+5
gen age_nondm = substr(age_gp1,1,2)
replace age_nondm = "15" if age_nondm == "0-"
destring age_nondm, replace
replace age_nondm = age_nondm+5
keep country calendar sex alldeath_d_dm alldeath_d_nondm age_dm age_nondm pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-
save Canada1, replace
```

1.3 Canada (Ontario)

For Canada (Ontario), we have the following variables (by age, sex, and calendar year): total population size, prevalence of diabetes, incidence of diabetes, person-years in people with diabetes, deaths in people with diabetes, and deaths in the total population. We can calculate person-years in the total population by assuming that the person-years of follow-up in a given calendar year are equal to the population size in the current year plus the population size in the next year, divided by two [this has been performed before I got the dataset–JM]. From there, person-years in people without diabetes is just person-years in the total population minus person-years in people with diabetes. Similarly, for deaths in people without diabetes, we can subtract the deaths in people with diabetes from the total deaths.

Ontario data restrictions prohibit the use of any cell count between 1 and 5 for people with diabetes and in the total population. I will fill them in randomly, where the number can be any number from 1 to 5 with equal probability, unless the number of deaths in the total population for the age/sex group is <5 (after being randomly generated), in which case the upper bound will be the number of deaths in the total population.

Sense checks will be as for Australia, above.

```
set seed 46792303
use uncleandbase, clear
keep if substr(country,1,9)=="Canada (O"
drop if cal < 2013
rename sex SEX
gen sex = 0 if SEX == "F"
replace sex = 1 if SEX == "M"
replace pys_nondm = pys_totpop-pys_dm
rename (alldeath_dm alldeath_nondm alldeath_totpop) (alldeath_d_dm alldeath_d_nondm alldeath_d_pop)
```

```
. ta age_gp1

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         12       14.29       14.29
      40-49 |         12       14.29       28.57
      50-59 |         12       14.29       42.86
      60-69 |         12       14.29       57.14
      70-79 |         12       14.29       71.43
      80-89 |         12       14.29       85.71
        90+ |         12       14.29      100.00
------------+-----------------------------------
      Total |         84      100.00
. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. di "`i´"
  3. ta age_gp1 if `i´_d_pop ==.
  4. gen min_`i´ = max(`i´_d_dm,1) if `i´_d_dm!=.
  5. replace min_`i´ = 1 if `i´_d_dm==.
  6. replace `i´_d_dm=0 if `i´_d_pop==0
  7. quietly replace `i´_d_pop = runiformint(min_`i´,5) if `i´_d_pop==.
  8. ta age_gp1 if `i´_d_dm ==.
  9. gen max_`i´ = min(`i´_d_pop,5)
 10. quietly replace `i´_d_dm = runiformint(1,max_`i´) if `i´_d_dm ==.
 11. }
alldeath
no observations
(0 real changes made)
(0 real changes made)
no observations
can
no observations
(1 missing value generated)
(1 real change made)
```

(0 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	1	100.00	100.00
Total	1	100.00	

cvd
no observations
(1 missing value generated)
(1 real change made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	1	100.00	100.00
Total	1	100.00	

chd

age_gp1	Freq.	Percent	Cum.
0-39	3	100.00	100.00
Total	3	100.00	

(9 missing values generated)
(9 real changes made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	9	100.00	100.00
Total	9	100.00	

cbd

age_gp1	Freq.	Percent	Cum.
0-39	1	100.00	100.00
Total	1	100.00	

(17 missing values generated)
(17 real changes made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	7	41.18	41.18
40-49	10	58.82	100.00
Total	17	100.00	

hfd

age_gp1	Freq.	Percent	Cum.
0-39	11	50.00	50.00
40-49	11	50.00	100.00
Total	22	100.00	

(13 missing values generated)
(13 real changes made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	2	15.38	15.38
40-49	8	61.54	76.92
50-59	3	23.08	100.00
Total	13	100.00	

res

age_gp1	Freq.	Percent	Cum.

0-39	9	75.00	75.00
40-49	3	25.00	100.00
Total	12	100.00	

(10 missing values generated)
(10 real changes made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	2	20.00	20.00
40-49	8	80.00	100.00
Total	10	100.00	

azd

age_gp1	Freq.	Percent	Cum.
40-49	5	83.33	83.33
50-59	1	16.67	100.00
Total	6	100.00	

(10 missing values generated)
(10 real changes made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
40-49	1	10.00	10.00
50-59	9	90.00	100.00
Total	10	100.00	

dmd
no observations
(0 real changes made)
(0 real changes made)
no observations
inf
no observations
(19 missing values generated)
(19 real changes made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	12	63.16	63.16
40-49	7	36.84	100.00
Total	19	100.00	

flu
no observations
(17 missing values generated)
(17 real changes made)
(0 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	12	70.59	70.59
40-49	5	29.41	100.00
Total	17	100.00	

ckd

age_gp1	Freq.	Percent	Cum.
0-39	7	87.50	87.50
40-49	1	12.50	100.00
Total	8	100.00	

(16 missing values generated)
(16 real changes made)
(0 real changes made)

```
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |          9       56.25       56.25
       40-49 |          7       43.75      100.00
-------------+-----------------------------------
       Total |         16      100.00
liv1
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |          1      100.00      100.00
-------------+-----------------------------------
       Total |          1      100.00
(21 missing values generated)
(21 real changes made)
(0 real changes made)
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |          7       33.33       33.33
       40-49 |          7       33.33       66.67
         90+ |          7       33.33      100.00
-------------+-----------------------------------
       Total |         21      100.00
liv2
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |          4      100.00      100.00
-------------+-----------------------------------
       Total |          4      100.00
(21 missing values generated)
(21 real changes made)
(0 real changes made)
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |          6       28.57       28.57
       40-49 |          8       38.10       66.67
         90+ |          7       33.33      100.00
-------------+-----------------------------------
       Total |         21      100.00
. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. di "`i´"
  3. count if `i´_d_dm > `i´_d_pop
  4. }
alldeath
  0
can
  0
cvd
  0
chd
  0
cbd
  0
hfd
  0
res
  0
azd
  0
dmd
  0
inf
  0
flu
  0
ckd
  0
liv1
```

```
  0
liv2
  0

. count if cvd_d_pop + can_d_pop + dmd_d_pop + inf_d_pop + flu_d_pop + res_d_pop + liv1_d_pop + ckd_d_pop + azd_d_pop > a
  0

. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm > alldeath_d
  0

. count if chd_d_pop + cbd_d_pop + hfd_d_pop > cvd_d_pop
  0

. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  1

. ta age_gp1 if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          1      100.00      100.00
------------+-----------------------------------
      Total |          1      100.00

. replace max_chd = min(cvd_d_dm,5)
(3 real changes made)

. replace chd_d_dm = runiformint(1,max_chd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm & inrange(chd_d_dm,1,5)
(1 real change made)

. replace max_cbd = min(cvd_d_dm-chd_d_dm,5)
(3 real changes made)

. replace cbd_d_dm = runiformint(0,max_cbd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm & inrange(cbd_d_dm,1,5)
(1 real change made)

. replace max_hfd = min(cvd_d_dm-chd_d_dm-cbd_d_dm,5)
(17 real changes made)

. replace hfd_d_dm = runiformint(0,max_hfd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm & inrange(hfd_d_dm,1,5)
(0 real changes made)

. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  0

. count if liv1_d_pop < liv2_d_pop
  1

. ta age_gp1 if liv1_d_pop < liv2_d_pop

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          1      100.00      100.00
------------+-----------------------------------
      Total |          1      100.00

. replace max_liv2 = min(liv1_d_pop,9)
(96 real changes made)

. replace liv2_d_pop = runiformint(1,max_liv2) if liv1_d_pop < liv2_d_pop & inrange(liv2_d_pop,1,9)
(1 real change made)

. count if liv1_d_pop < liv2_d_pop
  0

. count if liv1_d_dm < liv2_d_dm
  6

. ta age_gp1 if liv1_d_dm < liv2_d_dm

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          2       33.33       33.33
      40-49 |          2       33.33       66.67
        90+ |          2       33.33      100.00
------------+-----------------------------------
      Total |          6      100.00

. replace max_liv2 = min(liv1_d_dm,9)
(35 real changes made)

. replace liv2_d_dm = runiformint(1,max_liv2) if liv1_d_dm < liv2_d_dm & inrange(liv2_d_dm,1,9)
(6 real changes made)

. count if liv1_d_dm < liv2_d_dm
```

```
  0
. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. quietly replace `i´_d_nondm = `i´_d_pop-`i´_d_dm
  3. }
. count if cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_d_nondm + ckd_d_nondm
  0


keep if age_gp1!=""
replace country = "Canada2"
gen age_dm = substr(age_gp1,1,2)
replace age_dm = "30" if age_dm == "0-"
destring age_dm, replace
replace age_dm = age_dm+5
gen age_nondm = substr(age_gp1,1,2)
replace age_nondm = "15" if age_nondm == "0-"
destring age_nondm, replace
replace age_nondm = age_nondm+5
keep country calendar sex alldeath_d_dm alldeath_d_nondm age_dm age_nondm pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-
save Canada2, replace
```

1.4 Denmark

For Denmark, we have the following variables (by age, sex, and calendar year): Person-years and deaths in people with and without diabetes. I.e., no further variables need to be derived. Denmark restricts counts between 1 and 3 for both people with and without diabetes. I will fill them in randomly, where the number can be any number from 1 to 3 with equal probability. I will assume the mid-point of the age interval for people aged <40 is 35 and for 90+ is 95.

```
set seed 10239835
use uncleandbase, clear
keep if substr(country,1,7)=="Denmark"
rename sex SEX
gen sex = 0 if SEX == "F"
replace sex = 1 if SEX == "M"
rename (alldeath_dm alldeath_nondm alldeath_totpop) (alldeath_d_dm alldeath_d_nondm alldeath_d_pop)
```

```
. ta age_gp1

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         36       14.29       14.29
      40-49 |         36       14.29       28.57
      50-59 |         36       14.29       42.86
      60-69 |         36       14.29       57.14
      70-79 |         36       14.29       71.43
      80-89 |         36       14.29       85.71
        90+ |         36       14.29      100.00
------------+-----------------------------------
      Total |        252      100.00
. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. di "`i´"
  3. ta age_gp1 if `i´_d_nondm ==.
  4. replace `i´_d_nondm = runiformint(1,3) if `i´_d_nondm==.
  5. ta age_gp1 if `i´_d_dm ==.
  6. replace `i´_d_dm = runiformint(1,3) if `i´_d_dm ==.
  7. }
alldeath
no observations
(0 real changes made)
no observations
(0 real changes made)
can
no observations
(0 real changes made)

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         23      100.00      100.00
------------+-----------------------------------
      Total |         23      100.00
(23 real changes made)
cvd
no observations
(0 real changes made)

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         24       96.00       96.00
      40-49 |          1        4.00      100.00
------------+-----------------------------------
      Total |         25      100.00
(25 real changes made)
chd

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         12      100.00      100.00
------------+-----------------------------------
```

```
      Total |         12      100.00
(12 real changes made)
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         18       58.06       58.06
      40-49 |         13       41.94      100.00
------------+-----------------------------------
      Total |         31      100.00
(31 real changes made)
cbd
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          3      100.00      100.00
------------+-----------------------------------
      Total |          3      100.00
(3 real changes made)
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         11       29.73       29.73
      40-49 |         26       70.27      100.00
------------+-----------------------------------
      Total |         37      100.00
(37 real changes made)
hfd
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         14       31.82       31.82
      40-49 |         22       50.00       81.82
      50-59 |          8       18.18      100.00
------------+-----------------------------------
      Total |         44      100.00
(44 real changes made)
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          6       13.95       13.95
      40-49 |         15       34.88       48.84
      50-59 |         21       48.84       97.67
      60-69 |          1        2.33      100.00
------------+-----------------------------------
      Total |         43      100.00
(43 real changes made)
res
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         25       92.59       92.59
      40-49 |          2        7.41      100.00
------------+-----------------------------------
      Total |         27      100.00
(27 real changes made)
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          5       14.29       14.29
      40-49 |         28       80.00       94.29
      50-59 |          2        5.71      100.00
------------+-----------------------------------
      Total |         35      100.00
(35 real changes made)
azd
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          3       10.00       10.00
      40-49 |         13       43.33       53.33
      50-59 |         14       46.67      100.00
------------+-----------------------------------
      Total |         30      100.00
(30 real changes made)
```

age_gp1	Freq.	Percent	Cum.
40-49	1	3.85	3.85
50-59	8	30.77	34.62
60-69	16	61.54	96.15
90+	1	3.85	100.00
Total	26	100.00	

(26 real changes made)
dmd

age_gp1	Freq.	Percent	Cum.
0-39	8	12.12	12.12
40-49	21	31.82	43.94
50-59	17	25.76	69.70
60-69	13	19.70	89.39
70-79	1	1.52	90.91
90+	6	9.09	100.00
Total	66	100.00	

(66 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	11	91.67	91.67
40-49	1	8.33	100.00
Total	12	100.00	

(12 real changes made)
inf

age_gp1	Freq.	Percent	Cum.
0-39	16	88.89	88.89
40-49	2	11.11	100.00
Total	18	100.00	

(18 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	10	19.23	19.23
40-49	20	38.46	57.69
50-59	18	34.62	92.31
60-69	2	3.85	96.15
90+	2	3.85	100.00
Total	52	100.00	

(52 real changes made)
flu

age_gp1	Freq.	Percent	Cum.
0-39	22	84.62	84.62
40-49	4	15.38	100.00
Total	26	100.00	

(26 real changes made)

age_gp1	Freq.	Percent	Cum.
0-39	8	15.09	15.09
40-49	18	33.96	49.06
50-59	23	43.40	92.45
60-69	4	7.55	100.00
Total	53	100.00	

(53 real changes made)
ckd

age_gp1	Freq.	Percent	Cum.

```
              |
--------------+-----------------------------------
         0-39 |         20       37.74       37.74
        40-49 |         25       47.17       84.91
        50-59 |          8       15.09      100.00
--------------+-----------------------------------
        Total |         53      100.00
(53 real changes made)
      age_gp1 |      Freq.     Percent        Cum.
--------------+-----------------------------------
         0-39 |          3        4.92        4.92
        40-49 |         11       18.03       22.95
        50-59 |         24       39.34       62.30
        60-69 |         11       18.03       80.33
        70-79 |          2        3.28       83.61
          90+ |         10       16.39      100.00
--------------+-----------------------------------
        Total |         61      100.00
(61 real changes made)
liv1
      age_gp1 |      Freq.     Percent        Cum.
--------------+-----------------------------------
         0-39 |          7       29.17       29.17
          90+ |         17       70.83      100.00
--------------+-----------------------------------
        Total |         24      100.00
(24 real changes made)
      age_gp1 |      Freq.     Percent        Cum.
--------------+-----------------------------------
         0-39 |         15       28.30       28.30
        40-49 |         12       22.64       50.94
        80-89 |         11       20.75       71.70
          90+ |         15       28.30      100.00
--------------+-----------------------------------
        Total |         53      100.00
(53 real changes made)
liv2
      age_gp1 |      Freq.     Percent        Cum.
--------------+-----------------------------------
         0-39 |         20       33.90       33.90
        40-49 |         19       32.20       66.10
        50-59 |          3        5.08       71.19
          90+ |         17       28.81      100.00
--------------+-----------------------------------
        Total |         59      100.00
(59 real changes made)
      age_gp1 |      Freq.     Percent        Cum.
--------------+-----------------------------------
         0-39 |          4        4.82        4.82
        40-49 |         12       14.46       19.28
        50-59 |         23       27.71       46.99
        60-69 |          6        7.23       54.22
        70-79 |          7        8.43       62.65
        80-89 |         18       21.69       84.34
          90+ |         13       15.66      100.00
--------------+-----------------------------------
        Total |         83      100.00
(83 real changes made)

. count if cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_d_nondm + ckd_d_nondm
  0

. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm > alldeath_d
  1

. forval ii = 1/4 {
  2. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  3. quietly replace `i´_d_dm = runiformint(1,3) if (cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + li
  4. }
  5. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm > alldeat
```

```
  6. }
  1
  1
  1
  0

. count if chd_d_nondm + cbd_d_nondm + hfd_d_nondm > cvd_d_nondm
  0

. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  13

. ta age_gp1 if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         11       84.62       84.62
      40-49 |          2       15.38      100.00
------------+-----------------------------------
      Total |         13      100.00

. gen max_chd = min(cvd_d_dm,3)

. replace chd_d_dm = runiformint(1,max_chd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm & inrange(chd_d_dm,1,3)
(7 real changes made)

. gen max_cbd = min(cvd_d_dm-chd_d_dm,3)

. replace cbd_d_dm = runiformint(0,max_cbd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm & inrange(cbd_d_dm,1,3)
(8 real changes made)

. gen max_hfd = min(cvd_d_dm-chd_d_dm-cbd_d_dm,3)

. replace hfd_d_dm = runiformint(0,max_hfd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm & inrange(hfd_d_dm,1,3)
(2 real changes made)

. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  0

. count if liv1_d_nondm < liv2_d_nondm
  6

. ta age_gp1 if liv1_d_nondm < liv2_d_nondm

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          1       16.67       16.67
        90+ |          5       83.33      100.00
------------+-----------------------------------
      Total |          6      100.00

. gen max_liv2 = min(liv1_d_nondm,3)

. replace liv2_d_nondm = runiformint(1,max_liv2) if liv1_d_nondm < liv2_d_nondm & inrange(liv2_d_nondm,1,3)
(6 real changes made)

. count if liv1_d_nondm < liv2_d_nondm
  0

. count if liv1_d_dm < liv2_d_dm
  8

. ta age_gp1 if liv1_d_dm < liv2_d_dm

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          2       25.00       25.00
      80-89 |          1       12.50       37.50
        90+ |          5       62.50      100.00
------------+-----------------------------------
      Total |          8      100.00

. replace max_liv2 = min(liv1_d_dm,3)
(79 real changes made)

. replace liv2_d_dm = runiformint(1,max_liv2) if liv1_d_dm < liv2_d_dm & inrange(liv2_d_dm,1,3)
(8 real changes made)

. count if liv1_d_dm < liv2_d_dm
  0
```

```
gen age_dm = substr(age_gp1,1,2)
replace age_dm = "30" if age_dm == "0-"
```

```
destring age_dm, replace
replace age_dm = age_dm+5
gen age_nondm = substr(age_gp1,1,2)
replace age_nondm = "15" if age_nondm == "0-"
destring age_nondm, replace
replace age_nondm = age_nondm+5
replace country = "Denmark"
keep country calendar sex alldeath_d_dm alldeath_d_nondm age_dm age_nondm pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-
save Denmark, replace
```

1.5 Finland

For Finland, we have the following variables (by age, sex, and calendar year): Person-years and deaths in people with and without diabetes. I.e., no further variables need to be derived. Finland restricts counts between 1 and 5 for both people with and without diabetes. I will fill them in randomly, where the number can be any number from 1 to 5 with equal probability. I will assume the mid-point of the age interval for people aged <40 is 35 and for 90+ is 95.

```
set seed 8467215
use uncleandbase, clear
keep if substr(country,1,7)=="Finland"
rename sex SEX
gen sex = 0 if SEX == "F"
replace sex = 1 if SEX == "M"
rename (alldeath_dm alldeath_nondm alldeath_totpop) (alldeath_d_dm alldeath_d_nondm alldeath_d_pop)
```

```
. ta age_gp1
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         48       14.29       14.29
      40-49 |         48       14.29       28.57
      50-59 |         48       14.29       42.86
      60-69 |         48       14.29       57.14
      70-79 |         48       14.29       71.43
      80-89 |         48       14.29       85.71
        90+ |         48       14.29      100.00
------------+-----------------------------------
      Total |        336      100.00
. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. di "`i´"
  3. ta age_gp1 if `i´_d_nondm ==.
  4. quietly replace `i´_d_nondm = runiformint(1,5) if `i´_d_nondm==.
  5. ta age_gp1 if `i´_d_dm ==.
  6. quietly replace `i´_d_dm = runiformint(1,5) if `i´_d_dm ==.
  7. }
alldeath
no observations
no observations
can
no observations
no observations
cvd
no observations
no observations
chd
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         11       78.57       78.57
      40-49 |          3       21.43      100.00
------------+-----------------------------------
      Total |         14      100.00
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          8       72.73       72.73
      40-49 |          3       27.27      100.00
------------+-----------------------------------
      Total |         11      100.00
cbd
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          1      100.00      100.00
------------+-----------------------------------
      Total |          1      100.00
```

age_gp1	Freq.	Percent	Cum.
0-39	1	100.00	100.00
Total	1	100.00	

hfd

age_gp1	Freq.	Percent	Cum.
0-39	6	9.52	9.52
40-49	7	11.11	20.63
50-59	15	23.81	44.44
60-69	15	23.81	68.25
70-79	9	14.29	82.54
80-89	6	9.52	92.06
90+	5	7.94	100.00
Total	63	100.00	

age_gp1	Freq.	Percent	Cum.
40-49	1	1.92	1.92
50-59	17	32.69	34.62
60-69	19	36.54	71.15
70-79	6	11.54	82.69
80-89	5	9.62	92.31
90+	4	7.69	100.00
Total	52	100.00	

res

age_gp1	Freq.	Percent	Cum.
0-39	31	53.45	53.45
40-49	26	44.83	98.28
50-59	1	1.72	100.00
Total	58	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	4	30.77	30.77
40-49	8	61.54	92.31
50-59	1	7.69	100.00
Total	13	100.00	

azd

age_gp1	Freq.	Percent	Cum.
40-49	8	38.10	38.10
50-59	13	61.90	100.00
Total	21	100.00	

age_gp1	Freq.	Percent	Cum.
50-59	7	100.00	100.00
Total	7	100.00	

dmd
no observations

age_gp1	Freq.	Percent	Cum.
0-39	1	25.00	25.00
40-49	3	75.00	100.00
Total	4	100.00	

inf

age_gp1	Freq.	Percent	Cum.
0-39	9	27.27	27.27

40-49	17	51.52	78.79
50-59	7	21.21	100.00
Total	33	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	4	21.05	21.05
40-49	10	52.63	73.68
50-59	5	26.32	100.00
Total	19	100.00	

flu

age_gp1	Freq.	Percent	Cum.
0-39	16	32.65	32.65
40-49	16	32.65	65.31
50-59	10	20.41	85.71
60-69	5	10.20	95.92
70-79	1	2.04	97.96
80-89	1	2.04	100.00
Total	49	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	2	12.50	12.50
40-49	4	25.00	37.50
50-59	7	43.75	81.25
60-69	3	18.75	100.00
Total	16	100.00	

ckd

age_gp1	Freq.	Percent	Cum.
0-39	25	24.75	24.75
40-49	20	19.80	44.55
50-59	29	28.71	73.27
60-69	24	23.76	97.03
70-79	1	0.99	98.02
90+	2	1.98	100.00
Total	101	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	3	5.66	5.66
40-49	6	11.32	16.98
50-59	19	35.85	52.83
60-69	22	41.51	94.34
70-79	1	1.89	96.23
90+	2	3.77	100.00
Total	53	100.00	

liv1

age_gp1	Freq.	Percent	Cum.
0-39	4	12.12	12.12
90+	29	87.88	100.00
Total	33	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	2	8.70	8.70
90+	21	91.30	100.00
Total	23	100.00	

liv2

age_gp1	Freq.	Percent	Cum.

0-39	27	27.27	27.27
40-49	36	36.36	63.64
50-59	8	8.08	71.72
60-69	1	1.01	72.73
80-89	1	1.01	73.74
90+	26	26.26	100.00
Total	99	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	5	10.20	10.20
40-49	15	30.61	40.82
50-59	7	14.29	55.10
60-69	1	2.04	57.14
80-89	1	2.04	59.18
90+	20	40.82	100.00
Total	49	100.00	

```
. count if cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_d_nondm + ckd_d_nondm
  0

. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm > alldeath_d
  0

. count if chd_d_nondm + cbd_d_nondm + hfd_d_nondm > cvd_d_nondm
  0

. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  5

. ta age_gp1 if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
```

age_gp1	Freq.	Percent	Cum.
0-39	5	100.00	100.00
Total	5	100.00	

```
. gen max_chd = min(cvd_d_dm,5)

. replace chd_d_dm = runiformint(1,max_chd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm & inrange(chd_d_dm,1,5)
(5 real changes made)

. gen max_cbd = min(cvd_d_dm-chd_d_dm,5)

. replace cbd_d_dm = runiformint(0,max_cbd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm & inrange(cbd_d_dm,1,5)
(0 real changes made)

. gen max_hfd = min(cvd_d_dm-chd_d_dm-cbd_d_dm,5)

. replace hfd_d_dm = runiformint(0,max_hfd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm & inrange(hfd_d_dm,1,5)
(0 real changes made)

. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  0

. count if liv1_d_nondm < liv2_d_nondm
  15

. ta age_gp1 if liv1_d_nondm < liv2_d_nondm
```

age_gp1	Freq.	Percent	Cum.
0-39	1	6.67	6.67
90+	14	93.33	100.00
Total	15	100.00	

```
. gen max_liv2 = min(liv1_d_nondm,5)

. replace liv2_d_nondm = runiformint(1,max_liv2) if liv1_d_nondm < liv2_d_nondm & inrange(liv2_d_nondm,1,5)
(15 real changes made)

. count if liv1_d_nondm < liv2_d_nondm
  0

. count if liv1_d_dm < liv2_d_dm
  12

. ta age_gp1 if liv1_d_dm < liv2_d_dm
```

```
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          2       16.67       16.67
        90+ |         10       83.33      100.00
------------+-----------------------------------
      Total |         12      100.00
. replace max_liv2 = min(liv1_d_dm,5)
(94 real changes made)

. replace liv2_d_dm = runiformint(1,max_liv2) if liv1_d_dm < liv2_d_dm & inrange(liv2_d_dm,1,5)
(12 real changes made)

. count if liv1_d_dm < liv2_d_dm
  0


gen age_dm = substr(age_gp1,1,2)
replace age_dm = "30" if age_dm == "0-"
destring age_dm, replace
replace age_dm = age_dm+5
gen age_nondm = substr(age_gp1,1,2)
replace age_nondm = "15" if age_nondm == "0-"
destring age_nondm, replace
replace age_nondm = age_nondm+5
keep country calendar sex alldeath_d_dm alldeath_d_nondm age_dm age_nondm pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-
save Finland, replace
```

1.6 France

For France, we have the following variables (by age, sex, and calendar year): person-years and deaths in people with and without diabetes. I.e., no further variables need to be derived. France has excluded counts between 1 and 4, which I will fill in randomly. I will assume the mid-point of the age interval for people aged <40 is 35 and for 90+ is 95.

```
set seed 051968
use uncleandbase, clear
keep if substr(country,1,8)=="France_1"
rename sex SEX
gen sex = 0 if SEX == "F"
replace sex = 1 if SEX == "M"
rename (alldeath_dm alldeath_nondm alldeath_totpop) (alldeath_d_dm alldeath_d_nondm alldeath_d_pop)
recode dmd_d_nondm .=0

. ta age_gp1

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         16       14.29       14.29
      40-49 |         16       14.29       28.57
      50-59 |         16       14.29       42.86
      60-69 |         16       14.29       57.14
      70-79 |         16       14.29       71.43
      80-89 |         16       14.29       85.71
        90+ |         16       14.29      100.00
------------+-----------------------------------
      Total |        112      100.00
. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. di "`i´"
  3. ta age_gp1 if `i´_d_nondm ==.
  4. quietly replace `i´_d_nondm = runiformint(1,4) if `i´_d_nondm==.
  5. ta age_gp1 if `i´_d_dm ==.
  6. quietly replace `i´_d_dm = runiformint(1,4) if `i´_d_dm ==.
  7. }
alldeath
no observations
no observations
can
no observations
no observations
cvd
no observations
no observations
chd
no observations
no observations
cbd
no observations

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          1       50.00       50.00
      40-49 |          1       50.00      100.00
------------+-----------------------------------
      Total |          2      100.00
hfd
no observations

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          3       50.00       50.00
      40-49 |          3       50.00      100.00
------------+-----------------------------------
      Total |          6      100.00
res
no observations
```

```
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |          6       50.00       50.00
       40-49 |          6       50.00      100.00
-------------+-----------------------------------
       Total |         12      100.00
azd
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |          6       50.00       50.00
       40-49 |          6       50.00      100.00
-------------+-----------------------------------
       Total |         12      100.00
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
       40-49 |          1       50.00       50.00
       50-59 |          1       50.00      100.00
-------------+-----------------------------------
       Total |          2      100.00
dmd
no observations
no observations
inf
no observations
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |          2       50.00       50.00
       40-49 |          2       50.00      100.00
-------------+-----------------------------------
       Total |          4      100.00
flu
no observations
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |          4       50.00       50.00
       40-49 |          4       50.00      100.00
-------------+-----------------------------------
       Total |          8      100.00
ckd
no observations
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |          8       50.00       50.00
       40-49 |          8       50.00      100.00
-------------+-----------------------------------
       Total |         16      100.00
liv1
no observations
no observations
liv2
no observations
     age_gp1 |      Freq.     Percent        Cum.
-------------+-----------------------------------
        0-39 |          5       50.00       50.00
       40-49 |          5       50.00      100.00
-------------+-----------------------------------
       Total |         10      100.00
. count if cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_d_nondm + ckd_d_nondm
  0

. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm > alldeath_d
  0

. count if chd_d_nondm + cbd_d_nondm + hfd_d_nondm > cvd_d_nondm
  0

. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
```

```
  0
. count if liv1_d_nondm < liv2_d_nondm
  0
. count if liv1_d_dm < liv2_d_dm
  3
. ta age_gp1 if liv1_d_dm < liv2_d_dm

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          3      100.00      100.00
------------+-----------------------------------
      Total |          3      100.00
. gen max_liv2 = min(liv1_d_dm,4)
. replace liv2_d_dm = runiformint(1,max_liv2) if liv1_d_dm < liv2_d_dm & inrange(liv2_d_dm,1,4)
(3 real changes made)
. count if liv1_d_dm < liv2_d_dm
  0


replace country = substr(country,1,6)
gen age_dm = substr(age_gp1,1,2)
replace age_dm = "30" if age_dm == "0-"
destring age_dm, replace
replace age_dm = age_dm+5
gen age_nondm = substr(age_gp1,1,2)
replace age_nondm = "15" if age_nondm == "0-"
destring age_nondm, replace
replace age_nondm = age_nondm+5
keep country calendar sex alldeath_d_dm alldeath_d_nondm age_dm age_nondm pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-
save France, replace
```

1.7 Lithuania

For Lithuania, we have the following variables (by age, sex, and calendar year): total population size, prevalence of diabetes, incidence of diabetes, deaths in people with diabetes, and deaths in people without diabetes. We can calculate person-years in the total population by assuming that the person-years of follow-up in a given calendar year are equal to the population size in the current year plus the population size in the next year, divided by two. We can calculate person-years in people with diabetes, in a given calendar year, by adding the number of people with prevalent diabetes to half the number of people with incident diabetes and subtracting half the number of all-cause deaths. From there, person-years in people without diabetes is just person-years in the total population minus person-years in people with diabetes. [All of this has been performed before I got the dataset–JM.]

```
use uncleandbase, clear
keep if country == "Lithuania"
rename sex SEX
gen sex = 0 if SEX == "F"
replace sex = 1 if SEX == "M"
gen age_dm = substr(age_gp1,1,2)
replace age_dm = "30" if age_dm == "0-"
destring age_dm, replace
replace age_dm = age_dm+5
gen age_nondm = substr(age_gp1,1,2)
replace age_nondm = "15" if age_nondm == "0-"
destring age_nondm, replace
replace age_nondm = age_nondm+5
recode dmd_d_nondm .=0
rename (alldeath_dm alldeath_nondm alldeath_totpop) (alldeath_d_dm alldeath_d_nondm alldeath_d_pop)

. count if cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_d_nondm + ckd_d_nondm
  0

. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm > alldeath_d
  0

. count if chd_d_nondm + cbd_d_nondm + hfd_d_nondm > cvd_d_nondm
  0

. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  0

. count if liv1_d_nondm < liv2_d_nondm
  0

. count if liv1_d_dm < liv2_d_dm
  0

. count if liv1_d_dm < liv2_d_dm
  0


keep country calendar sex alldeath_d_dm alldeath_d_nondm age_dm age_nondm pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-
save Lithuania, replace
```

1.8 Netherlands

This data will only be used for an analysis of proportional mortality as there are issues with recruitment to the datasets over follow up that make the rates unreliable.

For Netherlands, we have the following variables (by age, sex, and calendar year): Person-years and deaths in people with and without diabetes. I.e., no further variables need to be derived. Netherlands restricts counts between 0 and 9 for both people with and without diabetes. I will fill them in randomly. I will assume the mid-point of the age interval for people aged <40 is 35 and for 90+ is 95.

Additionally, because the definition of diabetes in the Netherlands relies on 2 years of follow-up from 2006, we are dropping data from 2007 [done before I got the dataset – JM].

```
set seed 1836590237
use uncleandbase, clear
keep if country == "Netherlands"
rename sex SEX
gen sex = 0 if SEX == "F"
replace sex = 1 if SEX == "M"
rename (alldeath_dm alldeath_nondm alldeath_totpop) (alldeath_d_dm alldeath_d_nondm alldeath_d_pop)
```

```
. ta age_gp1

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         28       14.29       14.29
      40-49 |         28       14.29       28.57
      50-59 |         28       14.29       42.86
      60-69 |         28       14.29       57.14
      70-79 |         28       14.29       71.43
      80-89 |         28       14.29       85.71
        90+ |         28       14.29      100.00
------------+-----------------------------------
      Total |        196      100.00
. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. di "`i´"
  3. ta age_gp1 if `i´_d_nondm ==.
  4. quietly replace `i´_d_nondm = runiformint(0,9) if `i´_d_nondm==.
  5. ta age_gp1 if `i´_d_dm ==.
  6. quietly replace `i´_d_dm = runiformint(0,9) if `i´_d_dm ==.
  7. }
alldeath
no observations
no observations
can
no observations

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         25      100.00      100.00
------------+-----------------------------------
      Total |         25      100.00
cvd
no observations

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         28      100.00      100.00
------------+-----------------------------------
      Total |         28      100.00
chd
no observations

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         28       60.87       60.87
      40-49 |         18       39.13      100.00
```

Total	46	100.00	

cbd

age_gp1	Freq.	Percent	Cum.
0-39	2	100.00	100.00
Total	2	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	28	49.12	49.12
40-49	28	49.12	98.25
50-59	1	1.75	100.00
Total	57	100.00	

hfd

age_gp1	Freq.	Percent	Cum.
0-39	26	65.00	65.00
40-49	14	35.00	100.00
Total	40	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	28	41.18	41.18
40-49	28	41.18	82.35
50-59	12	17.65	100.00
Total	68	100.00	

res

age_gp1	Freq.	Percent	Cum.
0-39	28	87.50	87.50
40-49	4	12.50	100.00
Total	32	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	28	47.46	47.46
40-49	28	47.46	94.92
50-59	3	5.08	100.00
Total	59	100.00	

azd

age_gp1	Freq.	Percent	Cum.
0-39	28	43.75	43.75
40-49	28	43.75	87.50
50-59	8	12.50	100.00
Total	64	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	28	29.17	29.17
40-49	28	29.17	58.33
50-59	28	29.17	87.50
60-69	12	12.50	100.00
Total	96	100.00	

dmd

age_gp1	Freq.	Percent	Cum.
0-39	28	37.33	37.33
40-49	27	36.00	73.33
50-59	15	20.00	93.33

60-69	3	4.00	97.33
90+	2	2.67	100.00
Total	75	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	22	95.65	95.65
40-49	1	4.35	100.00
Total	23	100.00	

inf
no observations

age_gp1	Freq.	Percent	Cum.
0-39	28	43.75	43.75
40-49	28	43.75	87.50
50-59	8	12.50	100.00
Total	64	100.00	

flu

age_gp1	Freq.	Percent	Cum.
0-39	11	57.89	57.89
40-49	8	42.11	100.00
Total	19	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	28	34.57	34.57
40-49	28	34.57	69.14
50-59	25	30.86	100.00
Total	81	100.00	

ckd

age_gp1	Freq.	Percent	Cum.
0-39	28	43.75	43.75
40-49	27	42.19	85.94
50-59	9	14.06	100.00
Total	64	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	28	32.56	32.56
40-49	28	32.56	65.12
50-59	27	31.40	96.51
60-69	3	3.49	100.00
Total	86	100.00	

liv1

age_gp1	Freq.	Percent	Cum.
0-39	13	65.00	65.00
90+	7	35.00	100.00
Total	20	100.00	

age_gp1	Freq.	Percent	Cum.
0-39	28	31.11	31.11
40-49	27	30.00	61.11
50-59	6	6.67	67.78
80-89	1	1.11	68.89
90+	28	31.11	100.00
Total	90	100.00	

liv2

```
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         28       62.22       62.22
      40-49 |         10       22.22       84.44
        90+ |          7       15.56      100.00
------------+-----------------------------------
      Total |         45      100.00
    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         28       26.67       26.67
      40-49 |         28       26.67       53.33
      50-59 |         17       16.19       69.52
      60-69 |          2        1.90       71.43
      80-89 |          2        1.90       73.33
        90+ |         28       26.67      100.00
------------+-----------------------------------
      Total |        105      100.00
. count if cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_d_nondm + ckd_d_nondm
  0

. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm > alldeath_d
  24

. forval ii = 1/60 {
  2. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  3. quietly replace `i´_d_dm = runiformint(0,9) if (cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + li
  4. }
  5. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm > alldeat
  6. }
  17
  10
  9
  7
  6
  5
  4
  3
  2
  2
  2
  2
  2
  2
  2
  2
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  2
  2
  2
  1
  1
  1
  1
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  1
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  1
  1
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```

```
  1
  1
  1
  1
  1
  1
  1
  1
  1
  1
  1
  1
  1
  1
  1
  1
  1
  1
  1
  1
  0
. count if chd_d_nondm + cbd_d_nondm + hfd_d_nondm > cvd_d_nondm
  0
. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  30
. ta age_gp1 if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |         26       86.67       86.67
      40-49 |          4       13.33      100.00
------------+-----------------------------------
      Total |         30      100.00
. gen max_chd = min(cvd_d_dm,9)
. replace chd_d_dm = runiformint(0,max_chd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
(30 real changes made)
. gen max_cbd = min(cvd_d_dm-chd_d_dm,9)
. replace cbd_d_dm = runiformint(0,max_cbd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
(27 real changes made)
. gen max_hfd = min(cvd_d_dm-chd_d_dm-cbd_d_dm,9)
. replace hfd_d_dm = runiformint(0,max_hfd) if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
(27 real changes made)
. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  0
. count if liv1_d_nondm < liv2_d_nondm
  13
. ta age_gp1 if liv1_d_nondm < liv2_d_nondm

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
       0-39 |          7       53.85       53.85
        90+ |          6       46.15      100.00
------------+-----------------------------------
      Total |         13      100.00
. gen max_liv2 = min(liv1_d_nondm,9)
. replace liv2_d_nondm = runiformint(0,max_liv2) if liv1_d_nondm < liv2_d_nondm & inrange(liv2_d_nondm,0,9)
(13 real changes made)
. count if liv1_d_nondm < liv2_d_nondm
  0
. count if liv1_d_dm < liv2_d_dm
  40
. ta age_gp1 if liv1_d_dm < liv2_d_dm

    age_gp1 |      Freq.     Percent        Cum.
------------+-----------------------------------
            |
```

```
      0-39 |         15       37.50       37.50
     40-49 |         10       25.00       62.50
     50-59 |          4       10.00       72.50
     80-89 |          1        2.50       75.00
       90+ |         10       25.00      100.00
-----------+-----------------------------------
     Total |         40      100.00
. replace max_liv2 = min(liv1_d_dm,9)
(81 real changes made)

. replace liv2_d_dm = runiformint(0,max_liv2) if liv1_d_dm < liv2_d_dm & inrange(liv2_d_dm,0,9)
(40 real changes made)

. count if liv1_d_dm < liv2_d_dm
  0


gen age_dm = substr(age_gp1,1,2)
replace age_dm = "30" if age_dm == "0-"
destring age_dm, replace
replace age_dm = age_dm+5
gen age_nondm = substr(age_gp1,1,2)
replace age_nondm = "15" if age_nondm == "0-"
destring age_nondm, replace
replace age_nondm = age_nondm+5
keep country calendar sex alldeath_d_dm alldeath_d_nondm age_dm age_nondm pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-
save Netherlands, replace
```

1.9 Scotland

For Scotland, we have the following variables (by age, sex, and calendar year): total population size, person-years in people with diabetes, deaths in people with diabetes, and deaths in the total population. We can calculate person-years in the total population by assuming that the person-years of follow-up in a given calendar year are equal to the population size in the current year plus the population size in the next year, divided by two [this has been performed before I got the dataset – JM]. I then calculate person-years in people without diabetes by substracting the person-years in people with diabetes from person-years in the total population; similarly for deaths in people without diabetes. There were a few age groups in whom the number of deaths from diabetes in people with diabetes was slightly greater than the total population deaths; I will simply make these zero in people without diabetes.

Also note we have received two different age groupings for Scotland for total population deaths – from 2006-2015: 0-39, 40-49, . . . , 80+; from 2016-2020: 0-39, 40-49, . . . , 90+. For the 80+ age grouping I will assume the mean age is 87.5 years.

```
. use uncleandbase, clear

. keep if country == "Scotland"
(2,468 observations deleted)

. rename sex SEX

. gen sex = 0 if SEX == "F"
(120 missing values generated)

. replace sex = 1 if SEX == "M"
(120 real changes made)

. rename (alldeath_dm alldeath_nondm alldeath_totpop) (alldeath_d_dm alldeath_d_nondm alldeath_d_pop)

. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. quietly replace `i´_d_nondm = `i´_d_pop-`i´_d_dm
  3. di "`i´"
  4. ta `i´_d_nondm if `i´_d_nondm <0
  5. }
alldeath
no observations
can
no observations
cvd
no observations
chd
no observations
cbd
no observations
hfd
no observations
res
no observations
azd
no observations
dmd

 dmd_d_nondm |      Freq.     Percent        Cum.
-------------+-----------------------------------
          -4 |          1        7.69        7.69
          -2 |          2       15.38       23.08
          -1 |         10       76.92      100.00
-------------+-----------------------------------
       Total |         13      100.00
inf
no observations
flu
no observations
ckd
```

```
no observations
liv1
no observations
liv2
no observations
. count if cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_d_nondm + ckd_d_nondm
  0
. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm > alldeath_d
  0
. count if chd_d_nondm + cbd_d_nondm + hfd_d_nondm > cvd_d_nondm
  0
. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  0
. count if liv1_d_nondm < liv2_d_nondm
  0
. count if liv1_d_dm < liv2_d_dm
  0


replace dmd_d_nondm = 0 if dmd_d_nondm <0
replace pys_nondm = pys_totpop-pys_dm
gen age_dm = substr(age_gp1,1,2)
replace age_dm = "30" if age_dm == "0-"
destring age_dm, replace
replace age_dm = age_dm+5
gen age_nondm = substr(age_gp1,1,2)
replace age_nondm = substr(age_gp2,1,2) if cal <= 2015
replace age_nondm = "15" if age_nondm == "0-"
destring age_nondm, replace
replace age_nondm = age_nondm+5
replace age_nondm = age_nondm+2.5 if age_nondm == 85 & cal <= 2015
replace pys_dm =. if age_dm==.
replace pys_nondm =. if age_nondm==.
foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
replace `i´_d_dm = . if age_dm==.
replace `i´_d_nondm = . if age_nondm==.
}
drop if age_dm==. & age_nondm==.
keep country calendar sex alldeath_d_dm alldeath_d_nondm age_dm age_nondm pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-
save Scotland, replace
```

1.10 South Korea

For South Korea, we have the following variables (by age, sex, and calendar year): Person-years and deaths in people with and without diabetes. I.e., no further variables need to be derived. Note that from 2007-2010, there is no data for people aged 90 and above, although this shouldn't have a huge impact on any results. I will assume the mid-point of the age interval for people aged <40 is 35 and for 90+ is 95.

```
use uncleandbase, clear
keep if country=="South Korea"
rename sex SEX
gen sex = 0 if SEX == "F"
replace sex = 1 if SEX == "M"
drop if age_gp4=="all ages"
drop if age_gp1 == "90+" & cal <= 2010
rename (alldeath_dm alldeath_nondm alldeath_totpop) (alldeath_d_dm alldeath_d_nondm alldeath_d_pop)
gen age_dm = substr(age_gp1,1,2)
replace age_dm = "30" if age_dm == "0-"
destring age_dm, replace
replace age_dm = age_dm+5
gen age_nondm = substr(age_gp1,1,2)
replace age_nondm = "15" if age_nondm == "0-"
destring age_nondm, replace
replace age_nondm = age_nondm+5
replace country = "SKorea"
```

```
. count if cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_d_nondm + ckd_d_nondm
  0

. count if cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_d_nondm + ckd_d_nondm
  0

. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm > alldeath_d
  0

. count if chd_d_nondm + cbd_d_nondm + hfd_d_nondm > cvd_d_nondm
  0

. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  0

. count if liv1_d_nondm < liv2_d_nondm
  0

. count if liv1_d_dm < liv2_d_dm
  0
```

```
keep country calendar sex alldeath_d_dm alldeath_d_nondm age_dm age_nondm pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-
save SKorea, replace
```

1.11 Sweden

This data will only be used for an analysis of proportional mortality as there are issues with recruitment to the datasets over follow up that make the rates unreliable.

For Sweden, we have the following variables (by age, sex, and calendar year): total population size, person-years in people with diabetes, deaths in people with diabetes, and deaths in the total population. We can calculate person-years in the total population by assuming that the person-years of follow-up in a given calendar year are equal to the population size in the current year plus the population size in the next year, divided by two (this has been performed before I got the dataset). I then calculate person-years in people without diabetes by substracting the person-years in people with diabetes from person-years in the total population; similarly for deaths in people without diabetes.

The age groups are slightly different for Sweden – the youngest age group is 18-39, not 0-39 like other ages; for people with diabetes, the mean age is still probably 35, but for people without diabetes I will assume it is 29.

```
. use uncleandbase, clear

. keep if country == "Sweden"
(2,526 observations deleted)

. rename sex SEX

. gen sex = 0 if SEX == "F"
(91 missing values generated)

. replace sex = 1 if SEX == "M"
(91 real changes made)

. rename (alldeath_dm alldeath_nondm alldeath_totpop) (alldeath_d_dm alldeath_d_nondm alldeath_d_pop)

. foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd liv1 liv2 {
  2. quietly replace `i´_d_nondm = `i´_d_pop-`i´_d_dm
  3. }

. count if cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_d_nondm + ckd_d_nondm
  0

. count if cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm > alldeath_d
  0

. count if chd_d_nondm + cbd_d_nondm + hfd_d_nondm > cvd_d_nondm
  0

. count if chd_d_dm + cbd_d_dm + hfd_d_dm > cvd_d_dm
  0

. count if liv1_d_nondm < liv2_d_nondm
  0

. count if liv1_d_dm < liv2_d_dm
  0


replace pys_nondm = pys_totpop-pys_dm
gen age_dm = substr(age_gp1,1,2)
replace age_dm = "30" if age_dm == "18"
destring age_dm, replace
replace age_dm = age_dm+5
gen age_nondm = substr(age_gp1,1,2)
replace age_nondm = "24" if age_nondm == "18"
destring age_nondm, replace
replace age_nondm = age_nondm+5
keep country calendar sex alldeath_d_dm alldeath_d_nondm age_dm age_nondm pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-
save Sweden, replace
```

1.12 Summary

Table 5.9 shows a summary of the data included in this analysis.

```
*mkdir CSV
clear
foreach c in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
append using `c´
}
gen other_d_dm = alldeath_d_dm - ///
(cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm)
gen other_d_nondm = alldeath_d_nondm - ///
(cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_d_nondm + ckd_d_nondm + azd_d_n
save cleandbase, replace
use cleandbase, clear
foreach i in chd cbd hfd liv2 {
drop `i´_d_dm `i´_d_nondm
}
rename (liv1_d_dm liv1_d_nondm) (liv_d_dm liv_d_nondm)
save CMdata, replace
clear
foreach c in Australia Canada1 Canada2 Denmark Finland France Lithuania Netherlands Scotland SKorea Sweden {
append using `c´
}
gen other_d_dm = alldeath_d_dm - ///
(cvd_d_dm + can_d_dm + dmd_d_dm + inf_d_dm + flu_d_dm + res_d_dm + liv1_d_dm + ckd_d_dm + azd_d_dm)
gen other_d_nondm = alldeath_d_nondm - ///
(cvd_d_nondm + can_d_nondm + dmd_d_nondm + inf_d_nondm + flu_d_nondm + res_d_nondm + liv1_d_nondm + ckd_d_nondm + azd_d_n
foreach i in chd cbd hfd liv2 {
drop `i´_d_dm `i´_d_nondm
}
rename (liv1_d_dm liv1_d_nondm) (liv_d_dm liv_d_nondm)
save CMdata_prop, replace
use cleandbase, clear
foreach i in alldeath can res azd dmd inf flu ckd liv1 liv2 {
drop `i´_d_dm `i´_d_nondm
}
save CMdataCVD, replace
use cleandbase, clear
foreach i in alldeath can cvd chd cbd hfd res azd dmd inf flu ckd {
drop `i´_d_dm `i´_d_nondm
}
save CMdataLIV, replace
use cleandbase, clear
foreach i in alldeath can cvd chd cbd hfd res dmd inf flu ckd liv1 liv2 {
drop `i´_d_dm `i´_d_nondm
}
save CMdataDEM, replace
foreach c in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
use `c´, clear
foreach i in chd cbd hfd liv2 {
drop `i´_d_dm `i´_d_nondm
}
rename (liv1_d_dm liv1_d_nondm) (liv_d_dm liv_d_nondm)
save `c´, replace
}
erase uncleandbase.dta
use CMdata_prop, clear
bysort country (cal) : egen lb = min(cal)
bysort country (cal) : egen ub = max(cal)
tostring lb ub, replace
gen rang = lb+ "-" + ub
recode dmd_d_nondm .=0
collapse (sum) pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-azd_d_nondm other_d_dm other_d_nondm, by(country sex rang)
expand 2
bysort country sex : gen DM = _n-1
tostring sex pys_dm-DM, replace force format(%15.0fc)
gen pys = pys_dm if DM == "1"
```

```
replace pys = pys_nondm if DM == "0"
foreach i in can cvd res azd dmd inf flu ckd liv other {
gen `i´ = `i´_d_dm if DM == "1"
replace `i´ = `i´_d_nondm if DM == "0"
}
keep country-rang DM-other
order country rang DM sex
sort country rang DM sex
gen njm = _n
bysort country DM (njm) : replace DM ="" if _n!=1
bysort country (njm) : replace rang ="" if _n!=1
bysort country (njm) : replace country ="" if _n!=1
sort njm
replace DM = "No diabetes" if DM == "0"
replace DM = "Diabetes" if DM == "1"
replace sex = "Female" if sex == "0"
replace sex = "Male" if sex == "1"
drop njm
replace country = "South Korea" if country == "SKorea"
replace country = "Canada (Alberta)" if country == "Canada1"
replace country = "Canada (Ontario)" if country == "Canada2"
replace country = "Netherlands\textsuperscript{1}" if country == "Netherlands"
replace country = "Sweden\textsuperscript{1}" if country == "Sweden"
export delimited using CSV/T1.csv, delimiter(":") novarnames replace
```

Table 1.2: Summary of data received for the analysis.

Country	Period	Diabetes status	Sex	Person-years of follow-up	Death counts by cause of death									
					CAN	CVD	RES	DEM	DMD	INF	FLU	CKD	LIV	OTH
Australia	2005-2021	No diabetes	Female	151,257,460	218,204	265,623	38,657	83,335	5,778	12,464	17,309	13,629	5,545	162,315
			Male	147,983,729	269,439	232,867	41,653	41,288	5,291	12,635	12,878	11,644	11,940	191,067
		Diabetes	Female	6,134,057	37,351	46,499	6,129	11,029	21,342	3,321	2,930	3,634	2,030	24,337
			Male	6,975,868	60,957	58,985	7,786	8,590	25,263	3,814	3,222	4,037	3,712	31,245
Canada (Alberta)	2005-2020	No diabetes	Female	31,856,052	35,344	36,487	6,077	13,324	264	2,032	2,731	1,398	1,616	26,434
			Male	31,998,428	36,948	35,527	6,257	6,655	334	1,943	2,396	1,278	2,500	37,419
		Diabetes	Female	1,749,550	9,912	15,374	2,038	3,748	3,389	977	1,154	971	795	7,245
			Male	2,163,971	14,262	19,685	2,581	2,838	4,104	1,019	1,216	992	1,240	9,665
Canada (Ontario)	2013-2018	No diabetes	Female	40,714,649	58,439	54,326	7,803	23,714	450	4,041	10,655	3,360	1,604	51,202
			Male	39,136,829	58,242	51,186	6,941	11,188	530	4,069	8,926	3,425	2,735	56,467
		Diabetes	Female	2,978,146	15,756	21,812	2,059	6,069	4,314	1,948	3,817	2,462	1,055	15,510
			Male	3,369,845	21,762	27,372	2,398	4,332	5,298	2,226	4,419	2,905	1,490	18,987
Denmark	2002-2019	No diabetes	Female	47,999,917	117,552	116,692	28,838	32,941	579	7,125	15,933	2,871	4,542	92,362
			Male	46,993,523	120,657	107,745	24,313	15,529	737	6,022	13,051	3,633	8,278	89,662
		Diabetes	Female	1,844,344	16,049	19,314	4,279	3,595	10,164	1,395	2,335	605	842	11,634
			Male	2,071,414	23,096	24,103	4,373	2,458	12,699	1,495	2,551	750	1,963	13,287
Finland	2000-2023	No diabetes	Female	61,246,134	100,187	167,467	7,702	90,504	0	3,059	7,983	1,133	5,675	73,378
			Male	58,831,869	108,075	156,730	15,107	40,369	0	2,741	6,863	1,199	13,745	103,922
		Diabetes	Female	4,500,477	31,671	76,814	2,453	26,575	6,159	1,050	2,145	521	2,262	20,128
			Male	4,677,700	40,019	76,036	4,664	14,196	6,966	956	1,851	503	5,161	25,099
France	2013-2020	No diabetes	Female	248,386,875	389,029	398,245	25,997	141,470	0	30,199	41,802	16,641	12,203	659,163
			Male	218,181,642	475,727	313,608	34,453	59,458	0	25,634	33,547	15,551	26,454	611,890
		Diabetes	Female	10,932,947	62,306	75,088	3,989	12,402	29,723	6,630	6,917	4,418	3,682	98,562
			Male	12,594,448	116,141	90,925	7,358	8,860	30,152	7,638	8,354	4,998	8,797	124,831
Lithuania	2014-2021	No diabetes	Female	11,564,058	24,203	85,770	1,107	2,179	0	2,041	1,499	368	2,061	19,037
			Male	10,078,198	31,081	63,343	2,897	883	0	2,557	2,530	332	3,775	30,722
		Diabetes	Female	653,558	4,511	18,406	262	297	2,199	498	308	51	378	3,751
			Male	446,916	4,407	11,431	385	100	1,609	363	277	30	523	3,282
Netherlands[1]	2008-2021	No diabetes	Female	114,105,112	233,939	219,478	35,064	99,973	2,494	15,329	25,238	9,645	3,976	192,403
			Male	111,687,855	268,791	196,694	38,145	43,979	1,933	13,425	21,397	8,228	6,513	184,169
		Diabetes	Female	5,592,483	45,897	61,759	8,163	20,156	18,632	5,320	6,934	3,809	1,693	42,458
			Male	6,123,018	61,648	58,223	9,764	10,617	16,981	5,002	6,201	3,198	2,455	40,930
South Korea	2007-2019	No diabetes	Female	6,216,486	4,737	4,833	453	1,005	88	486	1,026	206	211	6,866
			Male	6,208,026	7,626	4,278	766	443	76	592	953	207	772	8,117
		Diabetes	Female	596,993	2,780	3,362	260	455	1,304	402	685	390	182	3,044
			Male	618,623	4,600	2,922	449	208	1,262	407	739	416	607	3,400
Scotland	2006-2020	No diabetes	Female	39,339,945	99,092	101,075	22,732	42,294	255	5,196	15,042	3,576	5,238	71,833
			Male	36,563,096	100,119	92,998	18,389	18,341	305	4,039	10,569	2,410	8,403	74,277
		Diabetes	Female	1,842,509	15,967	21,465	3,290	5,962	5,850	1,257	2,714	660	1,088	11,288
			Male	2,292,250	21,224	26,267	3,086	4,161	6,204	1,121	2,571	617	1,763	12,295
Sweden[1]	2007-2019	No diabetes	Female	60,483,854	121,089	195,813	18,929	61,554	3,847	11,394	12,089	3,675	2,938	93,323
			Male	59,683,040	125,548	170,610	14,963	28,771	3,434	10,076	11,459	4,033	5,129	97,089
		Diabetes	Female	2,344,353	16,932	31,325	2,414	6,046	8,551	2,462	1,858	690	738	10,838
			Male	3,032,266	24,849	39,566	2,280	4,372	10,345	2,779	2,364	858	1,505	14,514

[1]Only included in the proportional mortality analysis.

Abbreviations: DEM – Dementia; CAN – Cancer; CVD – Cardiovascular disease; RES – Chronic lower respiratory disease; DMD – Diabetes; INF – Infectious diseases; FLU – Influenza and pneumonia; CKD – Kidney disease; LIV – Liver disease; OTH – All other causes.

2 Crude rates

```
foreach c in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
use `c´, clear
if "`c´" == "Canada1" {
local co = "Canada (Alberta)"
}
else if "`c´" == "Canada2" {
local co = "Canada (Ontario)"
}
else if "`c´" == "SKorea" {
local co = "South Korea"
}
else {
local co = "`c´"
}
collapse (sum) pys_dm pys_nondm cvd_d_dm-azd_d_dm cvd_d_nondm-azd_d_nondm, by(calendar sex)
foreach i in can cvd res azd dmd inf flu ckd liv {
if "`i´" == "can" {
local ii = "Cancer"
}
if "`i´" == "cvd" {
local ii = "Cardiovascular disease"
}
if "`i´" == "res" {
local ii = "Chronic lower respiratory disease"
}
if "`i´" == "azd" {
local ii = "Dementia"
}
if "`i´" == "dmd" {
local ii = "Diabetes"
}
if "`i´" == "inf" {
local ii = "Infectious diseases"
}
if "`i´" == "flu" {
local ii = "Influenza and pneumonia"
}
if "`i´" == "ckd" {
local ii = "Kidney disease"
}
if "`i´" == "liv" {
local ii = "Liver disease"
}
foreach iii in dm nondm {
if "`iii´" == "dm" {
local dd = "with"
}
if "`iii´" == "nondm" {
local dd = "without"
}
gen `iii´_`i´ = 1000*`i´_d_`iii´/pys_`iii´
twoway ///
(connected `iii´_`i´ cal if sex == 0, col(red)) ///
(connected `iii´_`i´ cal if sex == 1, col(blue)) ///
, graphregion(color(white)) ///
ytitle(Mortality rate (per 1,000 person-years), margin(a+2)) ///
xtitle(Calendar year) ///
legend(order( ///
1 "Females" ///
2 "Males" ///
) cols(1) position(3) region(lcolor(none) color(none))) ///
ylabel(,angle(0) format(%9.2f)) ///
title("People `dd´ diabetes", placement(west) size(medium) col(black))
graph save GPH/cr_`i´_`iii´_`c´, replace
}
```

```
graph combine ///
GPH/cr_`i´_dm_`c´.gph ///
GPH/cr_`i´_nondm_`c´.gph ///
, graphregion(color(white)) cols(2) altshrink xsize(10)
}
}
```

Figure 2.1: Crude mortality rate by cause of death, sex, and diabetes status. Cancer. Australia.

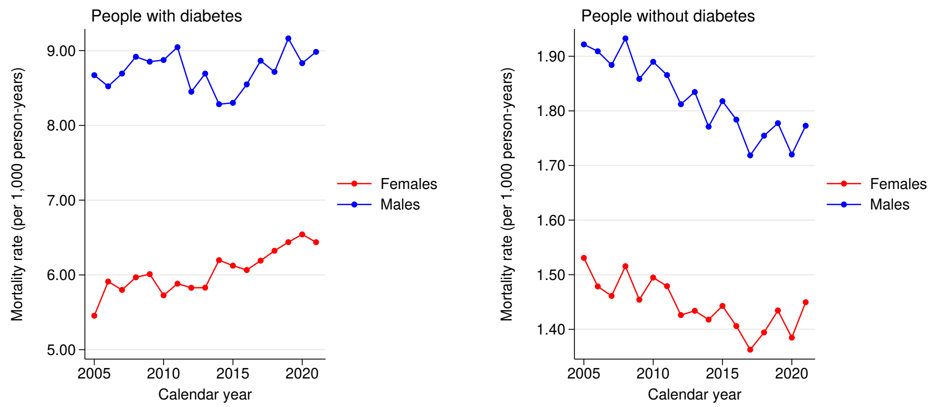


Figure 2.2: Crude mortality rate by cause of death, sex, and diabetes status. Cardiovascular disease. Australia.

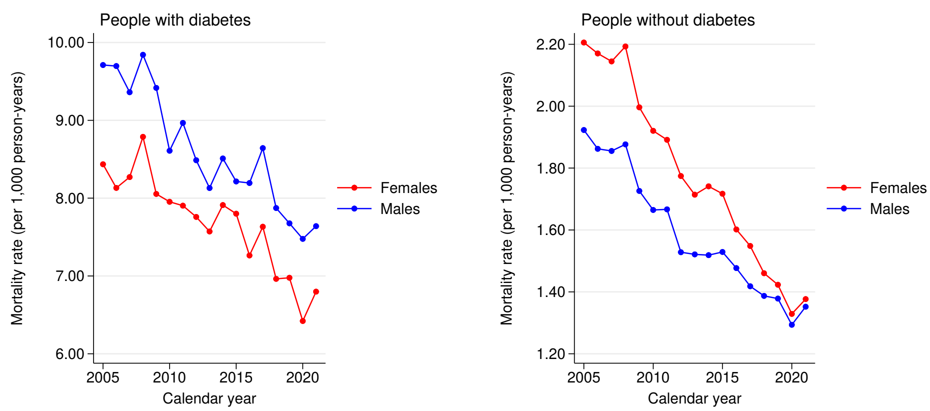


Figure 2.3: Crude mortality rate by cause of death, sex, and diabetes status. Chronic lower respiratory disease. Australia.

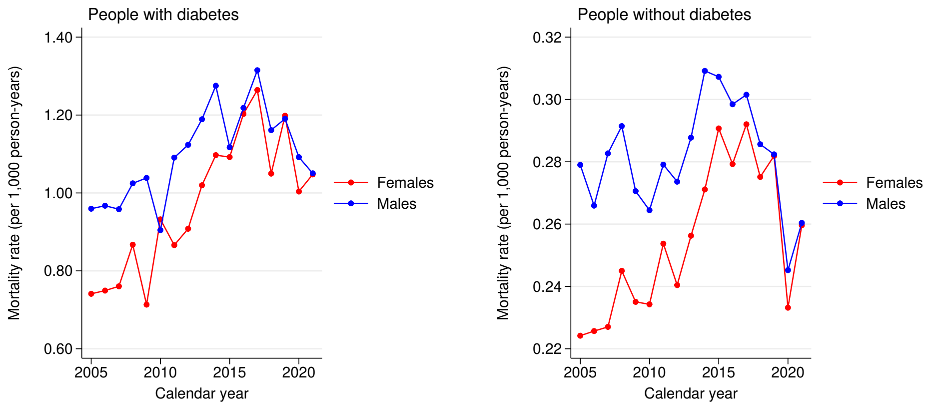


Figure 2.4: Crude mortality rate by cause of death, sex, and diabetes status. Dementia. Australia.

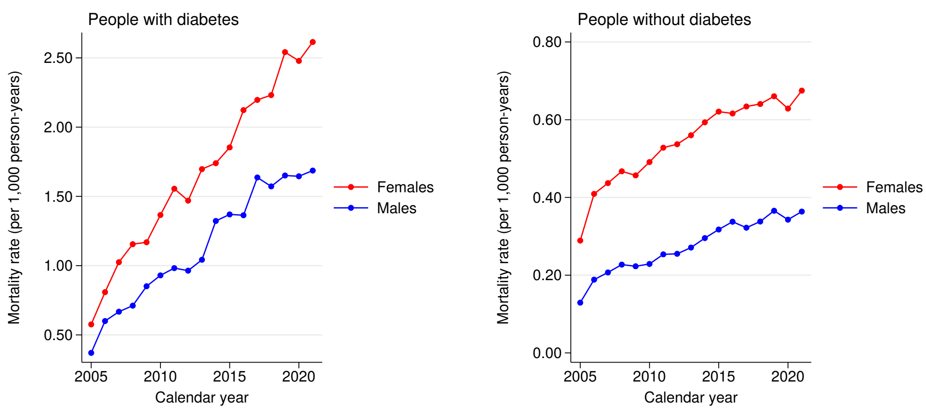


Figure 2.5: Crude mortality rate by cause of death, sex, and diabetes status. Diabetes. Australia.

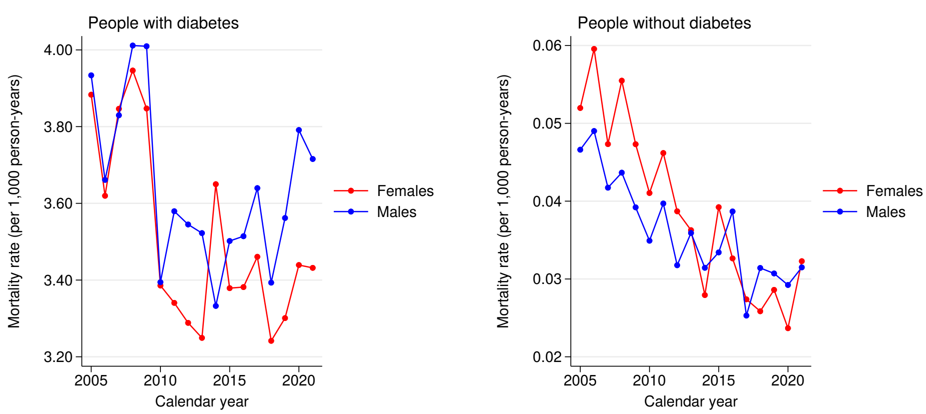


Figure 2.6: Crude mortality rate by cause of death, sex, and diabetes status. Infectious diseases. Australia.

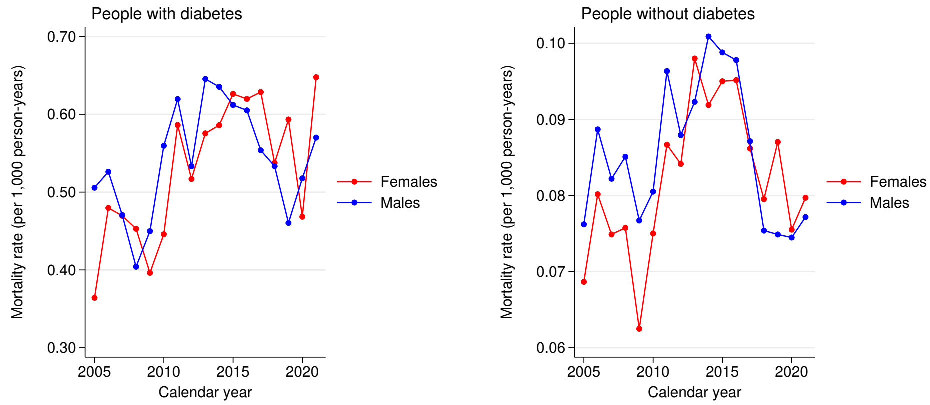


Figure 2.7: Crude mortality rate by cause of death, sex, and diabetes status. Influenza and pneumonia. Australia.

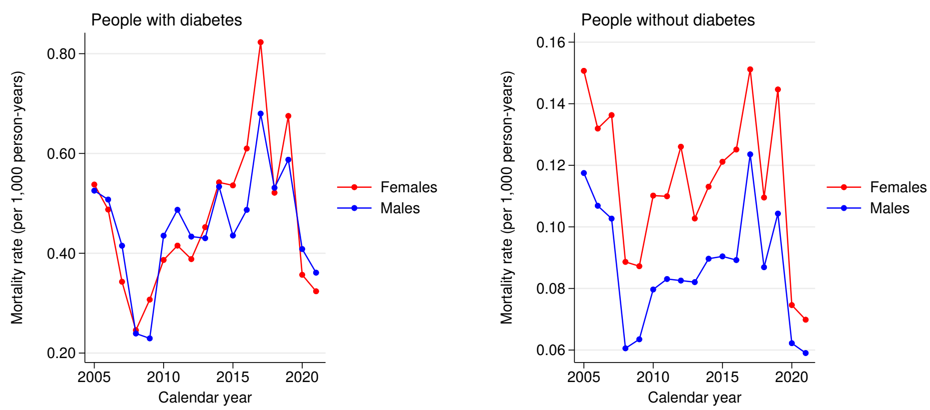


Figure 2.8: Crude mortality rate by cause of death, sex, and diabetes status. Kidney disease. Australia.

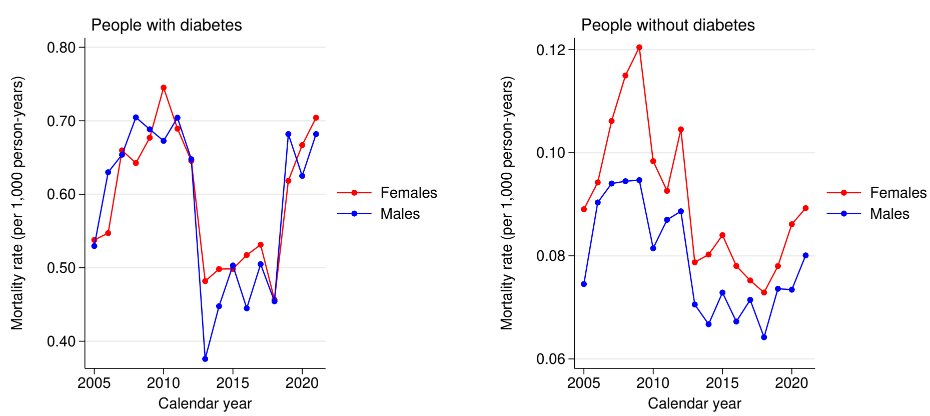


Figure 2.9: Crude mortality rate by cause of death, sex, and diabetes status. Liver disease. Australia.

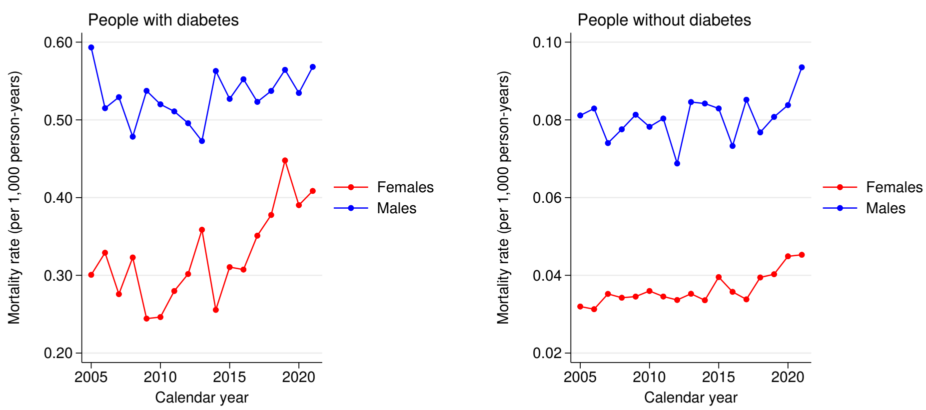


Figure 2.10: Crude mortality rate by cause of death, sex, and diabetes status. Cancer. Canada (Alberta).

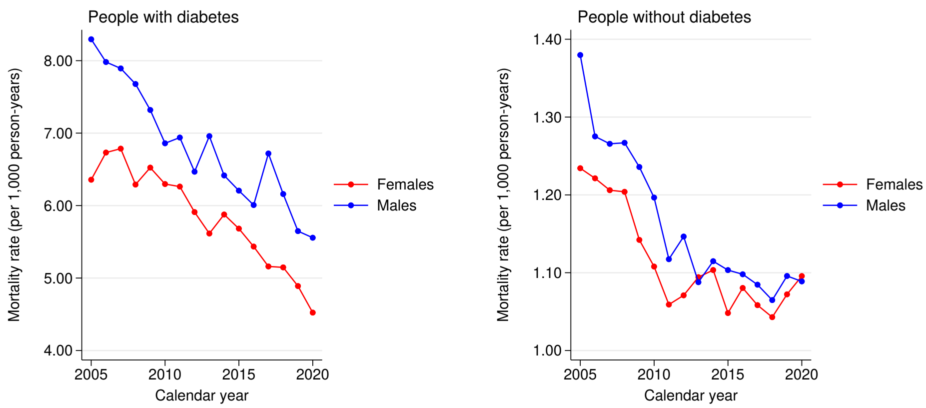


Figure 2.11: Crude mortality rate by cause of death, sex, and diabetes status. Cardiovascular disease. Canada (Alberta).

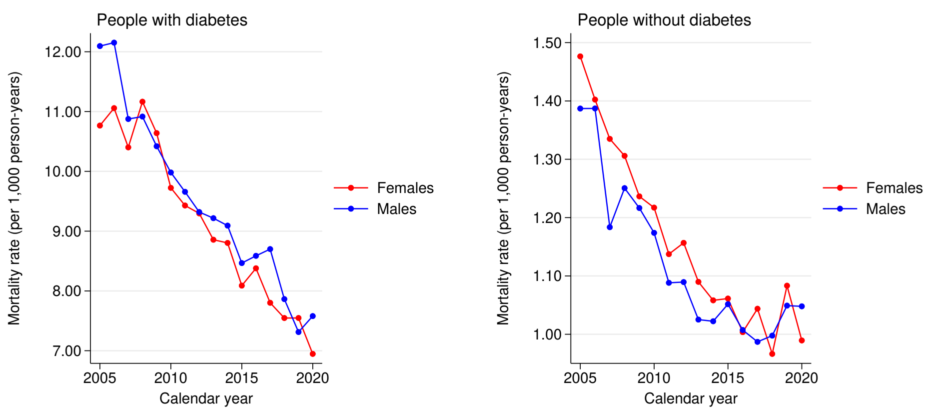


Figure 2.12: Crude mortality rate by cause of death, sex, and diabetes status. Chronic lower respiratory disease. Canada (Alberta).

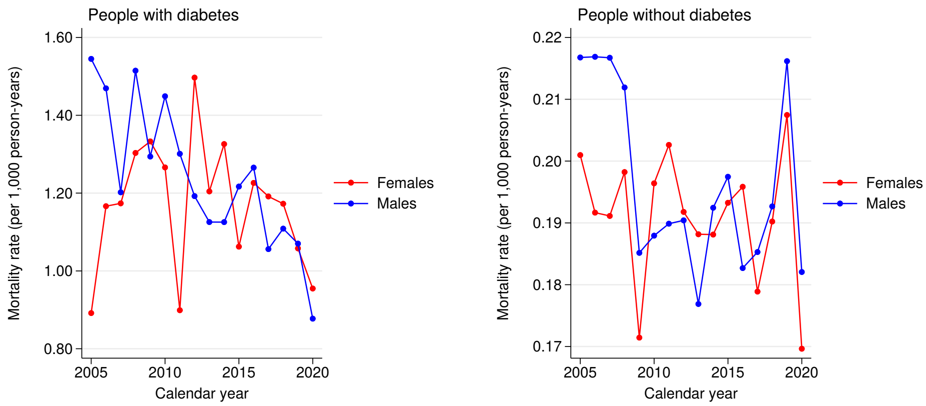


Figure 2.13: Crude mortality rate by cause of death, sex, and diabetes status. Dementia. Canada (Alberta).

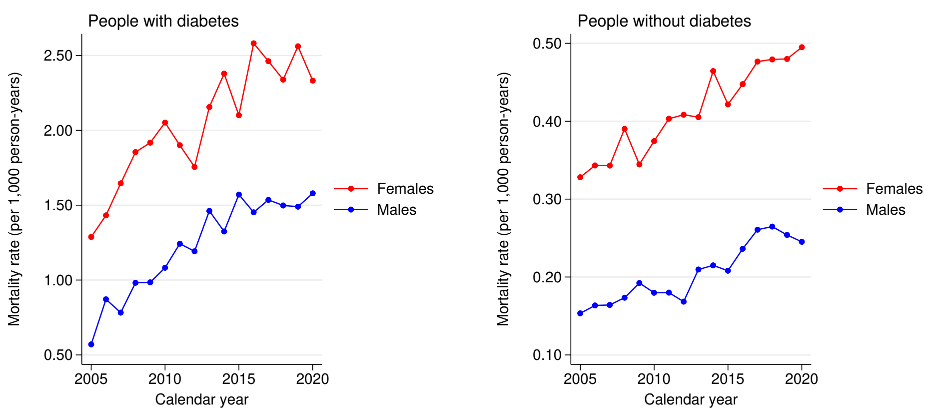


Figure 2.14: Crude mortality rate by cause of death, sex, and diabetes status. Diabetes. Canada (Alberta).

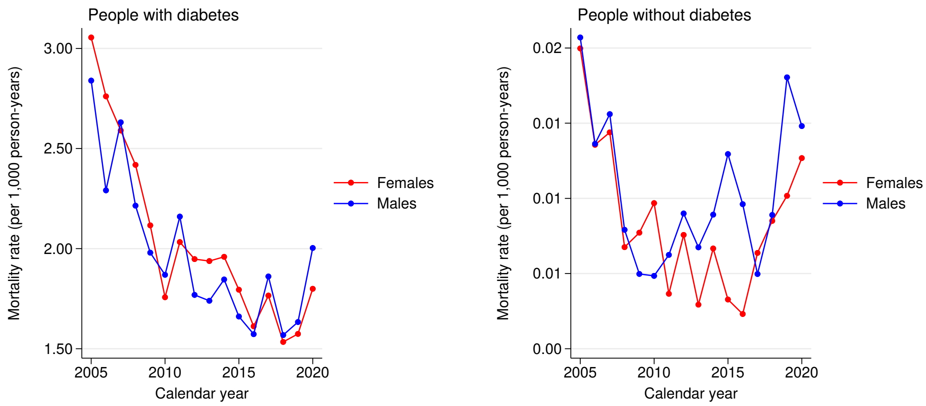


Figure 2.15: Crude mortality rate by cause of death, sex, and diabetes status. Infectious diseases. Canada (Alberta).

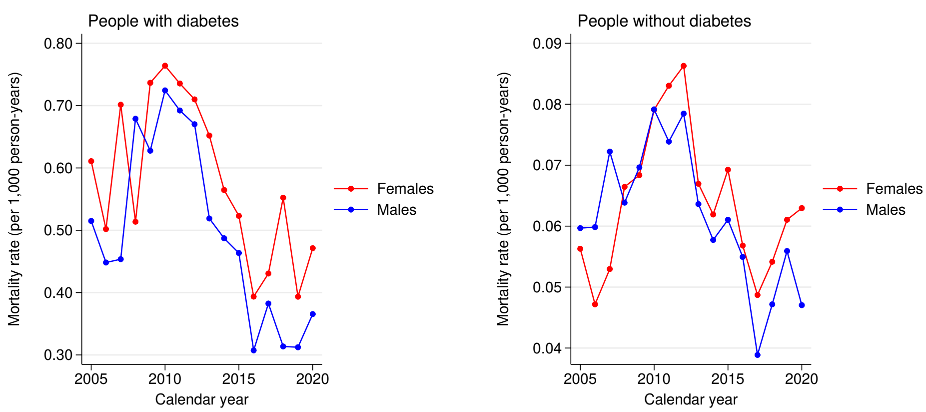


Figure 2.16: Crude mortality rate by cause of death, sex, and diabetes status. Influenza and pneumonia. Canada (Alberta).

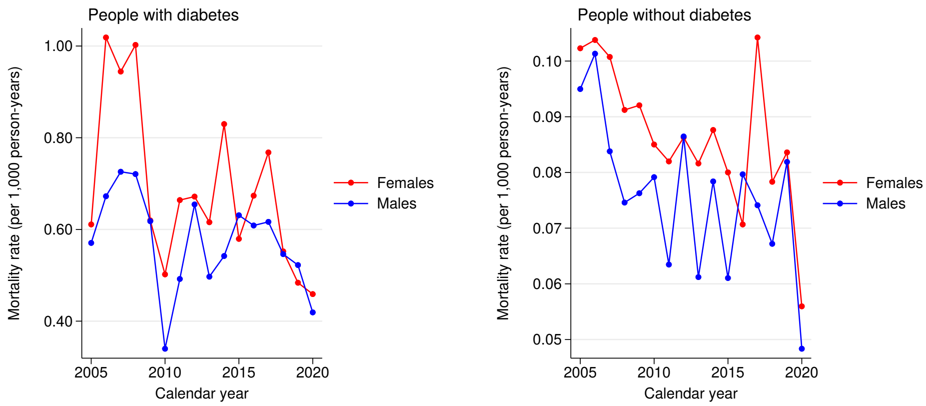


Figure 2.17: Crude mortality rate by cause of death, sex, and diabetes status. Kidney disease. Canada (Alberta).

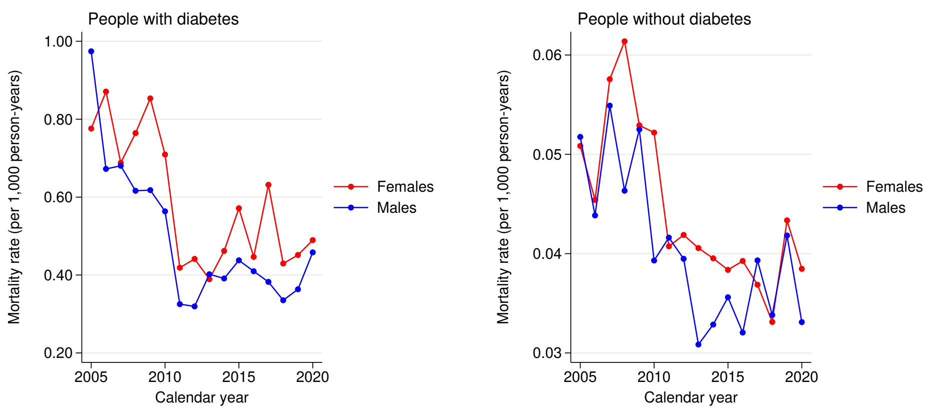


Figure 2.18: Crude mortality rate by cause of death, sex, and diabetes status. Liver disease. Canada (Alberta).

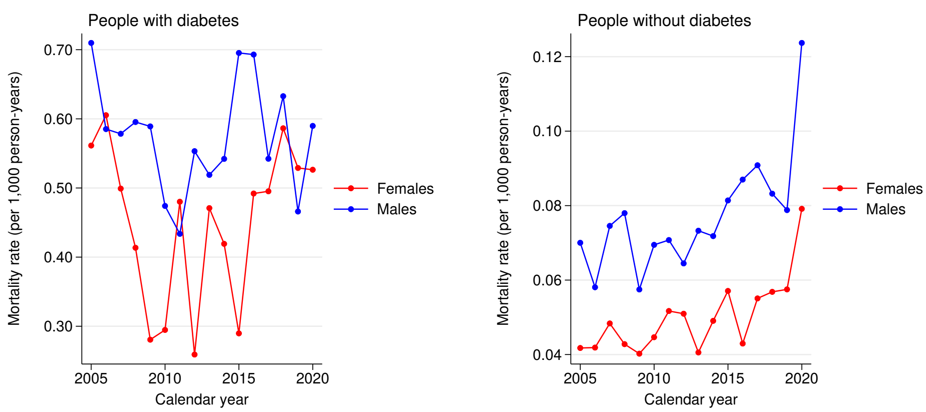


Figure 2.19: Crude mortality rate by cause of death, sex, and diabetes status. Cancer. Canada (Ontario).

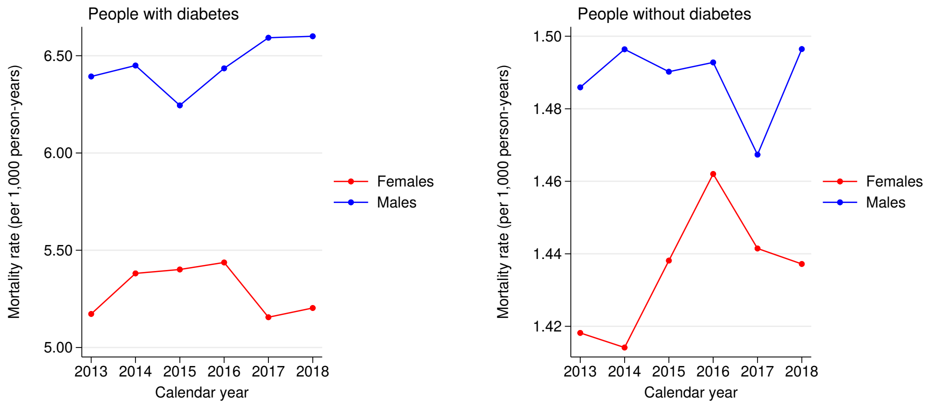


Figure 2.20: Crude mortality rate by cause of death, sex, and diabetes status. Cardiovascular disease. Canada (Ontario).

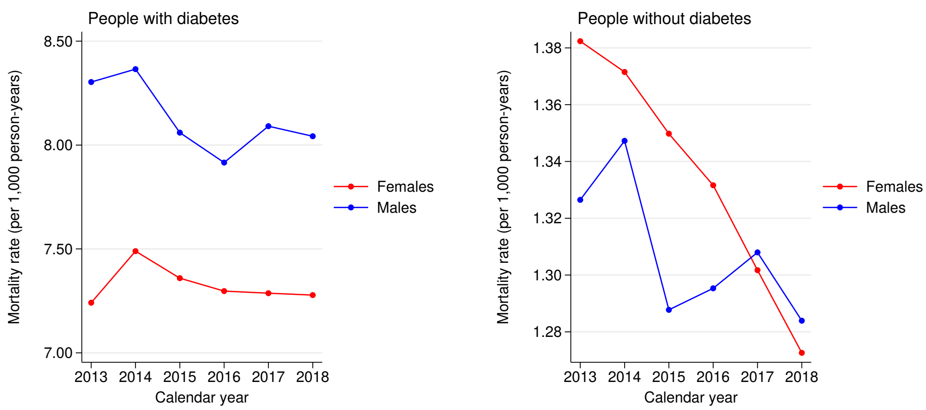


Figure 2.21: Crude mortality rate by cause of death, sex, and diabetes status. Chronic lower respiratory disease. Canada (Ontario).

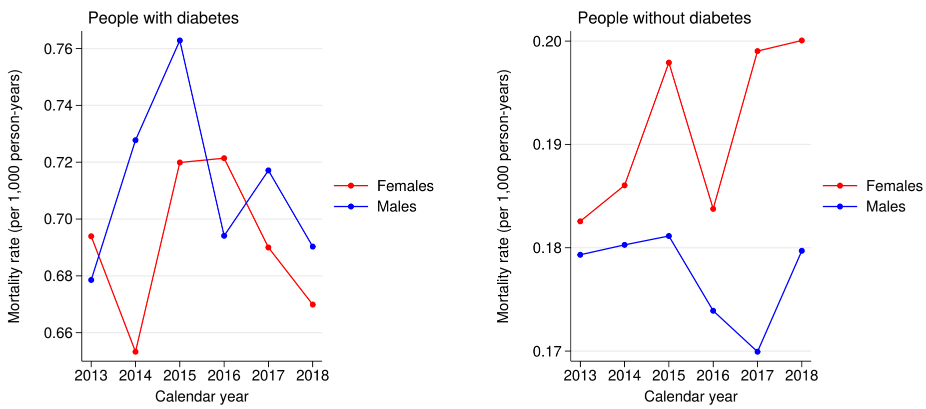


Figure 2.22: Crude mortality rate by cause of death, sex, and diabetes status. Dementia. Canada (Ontario).

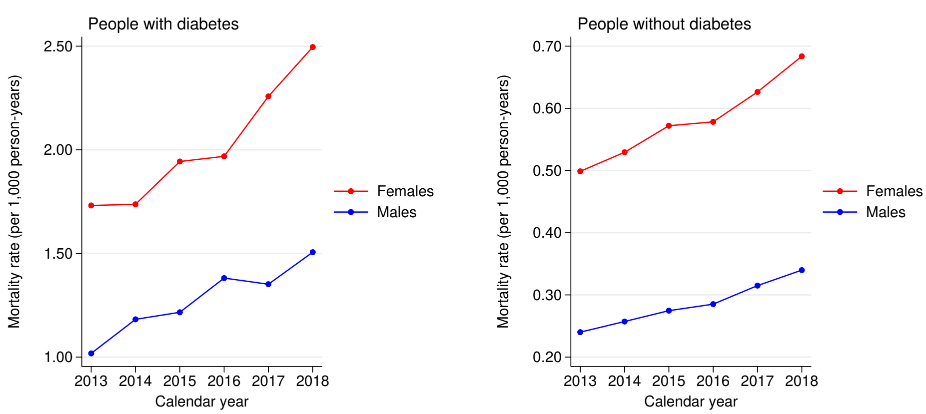


Figure 2.23: Crude mortality rate by cause of death, sex, and diabetes status. Diabetes. Canada (Ontario).

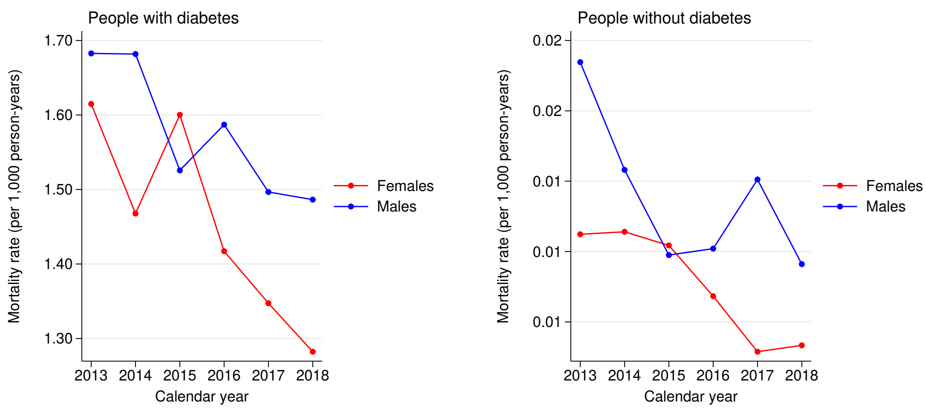


Figure 2.24: Crude mortality rate by cause of death, sex, and diabetes status. Infectious diseases. Canada (Ontario).

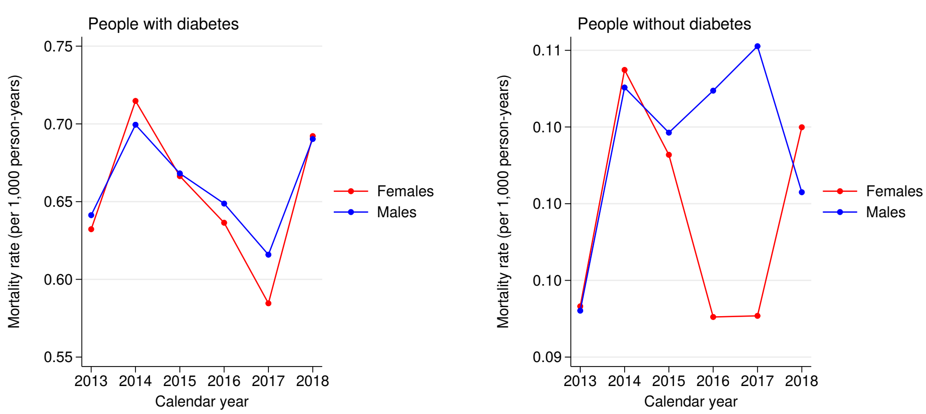


Figure 2.25: Crude mortality rate by cause of death, sex, and diabetes status. Influenza and pneumonia. Canada (Ontario).

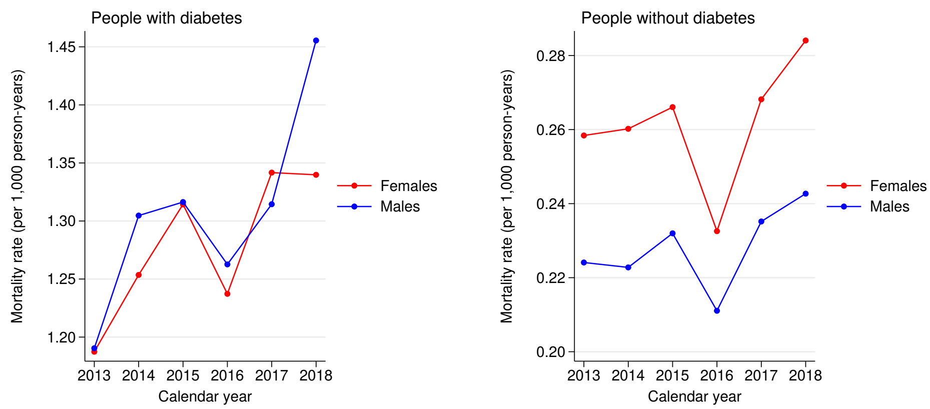


Figure 2.26: Crude mortality rate by cause of death, sex, and diabetes status. Kidney disease. Canada (Ontario).

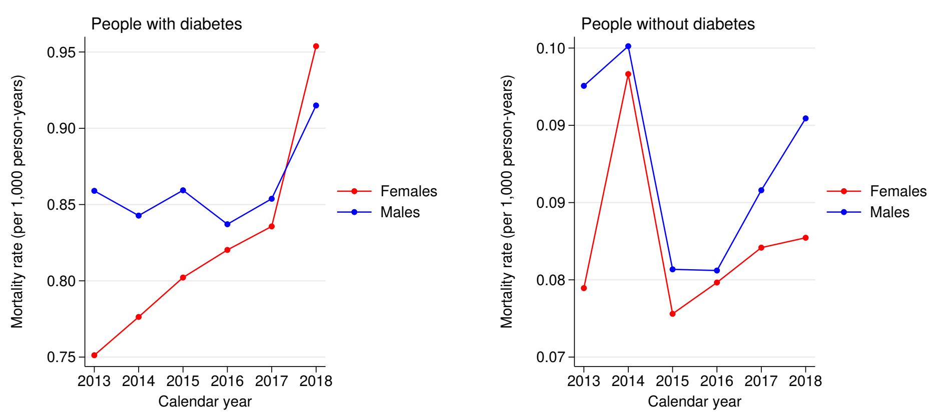


Figure 2.27: Crude mortality rate by cause of death, sex, and diabetes status. Liver disease. Canada (Ontario).

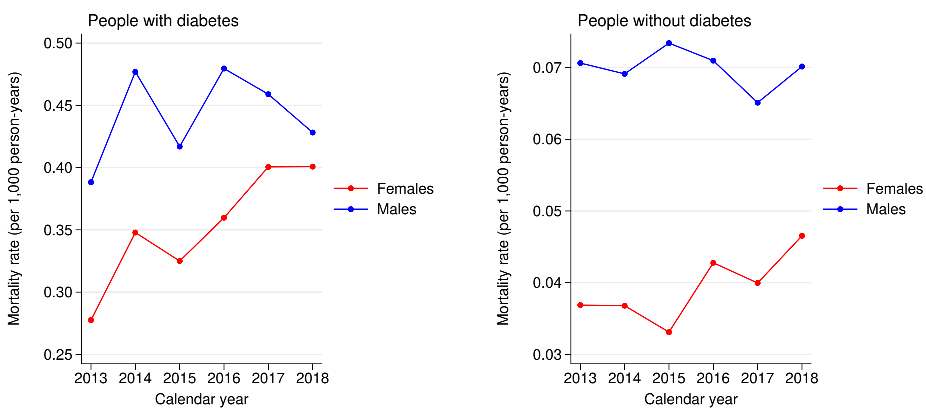


Figure 2.28: Crude mortality rate by cause of death, sex, and diabetes status. Cancer. Denmark.

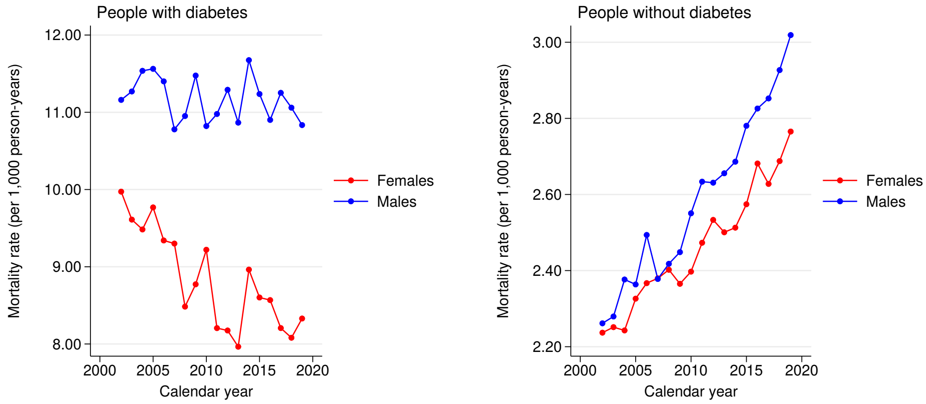


Figure 2.29: Crude mortality rate by cause of death, sex, and diabetes status. Cardiovascular disease. Denmark.

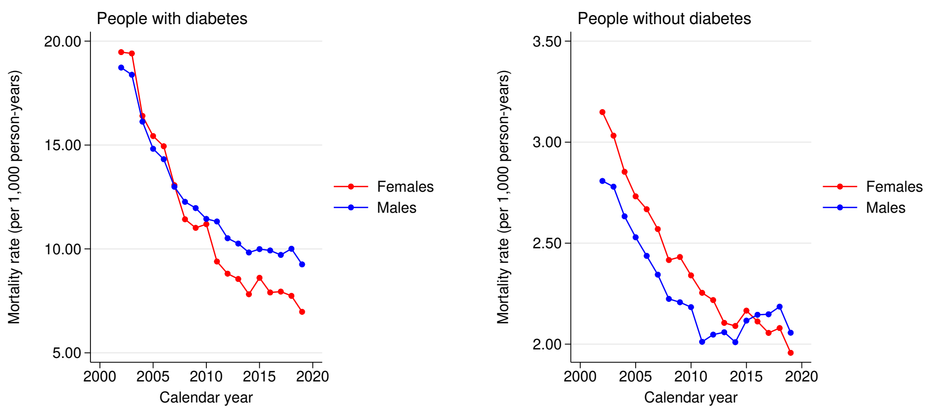


Figure 2.30: Crude mortality rate by cause of death, sex, and diabetes status. Chronic lower respiratory disease. Denmark.

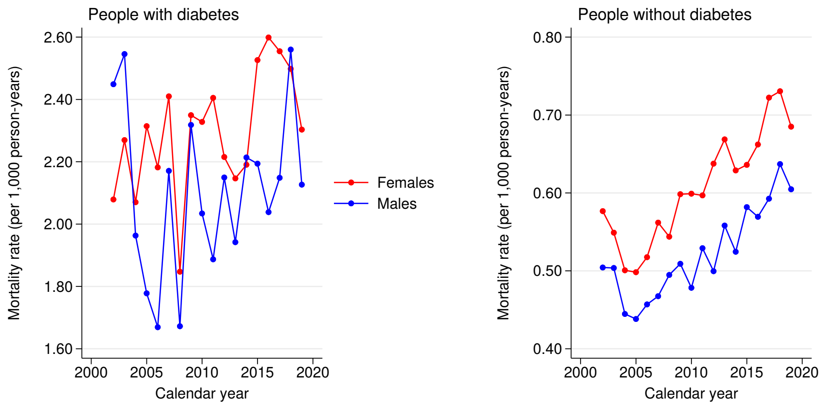


Figure 2.31: Crude mortality rate by cause of death, sex, and diabetes status. Dementia. Denmark.

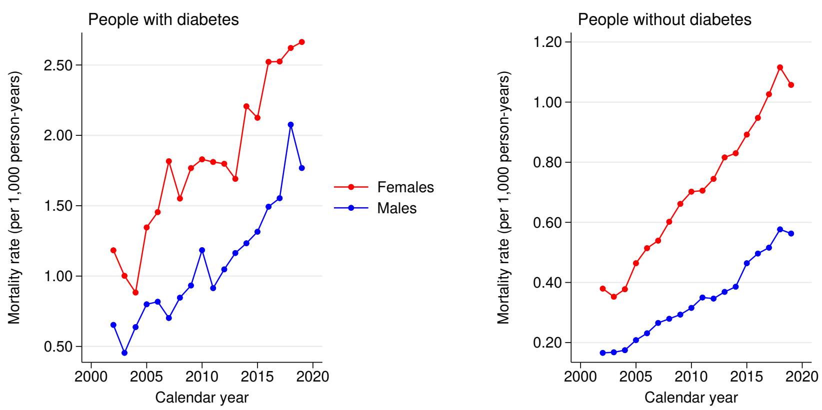


Figure 2.32: Crude mortality rate by cause of death, sex, and diabetes status. Diabetes. Denmark.

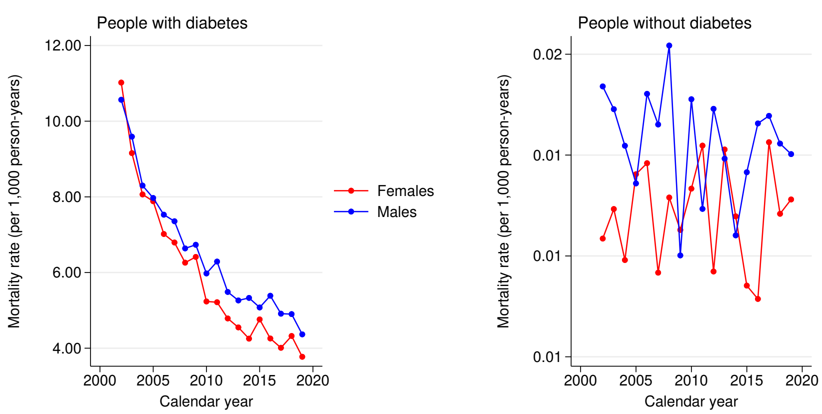


Figure 2.33: Crude mortality rate by cause of death, sex, and diabetes status. Infectious diseases. Denmark.

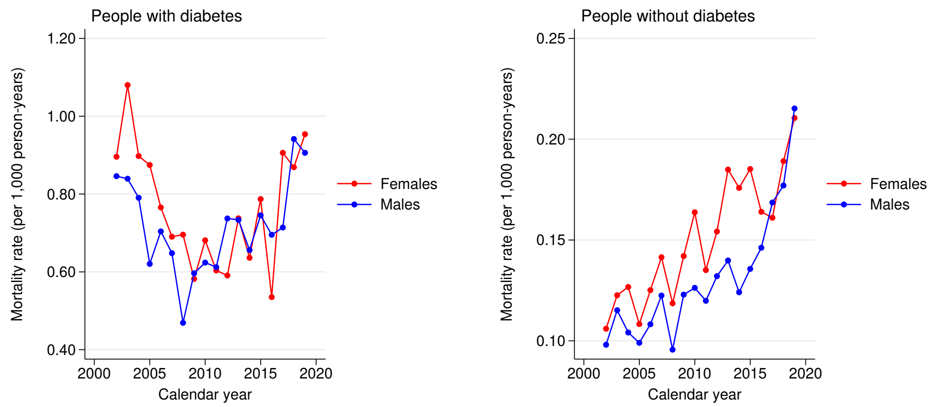


Figure 2.34: Crude mortality rate by cause of death, sex, and diabetes status. Influenza and pneumonia. Denmark.

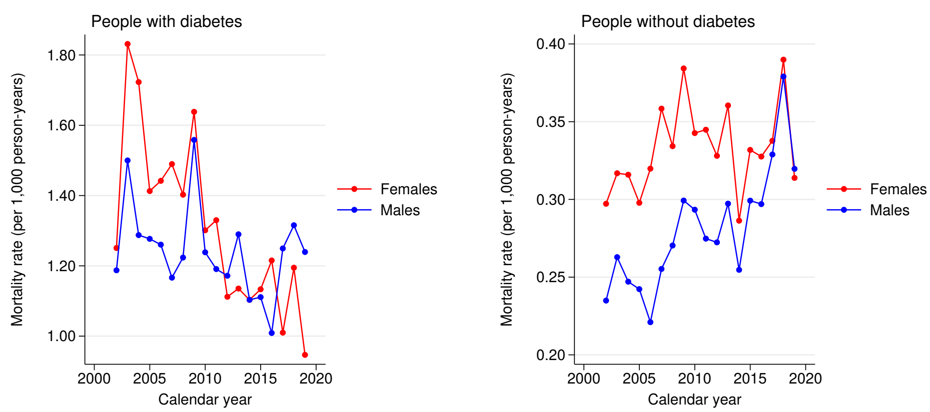


Figure 2.35: Crude mortality rate by cause of death, sex, and diabetes status. Kidney disease. Denmark.

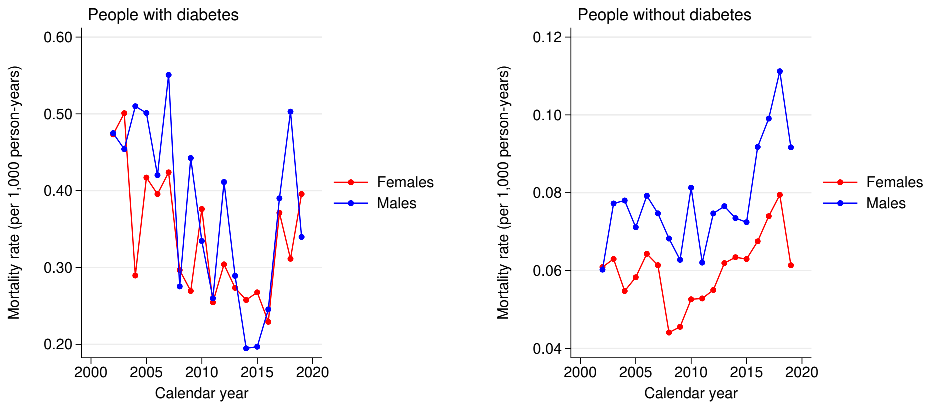


Figure 2.36: Crude mortality rate by cause of death, sex, and diabetes status. Liver disease. Denmark.

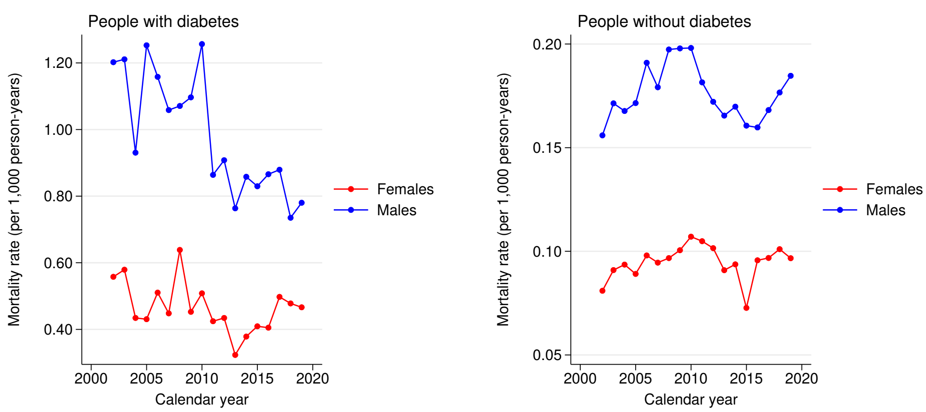


Figure 2.37: Crude mortality rate by cause of death, sex, and diabetes status. Cancer. Finland.

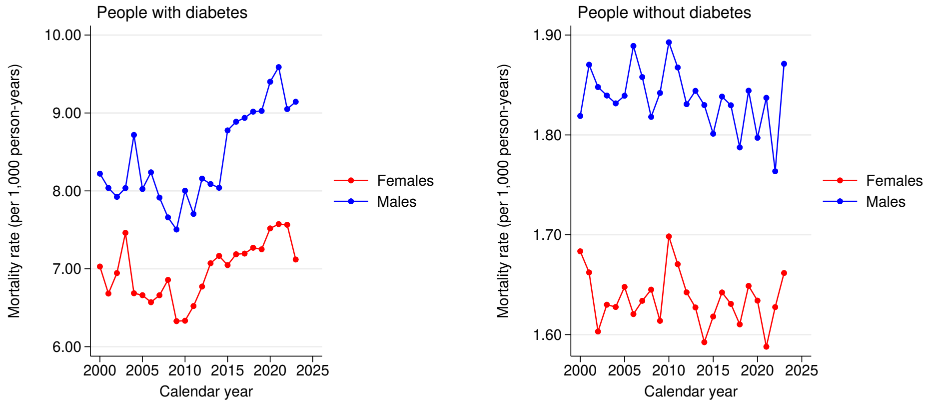


Figure 2.38: Crude mortality rate by cause of death, sex, and diabetes status. Cardiovascular disease. Finland.

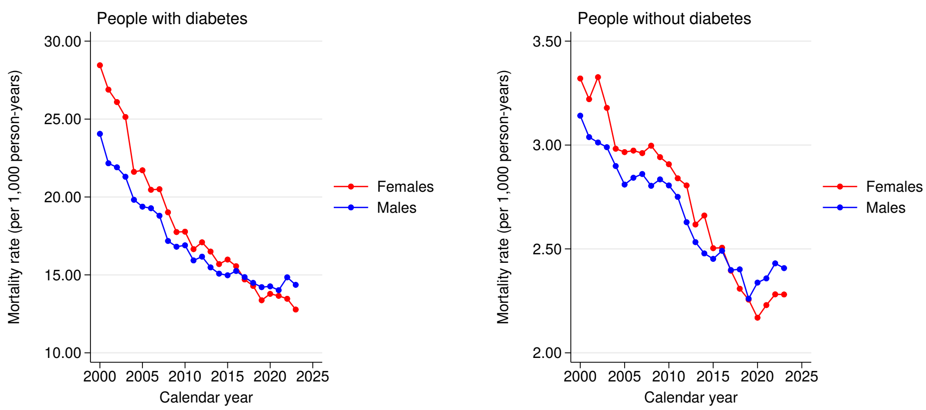


Figure 2.39: Crude mortality rate by cause of death, sex, and diabetes status. Chronic lower respiratory disease. Finland.

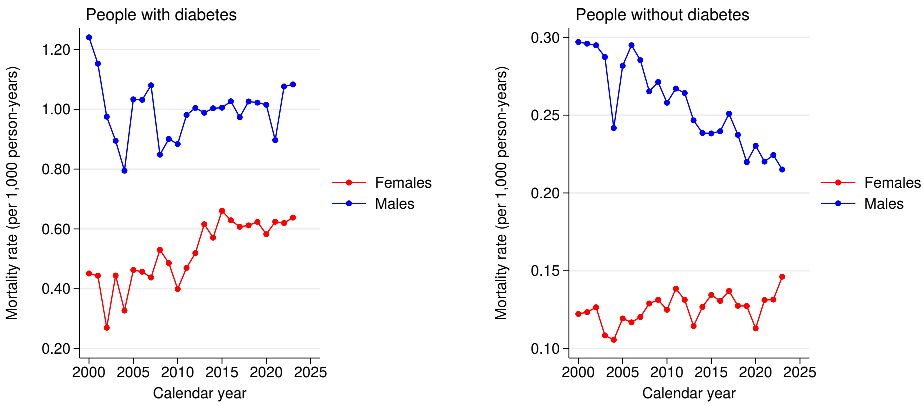


Figure 2.40: Crude mortality rate by cause of death, sex, and diabetes status. Dementia. Finland.

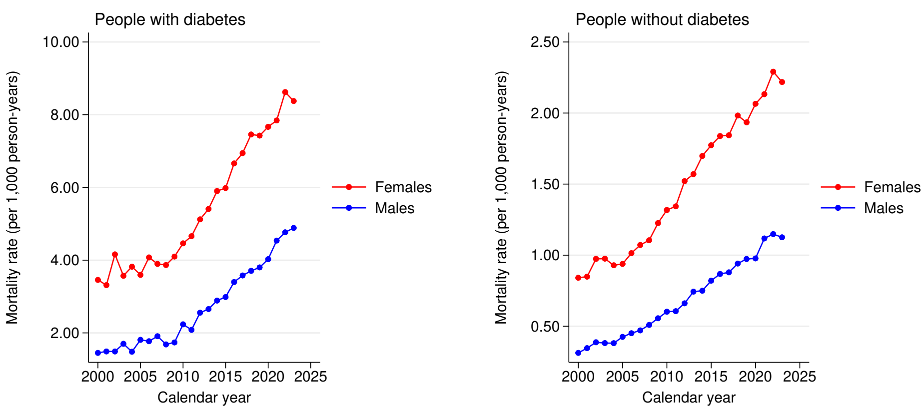


Figure 2.41: Crude mortality rate by cause of death, sex, and diabetes status. Diabetes. Finland.

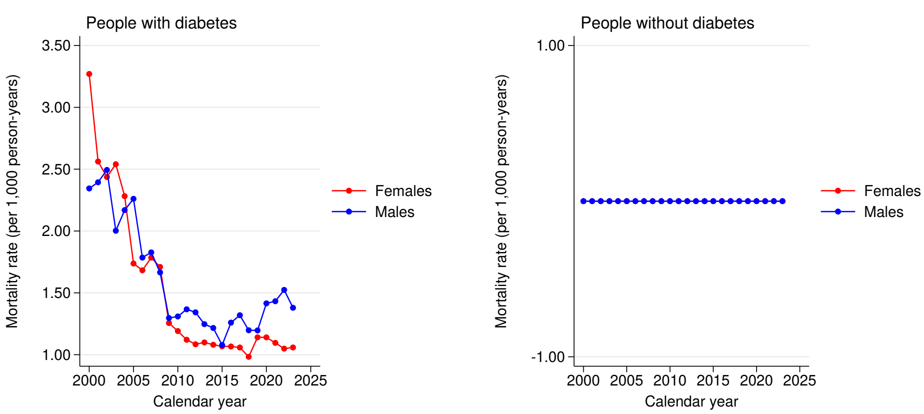


Figure 2.42: Crude mortality rate by cause of death, sex, and diabetes status. Infectious diseases. Finland.

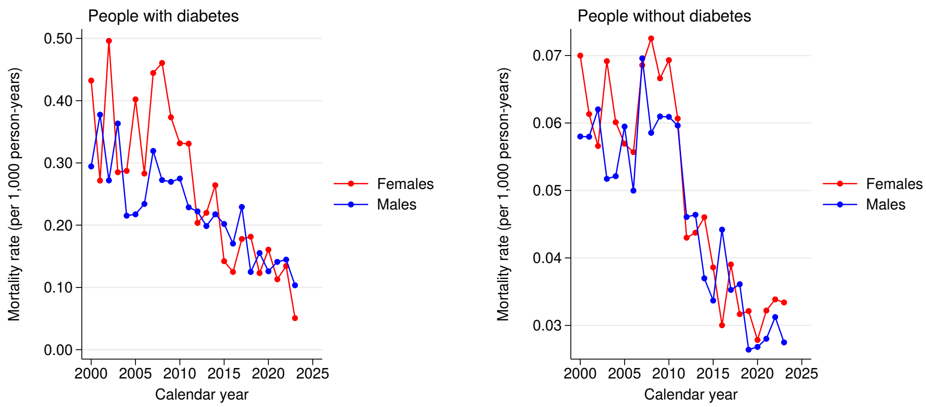


Figure 2.43: Crude mortality rate by cause of death, sex, and diabetes status. Influenza and pneumonia. Finland.

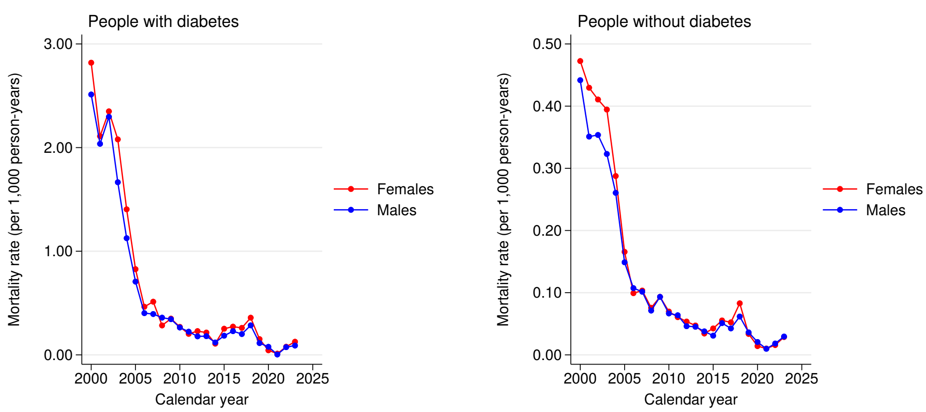


Figure 2.44: Crude mortality rate by cause of death, sex, and diabetes status. Kidney disease. Finland.

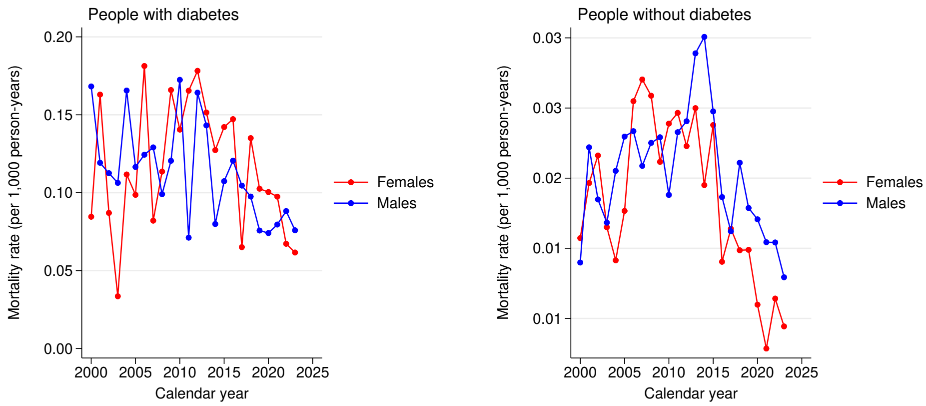


Figure 2.45: Crude mortality rate by cause of death, sex, and diabetes status. Liver disease. Finland.

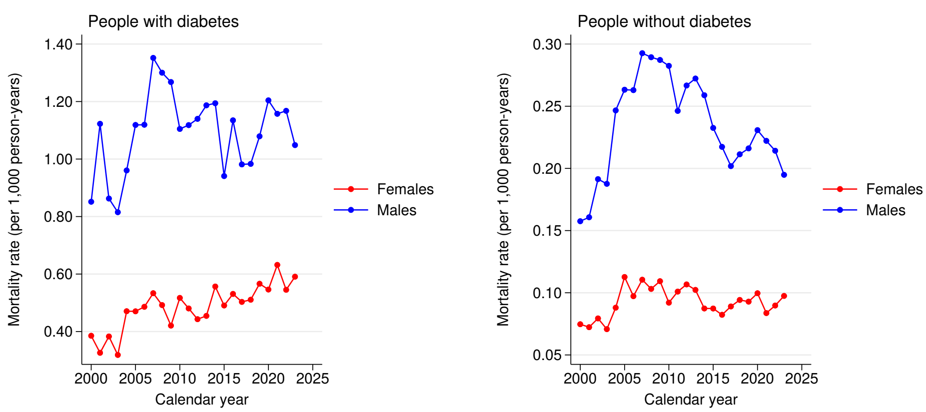


Figure 2.46: Crude mortality rate by cause of death, sex, and diabetes status. Cancer. France.

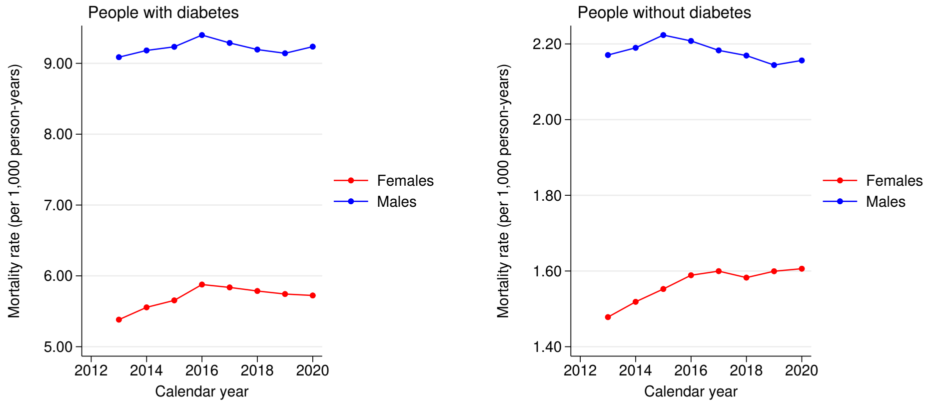


Figure 2.47: Crude mortality rate by cause of death, sex, and diabetes status. Cardiovascular disease. France.

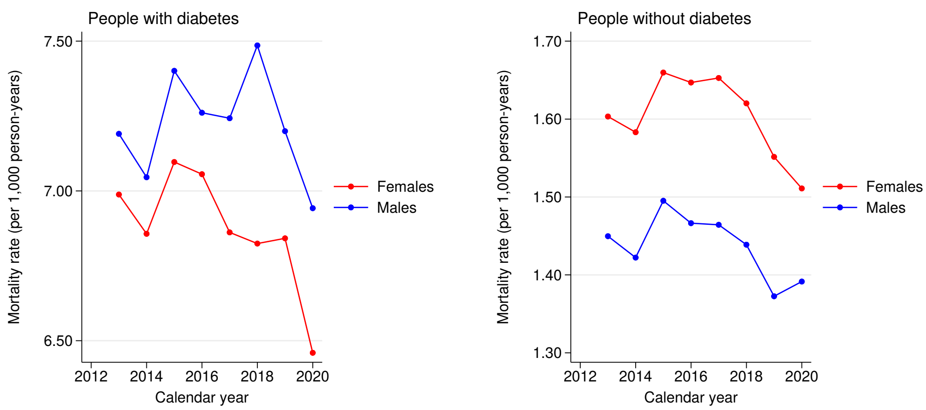


Figure 2.48: Crude mortality rate by cause of death, sex, and diabetes status. Chronic lower respiratory disease. France.

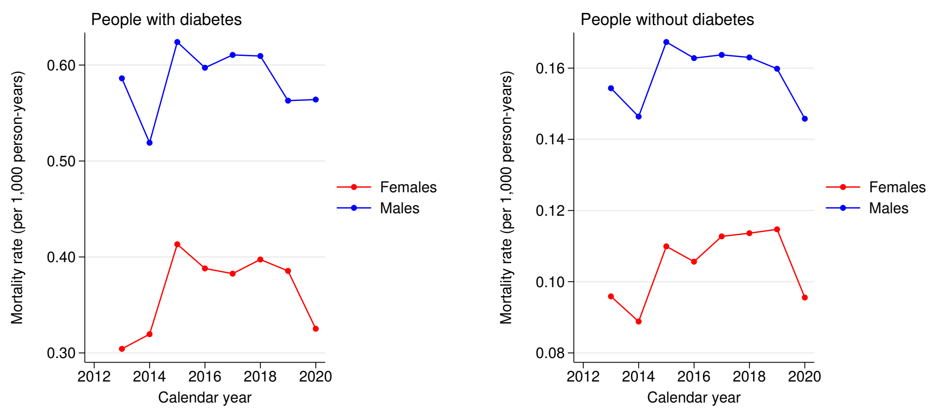


Figure 2.49: Crude mortality rate by cause of death, sex, and diabetes status. Dementia. France.

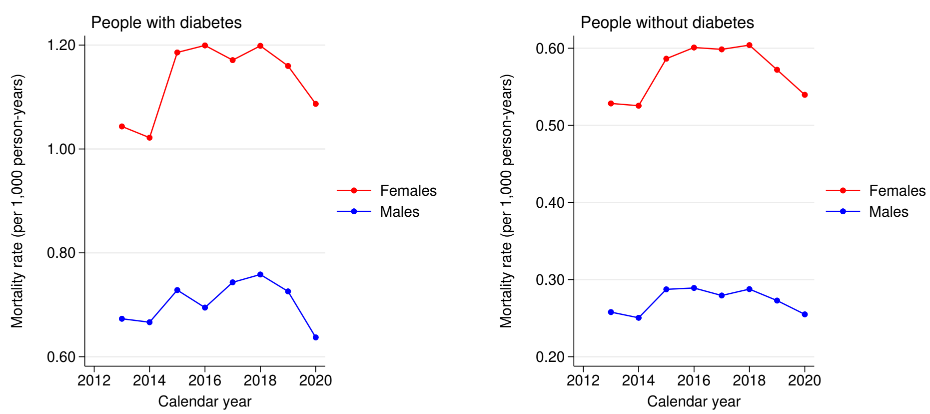


Figure 2.50: Crude mortality rate by cause of death, sex, and diabetes status. Diabetes. France.

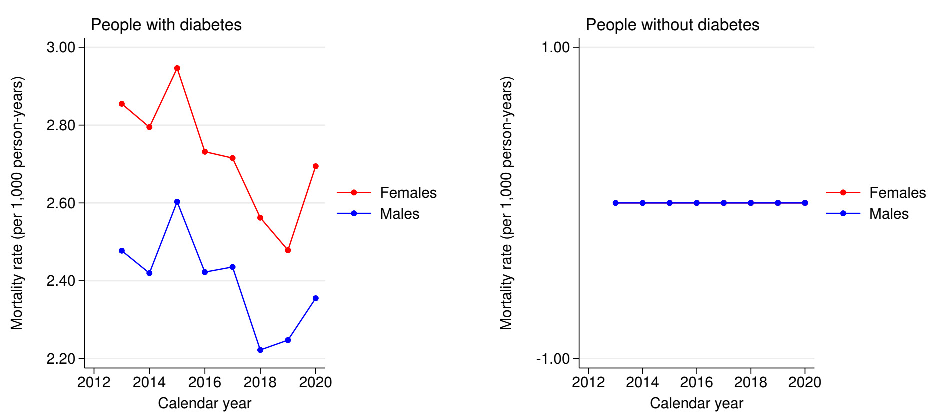


Figure 2.51: Crude mortality rate by cause of death, sex, and diabetes status. Infectious diseases. France.

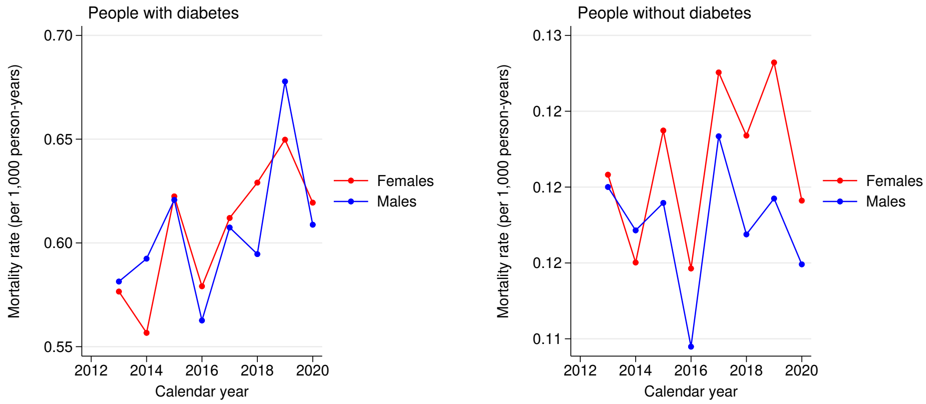


Figure 2.52: Crude mortality rate by cause of death, sex, and diabetes status. Influenza and pneumonia. France.

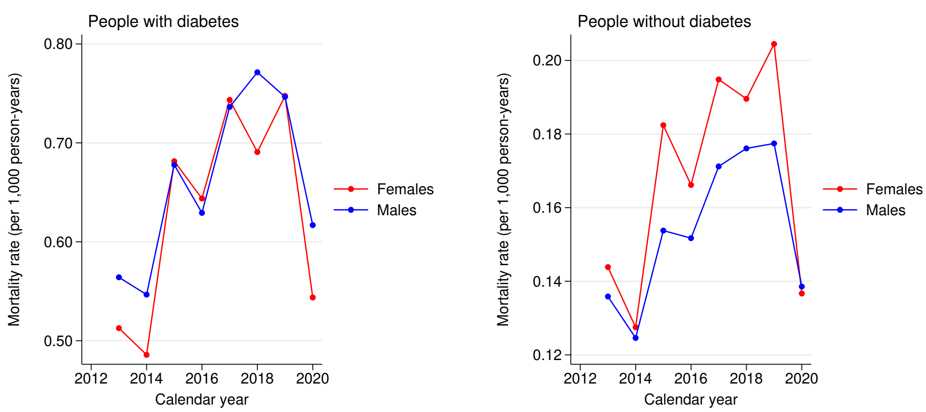


Figure 2.53: Crude mortality rate by cause of death, sex, and diabetes status. Kidney disease. France.

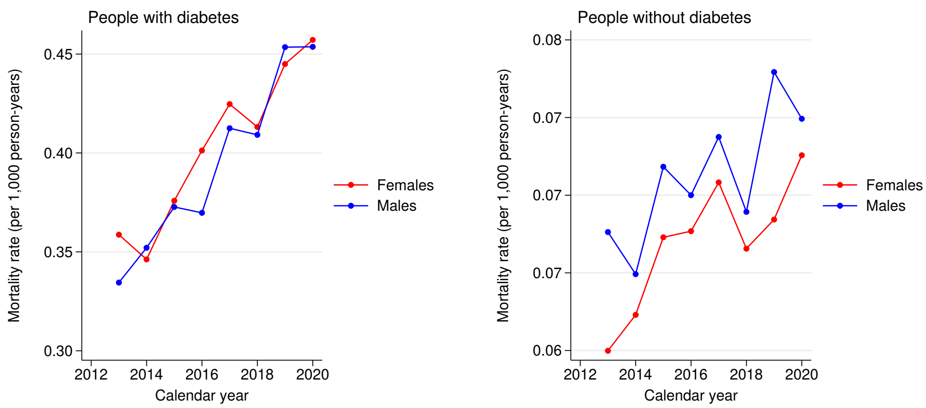


Figure 2.54: Crude mortality rate by cause of death, sex, and diabetes status. Liver disease. France.

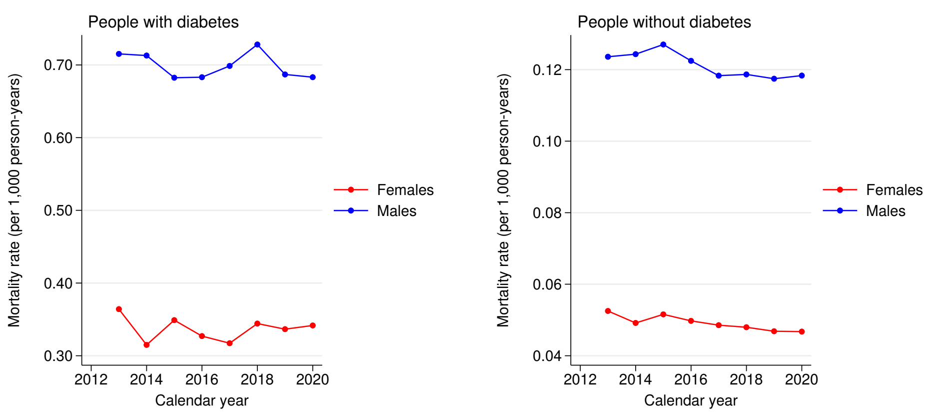


Figure 2.55: Crude mortality rate by cause of death, sex, and diabetes status. Cancer. Lithuania.

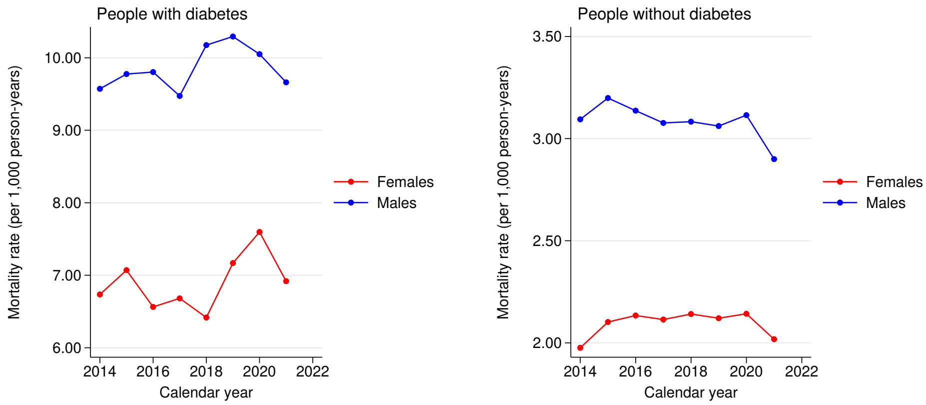


Figure 2.56: Crude mortality rate by cause of death, sex, and diabetes status. Cardiovascular disease. Lithuania.

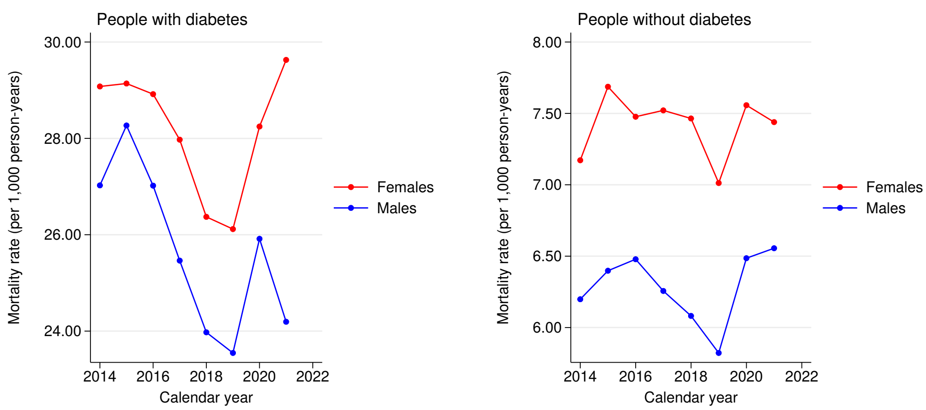


Figure 2.57: Crude mortality rate by cause of death, sex, and diabetes status. Chronic lower respiratory disease. Lithuania.

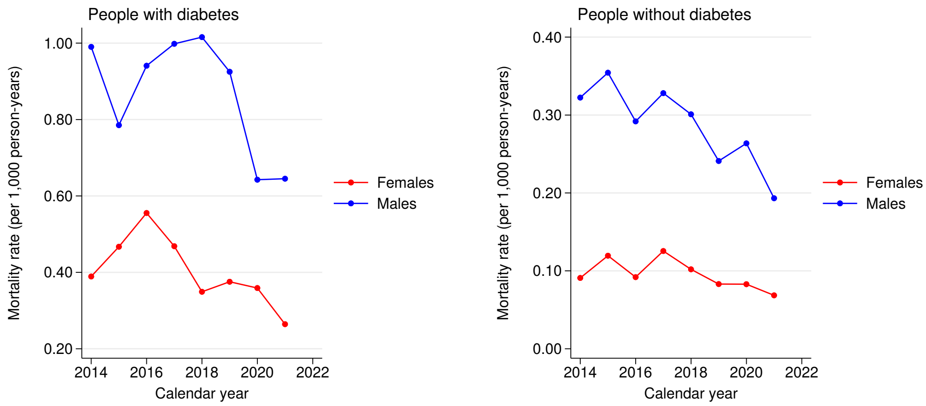


Figure 2.58: Crude mortality rate by cause of death, sex, and diabetes status. Dementia. Lithuania.

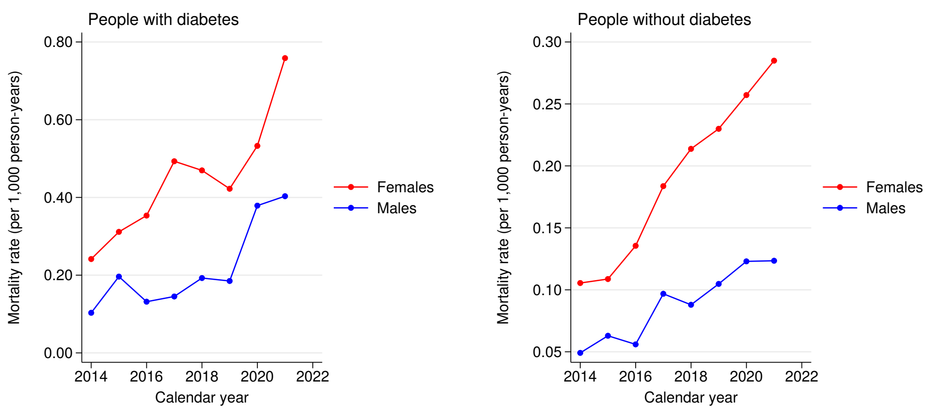


Figure 2.59: Crude mortality rate by cause of death, sex, and diabetes status. Diabetes. Lithuania.

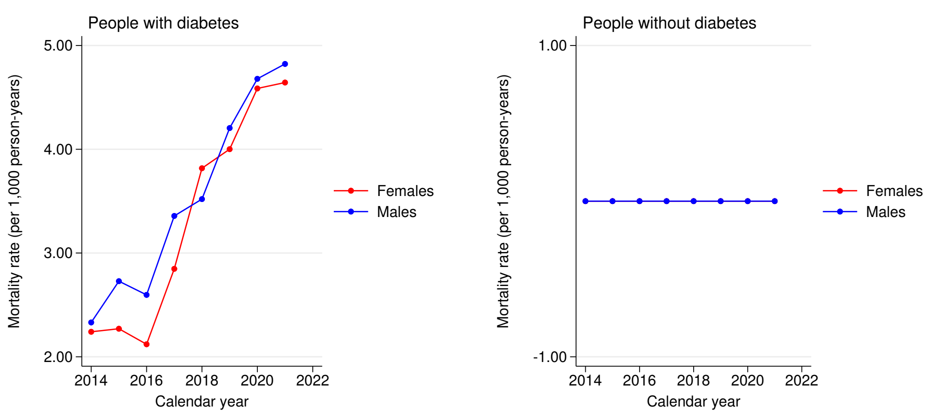


Figure 2.60: Crude mortality rate by cause of death, sex, and diabetes status. Infectious diseases. Lithuania.

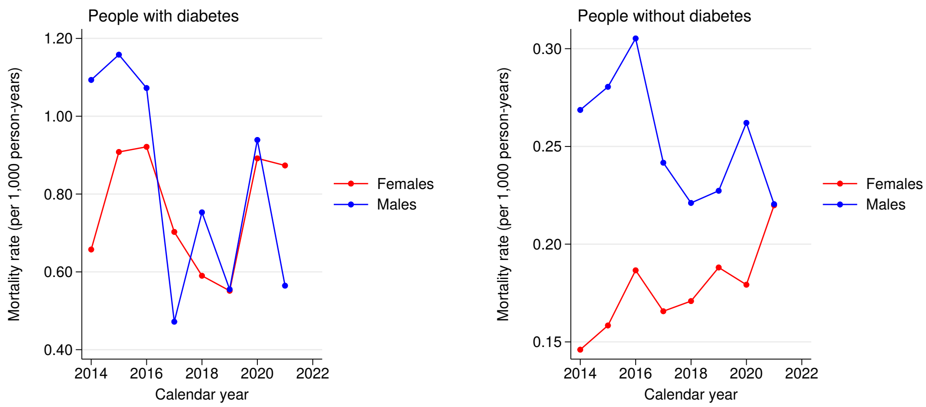


Figure 2.61: Crude mortality rate by cause of death, sex, and diabetes status. Influenza and pneumonia. Lithuania.

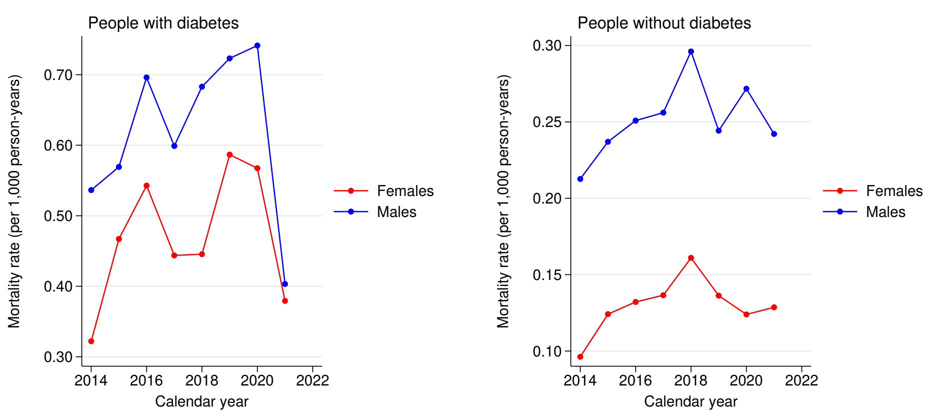


Figure 2.62: Crude mortality rate by cause of death, sex, and diabetes status. Kidney disease. Lithuania.

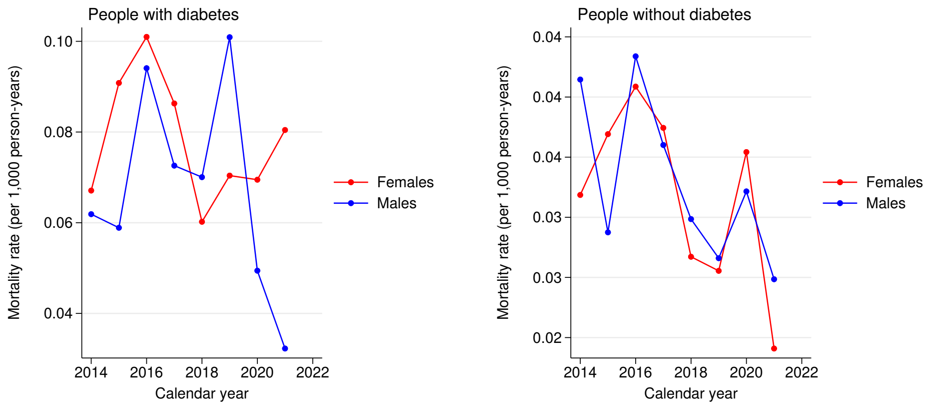


Figure 2.63: Crude mortality rate by cause of death, sex, and diabetes status. Liver disease. Lithuania.

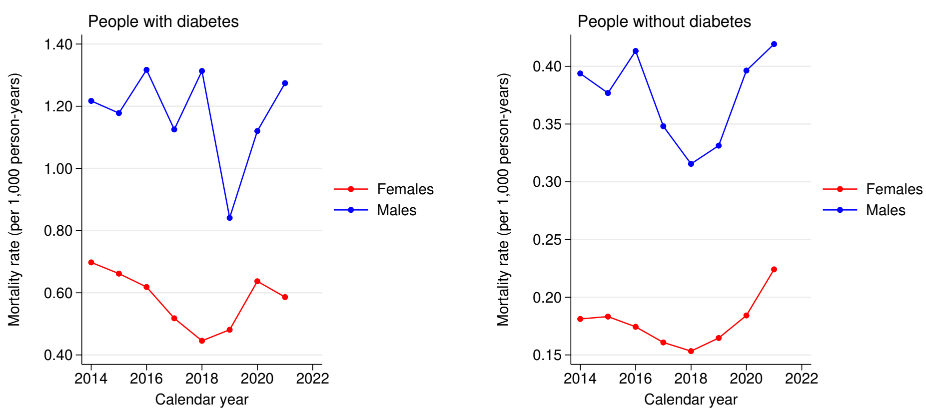


Figure 2.64: Crude mortality rate by cause of death, sex, and diabetes status. Cancer. Scotland.

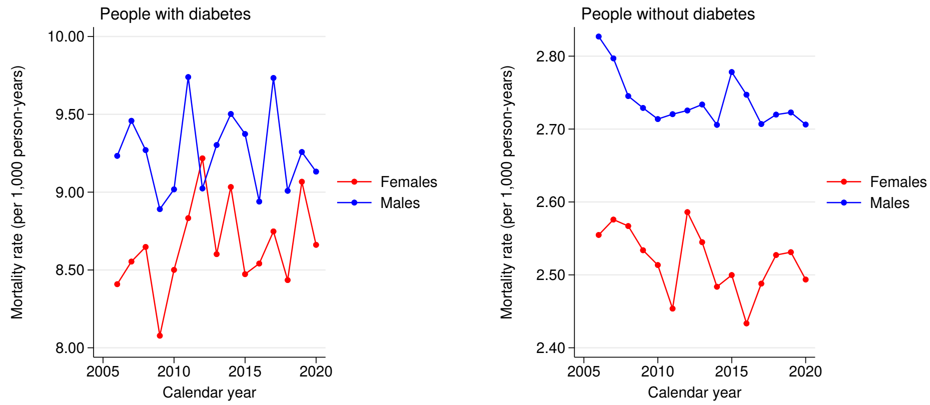


Figure 2.65: Crude mortality rate by cause of death, sex, and diabetes status. Cardiovascular disease. Scotland.

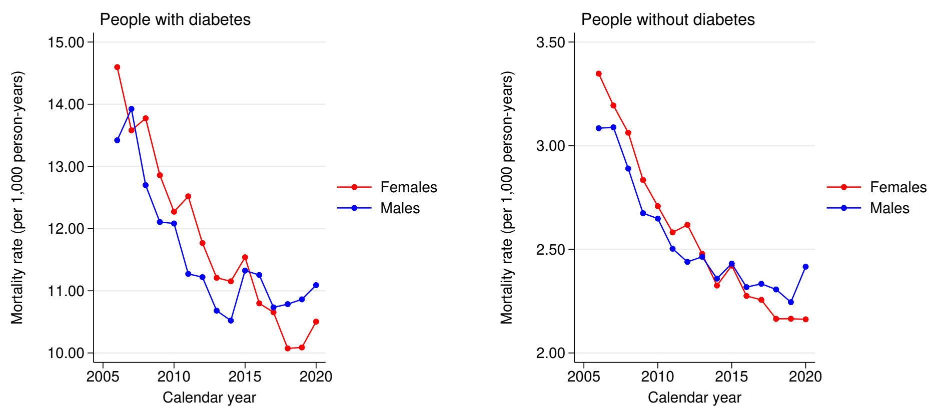


Figure 2.66: Crude mortality rate by cause of death, sex, and diabetes status. Chronic lower respiratory disease. Scotland.

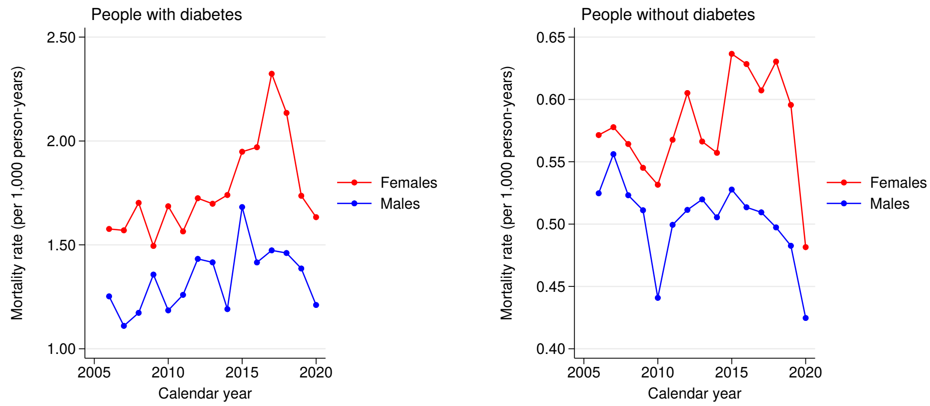


Figure 2.67: Crude mortality rate by cause of death, sex, and diabetes status. Dementia. Scotland.

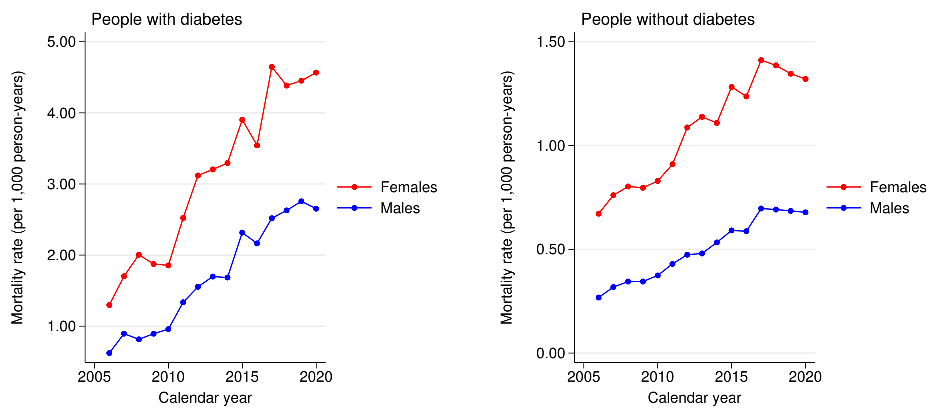


Figure 2.68: Crude mortality rate by cause of death, sex, and diabetes status. Diabetes. Scotland.

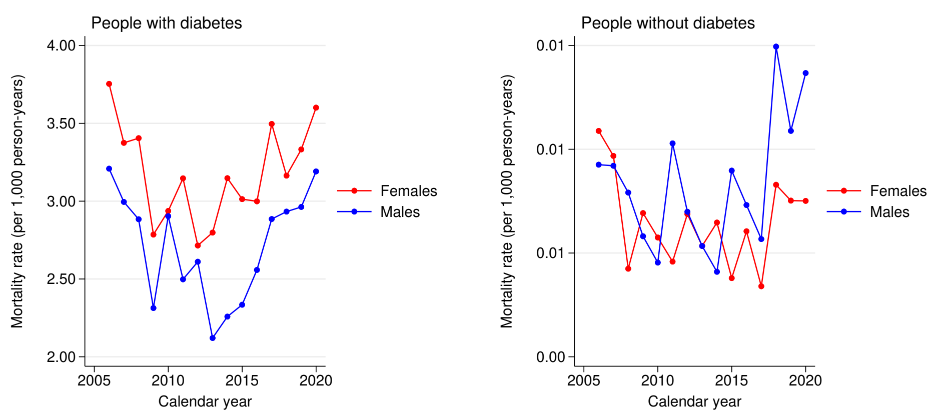


Figure 2.69: Crude mortality rate by cause of death, sex, and diabetes status. Infectious diseases. Scotland.

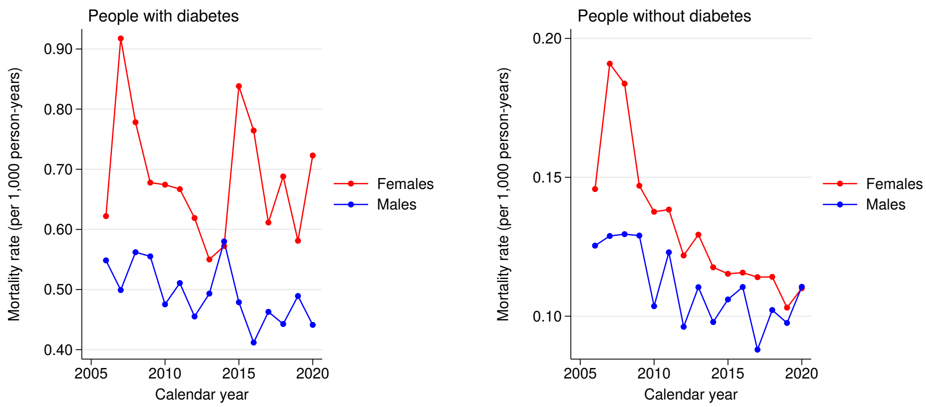


Figure 2.70: Crude mortality rate by cause of death, sex, and diabetes status. Influenza and pneumonia. Scotland.

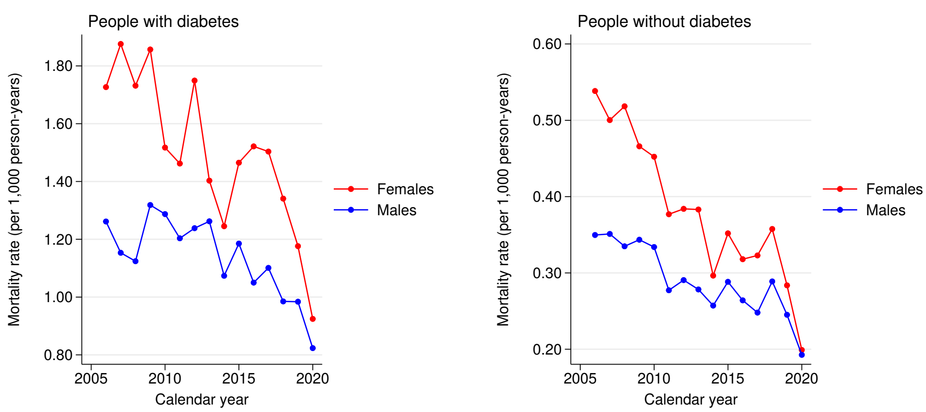


Figure 2.71: Crude mortality rate by cause of death, sex, and diabetes status. Kidney disease. Scotland.

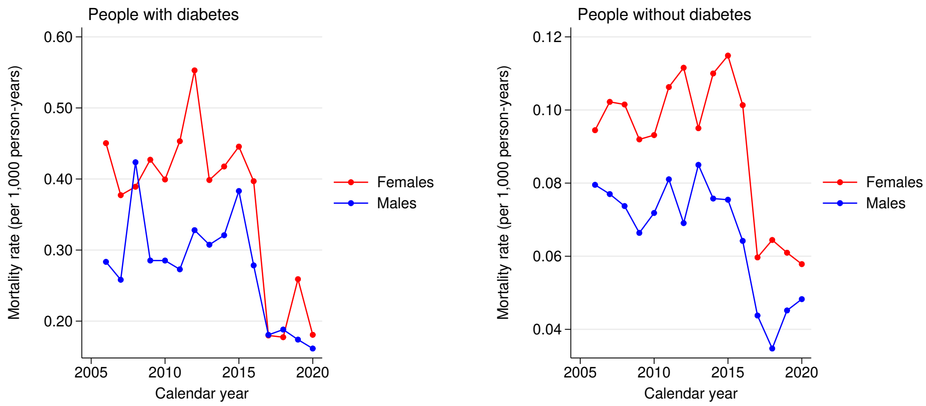


Figure 2.72: Crude mortality rate by cause of death, sex, and diabetes status. Liver disease. Scotland.

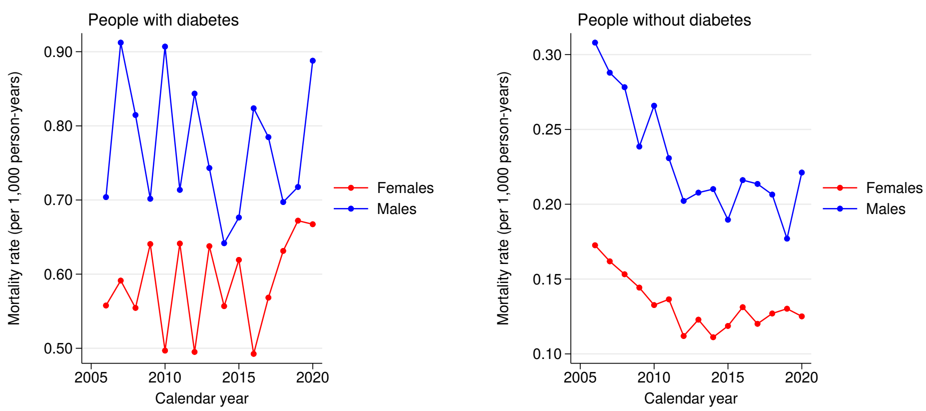


Figure 2.73: Crude mortality rate by cause of death, sex, and diabetes status. Cancer. South Korea.

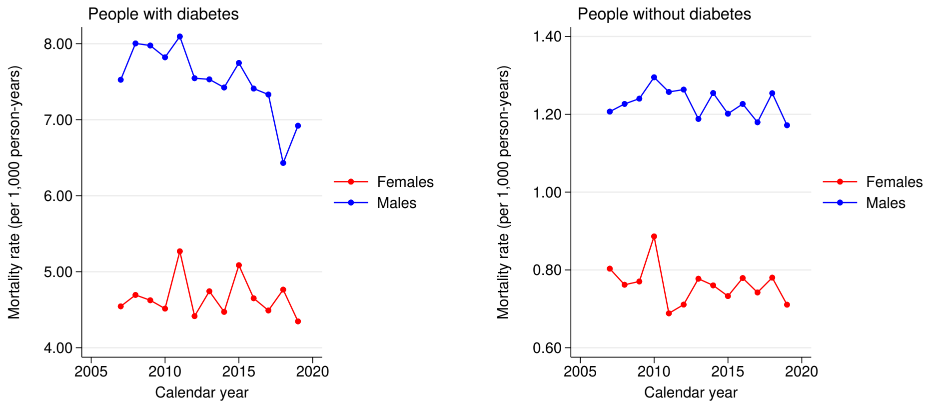


Figure 2.74: Crude mortality rate by cause of death, sex, and diabetes status. Cardiovascular disease. South Korea.

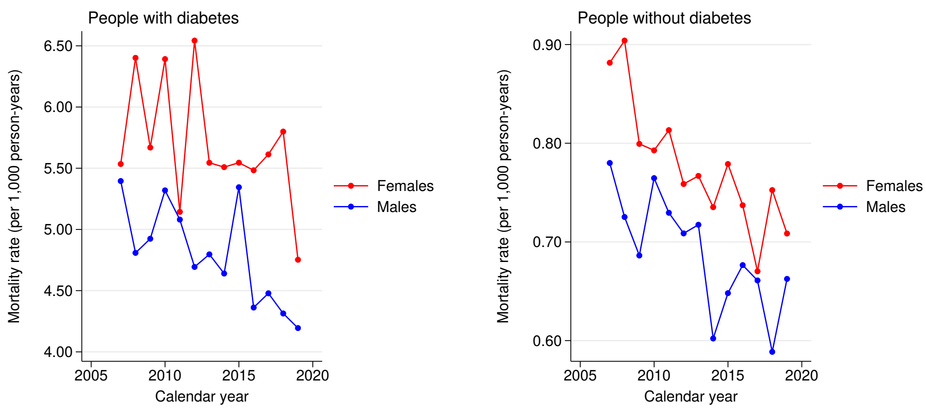


Figure 2.75: Crude mortality rate by cause of death, sex, and diabetes status. Chronic lower respiratory disease. South Korea.

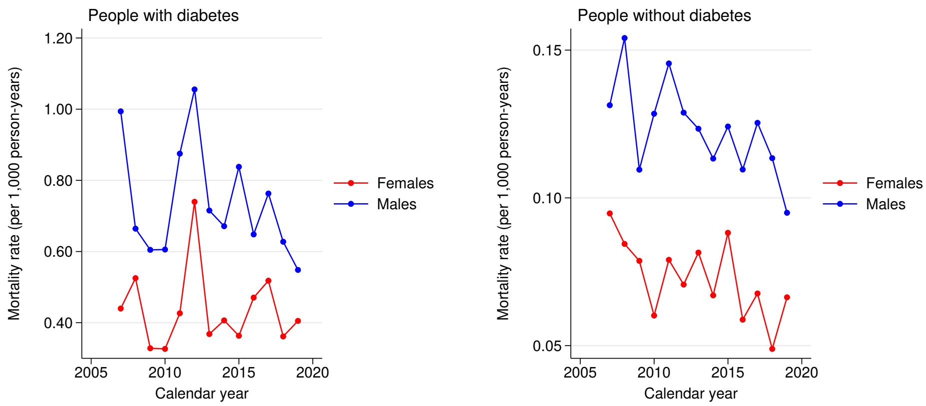


Figure 2.76: Crude mortality rate by cause of death, sex, and diabetes status. Dementia. South Korea.

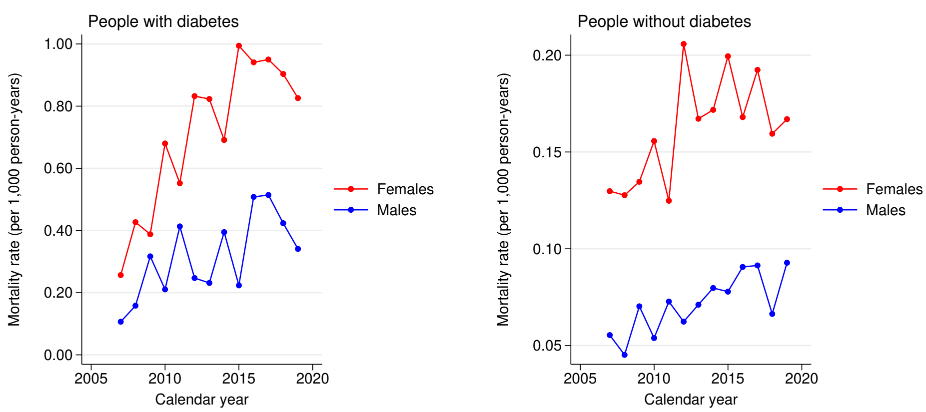


Figure 2.77: Crude mortality rate by cause of death, sex, and diabetes status. Diabetes. South Korea.

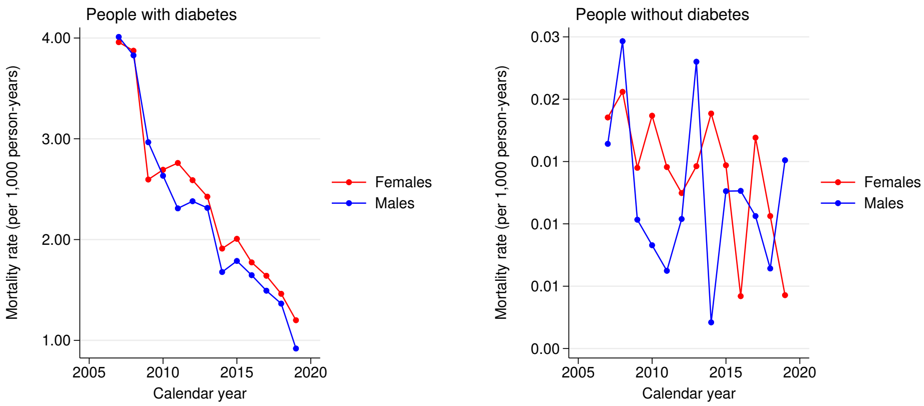


Figure 2.78: Crude mortality rate by cause of death, sex, and diabetes status. Infectious diseases. South Korea.

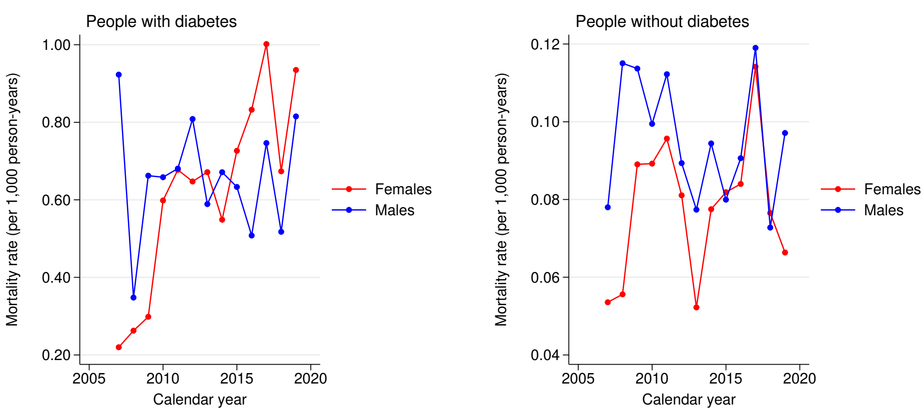


Figure 2.79: Crude mortality rate by cause of death, sex, and diabetes status. Influenza and pneumonia. South Korea.

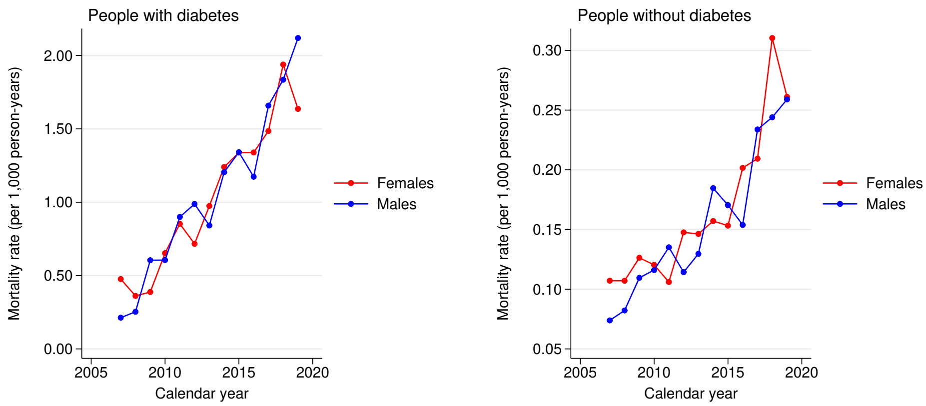


Figure 2.80: Crude mortality rate by cause of death, sex, and diabetes status. Kidney disease. South Korea.

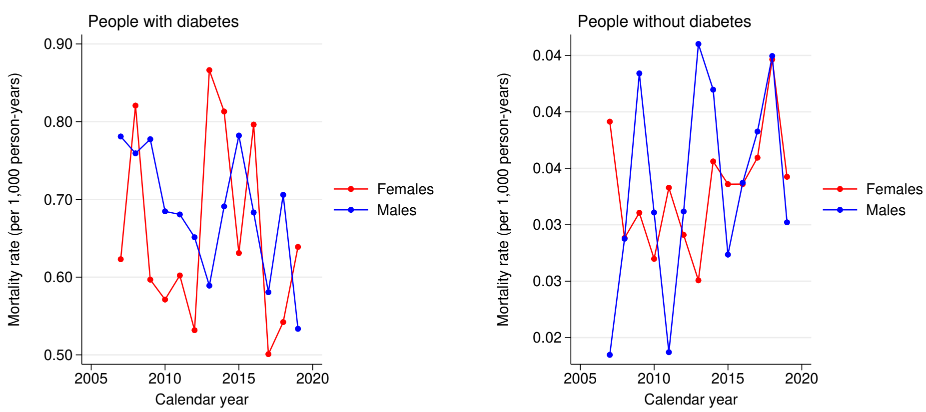
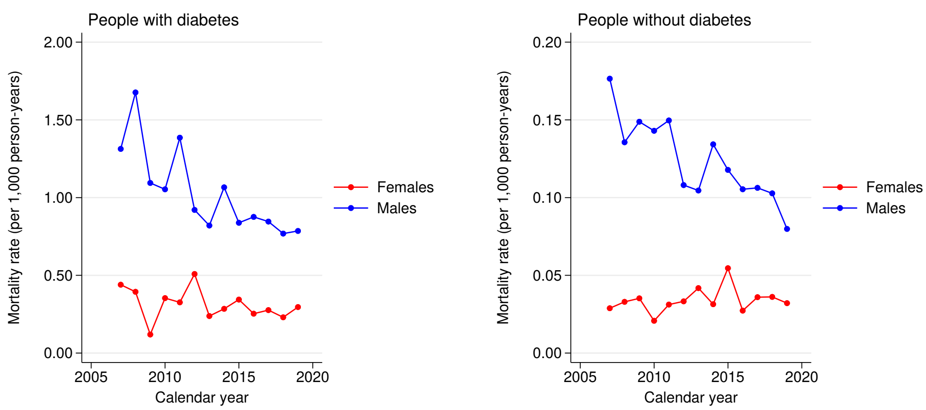


Figure 2.81: Crude mortality rate by cause of death, sex, and diabetes status. Liver disease. South Korea.



A few potential coding changes to note:

- Figure 2.8, Australia, kidney disease in 2013 – there is a big drop, suggesting a change in how kidney disease deaths were coded. Indeed, there were changes in coding kidney disease deaths by the Australian Burea of Statistics with the implementation of new software, which were as follows:
  - "N17-N19 Renal failure: There has been an increase in the number of conditions that have a causal relationship with renal failure. As a result, fewer deaths have been assigned to the code block N17-N19 as an underlying cause of death. Of note, E11 Non-insulin-dependent diabetes mellitus now combines with renal failure to form the code E11.2 Non-insulin- dependent diabetes mellitus with renal complications."
  - "N18 Chronic kidney disease: The title of code N18 has changed from Chronic renal failure to Chronic kidney disease. With the title update a coding change has occurred. Previously the term 'Chronic kidney disease' was coded to N03 Chronic nephritic syndrome. It is now coded to N18 Chronic kidney disease. Consequently, deaths assigned to N03 as an underlying cause have decreased."
- Figure 2.43, Finland, influenza and pneumonia from 2000-2005 – the continuous drop suggests a gradual change in how these deaths were coded.
- Figure 2.71, Scotland, kidney disease in 2017 – the big drop in 2017 for people with and without diabetes suggests a coding change.

Additionally, Lithuania and South Korea have indicated that their Dementia trends are unreliable. We will not present this data.

3 Cause-specific mortality rates

3.1 Methods

The methods are largely derived from Magliano et al. [1]. To generate age- and period-specific rates, which will be used to generate age-standardised rates, we will model mortality rates using age-period-cohort models [2]. Each model will be a Poisson model, parameterised using spline effects of age, period, and cohort (period − age), with log of person-years as the offset. Age is defined as above (i.e., the midpoint of the interval in most cases) and models are fit separately for each cause of death and country in people with and without diabetes and by sex. Because this will be $9 \times 9 \times 2 \times 2 = 324$ models, we won't check model fit for each model. Instead, to check model fit we will select a few at random and check the modelled and crude rates as well as the Pearson residuals. These models will be used to estimate mortality rates for single year ages and calendar years. These modelled rates will be used to generate age-standardised rates in people with and without diabetes by period, using direct standardisation (using the total diabetes population formed by pooling the consortium data).

```
*mkdir MD
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
foreach ii in can cvd res azd dmd inf flu ckd liv {
foreach iii in dm nondm {
if "`ii´" == "dmd" & "`iii´" == "nondm" {
}
else {
foreach iiii in 0 1 {
use `i´, clear
keep if sex == `iiii´
replace calendar = calendar-2009.5
gen coh = calendar-age_`iii´
centile(age_`iii´), centile(5 35 65 95)
local A1 = r(c_1)
local A2 = r(c_2)
local A3 = r(c_3)
local A4 = r(c_4)
mkspline agesp = age_`iii´, cubic knots(`A1´ `A2´ `A3´ `A4´)
su(calendar), detail
local rang = r(max)-r(min)
if `rang´ < 10 {
centile calendar, centile(25 75)
local CK1 = r(c_1)
local CK2 = r(c_2)
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´)
}
else if inrange(`rang´,10,14.9) {
centile calendar, centile(10 50 90)
local CK1 = r(c_1)
local CK2 = r(c_2)
local CK3 = r(c_3)
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´ `CK3´)
}
else {
centile calendar, centile(5 35 65 95)
local CK1 = r(c_1)
local CK2 = r(c_2)
local CK3 = r(c_3)
local CK4 = r(c_4)
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´ `CK3´ `CK4´)
}
centile(coh), centile(5 35 65 95)
local CO1 = r(c_1)
local CO2 = r(c_2)
```

```
local CO3 = r(c_3)
local CO4 = r(c_4)
mkspline cohsp = coh, cubic knots(`CO1´ `CO2´ `CO3´ `CO4´)
poisson `ii´_d_`iii´ agesp* timesp* cohsp*, exposure(pys_`iii´)
predict pred
gen OC = "`ii´"
gen DM = "`iii´"
save MD/RC_pred_`i´_`ii´_`iii´_`iiii´, replace
keep calendar
bysort cal : keep if _n == 1
expand 10
bysort cal : replace cal = cal+((_n-6)/10)
expand 700
bysort cal : gen age_`iii´ = (_n/10)+29.9
gen pys_`iii´ = 1
gen coh = calendar-age
mkspline agesp = age, cubic knots(`A1´ `A2´ `A3´ `A4´)
if `rang´ < 9.99 {
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´)
}
else if inrange(`rang´,10,14.99) {
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´ `CK3´)
}
else {
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´ `CK3´ `CK4´)
}
mkspline cohsp = coh, cubic knots(`CO1´ `CO2´ `CO3´ `CO4´)
predict _Rate, ir
predict errr, stdp
replace _Rate = _Rate*1000
gen lb = exp(ln(_Rate)-1.96*errr)
gen ub = exp(ln(_Rate)+1.96*errr)
gen country = "`i´"
gen OC = "`ii´"
gen DM = "`iii´"
gen sex = `iiii´
replace cal = cal+2010
tostring age_`iii´, replace force format(%9.1f)
destring age_`iii´, replace
save MD/R_`i´_`ii´_`iii´_`iiii´, replace
}
}
}
}
}
set seed 1312
clear
gen A =.
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
foreach ii in can cvd res azd dmd inf flu ckd liv {
foreach iii in dm nondm {
if "`ii´" == "dmd" & "`iii´" == "nondm" {
}
else {
foreach iiii in 0 1 {
local B = runiform()
append using MD/RC_pred_`i´_`ii´_`iii´_`iiii´
recode A .=`B´
keep if A > 0.985
}
}
}
}
}
save RCc, replace
set seed 1312
clear
gen A =.
```

```
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
foreach ii in can cvd res azd dmd inf flu ckd liv {
foreach iii in dm nondm {
if "`ii´" == "dmd" & "`iii´" == "nondm" {
}
else {
foreach iiii in 0 1 {
local B = runiform()
append using MD/R_`i´_`ii´_`iii´_`iiii´
recode A .=`B´
keep if A > 0.985
}
}
}
}
}
save Rc, replace
```

```
. use Rc, clear

. bysort A : keep if _n == 1
(874,990 observations deleted)

. list country OC DM sex
```

	country	OC	DM	sex
1.	Denmark	cvd	dm	0
2.	Finland	azd	nondm	1
3.	Australia	ckd	nondm	1
4.	Canada2	inf	dm	0
5.	Finland	liv	nondm	0
6.	Lithuania	azd	dm	1
7.	France	ckd	nondm	1
8.	Canada2	azd	dm	1
9.	France	cvd	dm	1
10.	Canada2	cvd	dm	1

```
forval i = 1/10 {
use Rc, clear
bysort A : keep if _n == 1
local c=country[`i´]
local o=OC[`i´]
local d=DM[`i´]
local s=sex[`i´]
if "`o´" == "can" {
local oo = "Cancer"
}
if "`o´" == "cvd" {
local oo = "Cardiovascular disease"
}
if "`o´" == "res" {
local oo = "Chronic lower respiratory disease"
}
if "`o´" == "azd" {
local oo = "Dementia"
}
if "`o´" == "dmd" {
local oo = "Diabetes"
}
if "`o´" == "inf" {
local oo = "Infectious diseases"
}
if "`o´" == "flu" {
local oo = "Influenza and pneumonia"
}
```

```
if "`o´" == "ckd" {
local oo = "Kidney disease"
}
if "`o´" == "liv" {
local oo = "Liver disease"
}
if "`d´" == "dm" {
local dd = "with"
}
if "`d´" == "nondm" {
local dd = "without"
}
if `s´ == 0 {
local ss = "Females"
}
if `s´ == 1 {
local ss = "Males"
}
use Rc, clear
keep if country == "`c´" & OC == "`o´" & sex == `s´ & DM == "`d´"
drop pys_nondm pys_dm
merge 1:1 age_`d´ sex cal using `c´
drop if _merge == 2
gen rate = 1000*`o´_d_`d´/pys_`d´
egen calmen = mean(calendar)
replace calmen = round(calmen,1)
local cmu = calmen[1]
twoway ///
(rarea ub lb age_`d´ if cale == `cmu´, color(black%30) fintensity(inten80) lwidth(none)) ///
(line _Rate age_`d´ if cale == `cmu´, color(black)) ///
(scatter rate age_`d´ if cale == `cmu´ & rate !=0, col(black)) ///
, graphregion(color(white)) ylabel(, angle(0) glpattern(solid) glcolor(gs10%20)) ///
xlabel(30(10)100, nogrid) ytitle("Mortality rate (per 1000 person-years)") ///
xtitle(Age) yscale(nolog) ylabel(, format(%9.1f)) legend(order( ///
2 "Modelled" ///
3 "Crude" ///
) ring(0) cols(1) position(11) region(lcolor(none) col(none))) ///
title("`c´, `oo´, `ss´ `dd´ diabetes", col(black) placement(west) size(medium))
graph save GPH/Rc_`c´_`o´_`d´_`s´_age, replace
twoway ///
(rarea ub lb cale if age_`d´ == 45, color(gs0%30) fintensity(inten80) lwidth(none)) ///
(line _Rate cale if age_`d´ == 45, color(gs0)) ///
(scatter rate cale if age_`d´ == 45 & rate !=0, col(gs0)) ///
(rarea ub lb cale if age_`d´ == 65, color(gs5%30) fintensity(inten80) lwidth(none)) ///
(line _Rate cale if age_`d´ == 65, color(gs5)) ///
(scatter rate cale if age_`d´ == 65 & rate !=0, col(gs5)) ///
(rarea ub lb cale if age_`d´ == 85, color(gs10%30) fintensity(inten80) lwidth(none)) ///
(line _Rate cale if age_`d´ == 85, color(gs10)) ///
(scatter rate cale if age_`d´ == 85 & rate !=0, col(gs10)) ///
, graphregion(color(white)) ylabel(, angle(0) glpattern(solid) glcolor(gs10%20)) ///
ytitle("Mortality rate (per 1000 person-years)") ///
xtitle(Year) yscale(nolog) ylabel(, format(%9.1f)) legend(order( ///
2 "Modelled" ///
2 "45" 5 "65" 8 "85" ///
3 "Crude" ///
3 "40-49" 6 "60-69" 9 "80-89" ///
) cols(4) position(12) region(lcolor(none) col(none))) ///
title("`c´, `oo´, `ss´ `dd´ diabetes", col(black) placement(west) size(medium))
graph save GPH/Rc_`c´_`o´_`d´_`s´_period, replace
use RCc, clear
replace coh= coh+2010
keep if country == "`c´" & OC == "`o´" & sex == `s´ & DM == "`d´"
gen res = (`o´_d_`d´-pred)/sqrt(pred)
twoway ///
(scatter res age_`d´, col(black)) ///
, legend(off) ///
graphregion(color(white)) ///
ylabel(, format(%9.0f) grid angle(0) glpattern(solid) glcolor(gs10%20)) ///
```

```
ytitle("Pearson residuals", margin(a+2)) ///
xtitle("Age (years)") ///
title("`c´, `oo´, `ss´ `dd´ diabetes", col(black) placement(west) size(medium))
graph save GPH/RCc_`c´_`o´_`d´_`s´_age, replace
twoway ///
(scatter res cale, col(black)) ///
, legend(off) ///
graphregion(color(white)) ///
ylabel(, format(%9.0f) grid angle(0) glpattern(solid) glcolor(gs10%20)) ///
ytitle("Pearson residuals", margin(a+2)) ///
xtitle("Period") ///
title("`c´, `oo´, `ss´ `dd´ diabetes", col(black) placement(west) size(medium))
graph save GPH/RCc_`c´_`o´_`d´_`s´_period, replace
}


use Rc, clear
bysort A : keep if _n == 1
forval i = 1/10 {
local c`i´=country[`i´]
local o`i´=OC[`i´]
local d`i´=DM[`i´]
local s`i´=sex[`i´]
}
graph combine ///
GPH/Rc_`c1´_`o1´_`d1´_`s1´_age.gph ///
GPH/Rc_`c2´_`o2´_`d2´_`s2´_age.gph ///
GPH/Rc_`c3´_`o3´_`d3´_`s3´_age.gph ///
GPH/Rc_`c4´_`o4´_`d4´_`s4´_age.gph ///
GPH/Rc_`c5´_`o5´_`d5´_`s5´_age.gph ///
GPH/Rc_`c6´_`o6´_`d6´_`s6´_age.gph ///
GPH/Rc_`c7´_`o7´_`d7´_`s7´_age.gph ///
GPH/Rc_`c8´_`o8´_`d8´_`s8´_age.gph ///
GPH/Rc_`c9´_`o9´_`d9´_`s9´_age.gph ///
GPH/Rc_`c10´_`o10´_`d10´_`s10´_age.gph ///
, graphregion(color(white)) cols(2) altshrink xsize(3)
graph combine ///
GPH/Rc_`c1´_`o1´_`d1´_`s1´_period.gph ///
GPH/Rc_`c2´_`o2´_`d2´_`s2´_period.gph ///
GPH/Rc_`c3´_`o3´_`d3´_`s3´_period.gph ///
GPH/Rc_`c4´_`o4´_`d4´_`s4´_period.gph ///
GPH/Rc_`c5´_`o5´_`d5´_`s5´_period.gph ///
GPH/Rc_`c6´_`o6´_`d6´_`s6´_period.gph ///
GPH/Rc_`c7´_`o7´_`d7´_`s7´_period.gph ///
GPH/Rc_`c8´_`o8´_`d8´_`s8´_period.gph ///
GPH/Rc_`c9´_`o9´_`d9´_`s9´_period.gph ///
GPH/Rc_`c10´_`o10´_`d10´_`s10´_period.gph ///
, graphregion(color(white)) cols(2) altshrink xsize(3)
graph combine ///
GPH/RCc_`c1´_`o1´_`d1´_`s1´_age.gph ///
GPH/RCc_`c2´_`o2´_`d2´_`s2´_age.gph ///
GPH/RCc_`c3´_`o3´_`d3´_`s3´_age.gph ///
GPH/RCc_`c4´_`o4´_`d4´_`s4´_age.gph ///
GPH/RCc_`c5´_`o5´_`d5´_`s5´_age.gph ///
GPH/RCc_`c6´_`o6´_`d6´_`s6´_age.gph ///
GPH/RCc_`c7´_`o7´_`d7´_`s7´_age.gph ///
GPH/RCc_`c8´_`o8´_`d8´_`s8´_age.gph ///
GPH/RCc_`c9´_`o9´_`d9´_`s9´_age.gph ///
GPH/RCc_`c10´_`o10´_`d10´_`s10´_age.gph ///
, graphregion(color(white)) cols(2) altshrink xsize(3)
graph combine ///
GPH/RCc_`c1´_`o1´_`d1´_`s1´_period.gph ///
GPH/RCc_`c2´_`o2´_`d2´_`s2´_period.gph ///
GPH/RCc_`c3´_`o3´_`d3´_`s3´_period.gph ///
GPH/RCc_`c4´_`o4´_`d4´_`s4´_period.gph ///
GPH/RCc_`c5´_`o5´_`d5´_`s5´_period.gph ///
GPH/RCc_`c6´_`o6´_`d6´_`s6´_period.gph ///
GPH/RCc_`c7´_`o7´_`d7´_`s7´_period.gph ///
GPH/RCc_`c8´_`o8´_`d8´_`s8´_period.gph ///
```

Figure 3.1: Modelled and crude mortality rates by age for 10 randomly selected country/cause of death/diabetes status/sex combinations.

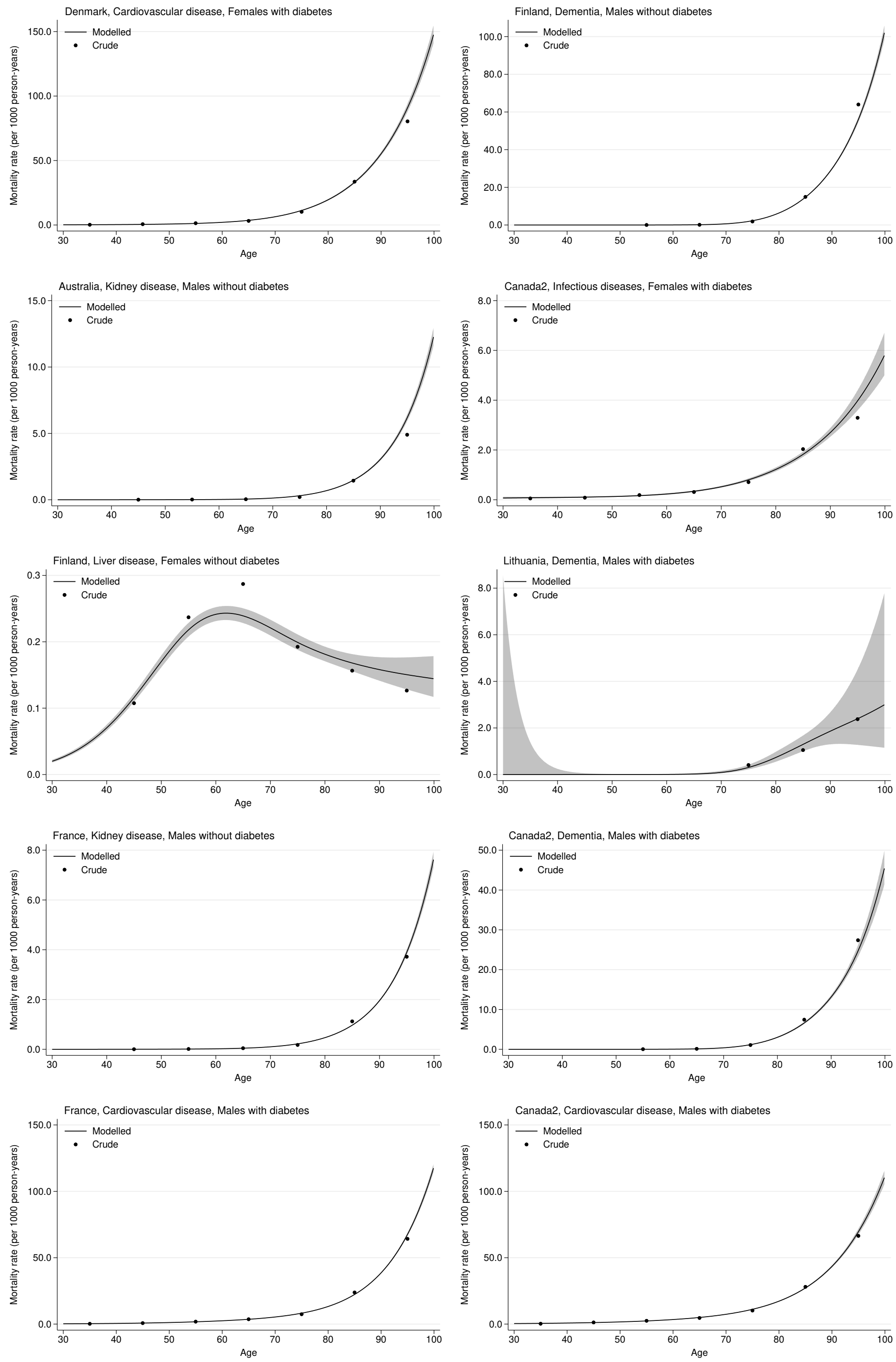


Figure 3.2: Modelled and crude mortality rates by year for 10 randomly selected country/cause of death/diabetes status/sex combinations.

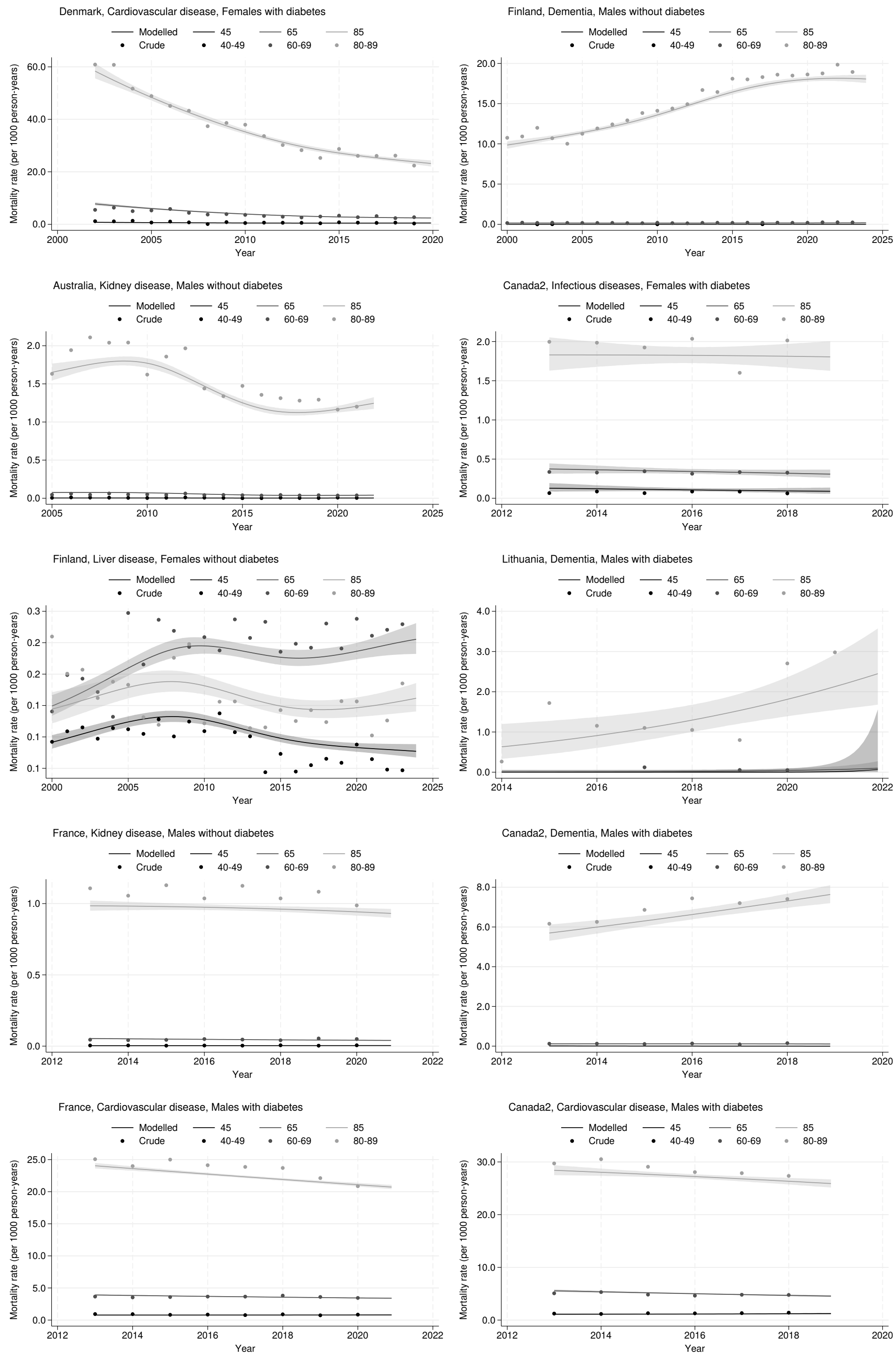


Figure 3.3: Pearson residuals by age for 10 randomly selected country/cause of death/diabetes status/sex combinations.

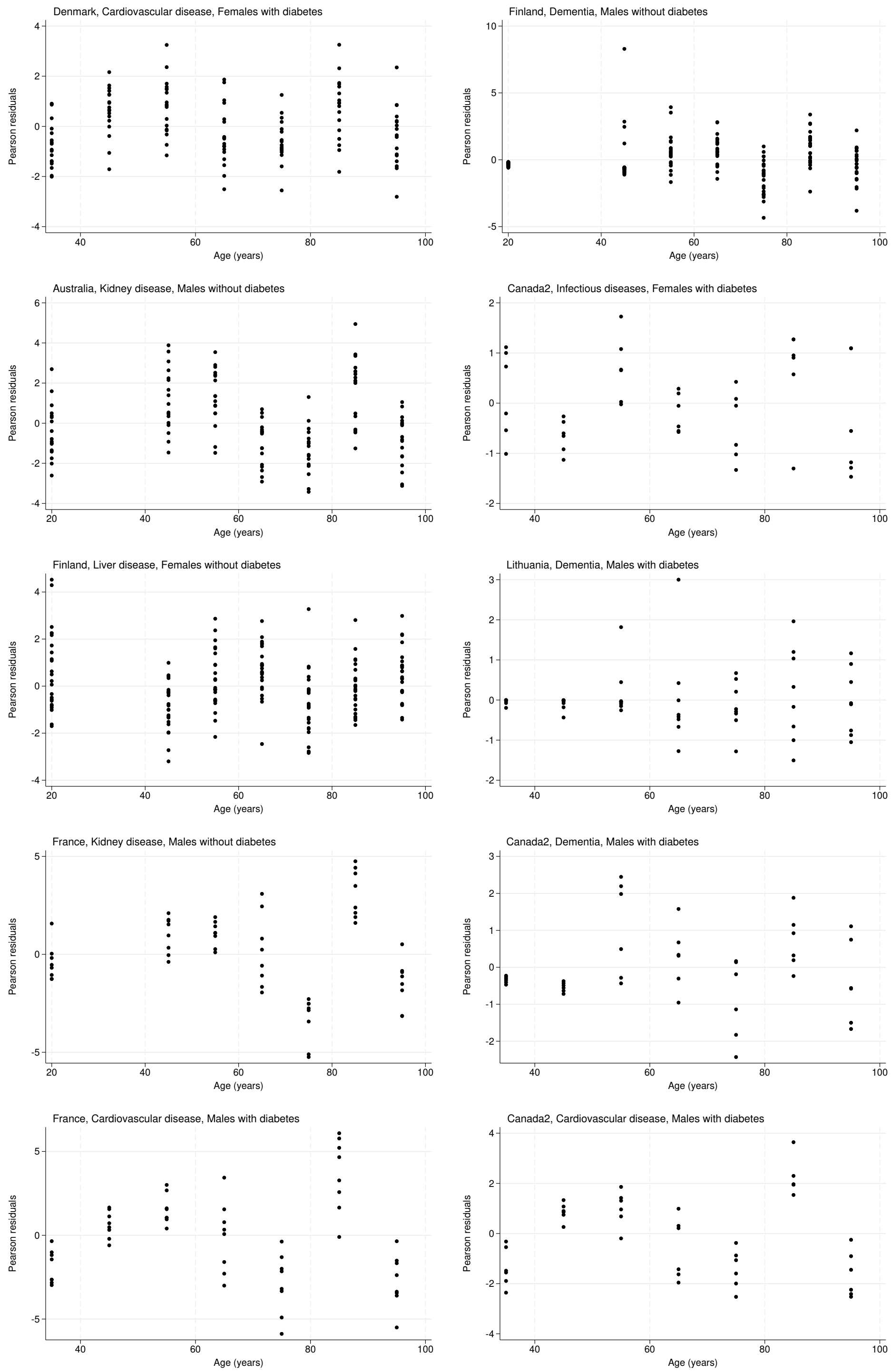
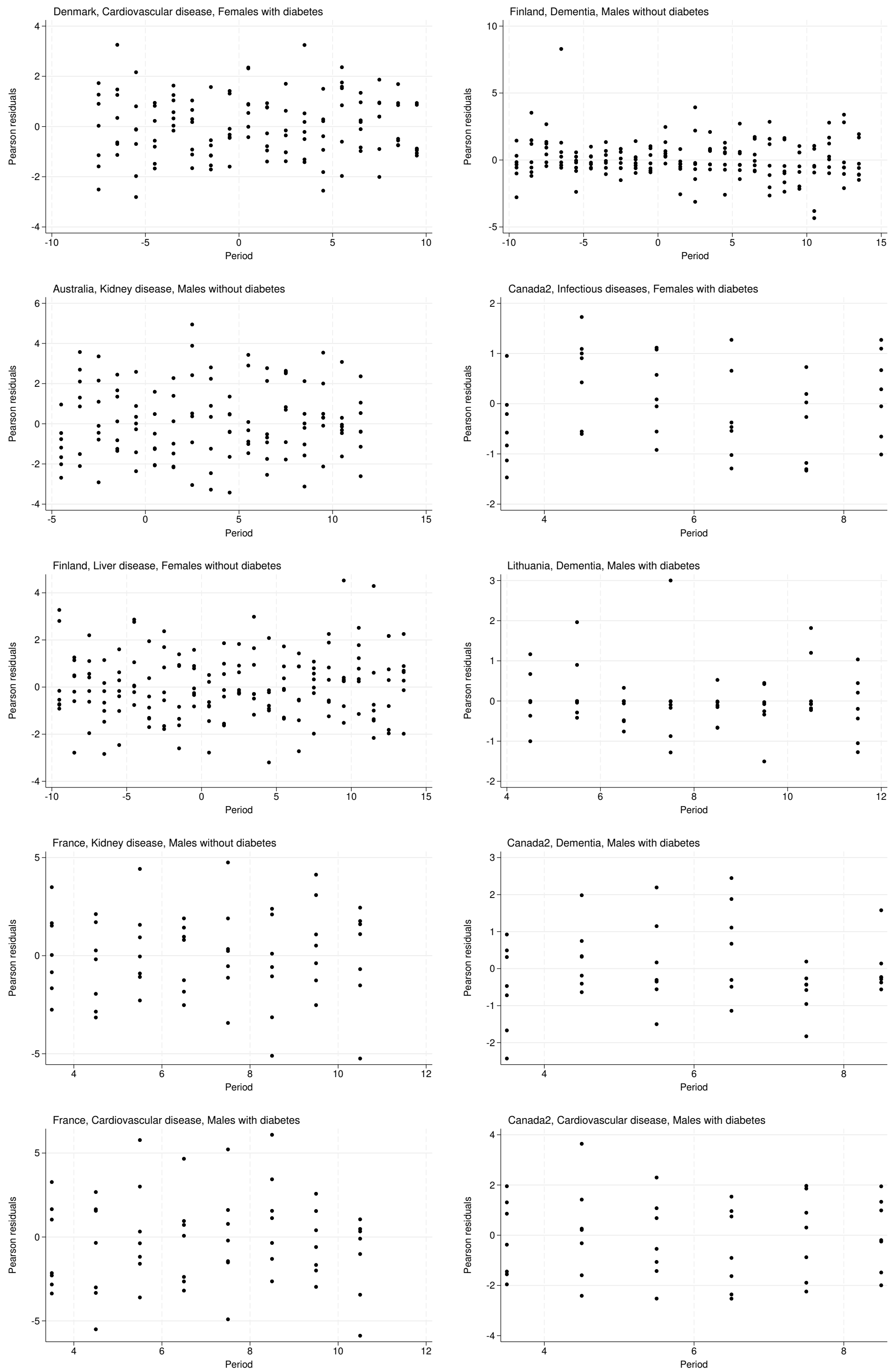


Figure 3.4: Pearson residuals by period for 10 randomly selected country/cause of death/diabetes status/sex combinations.



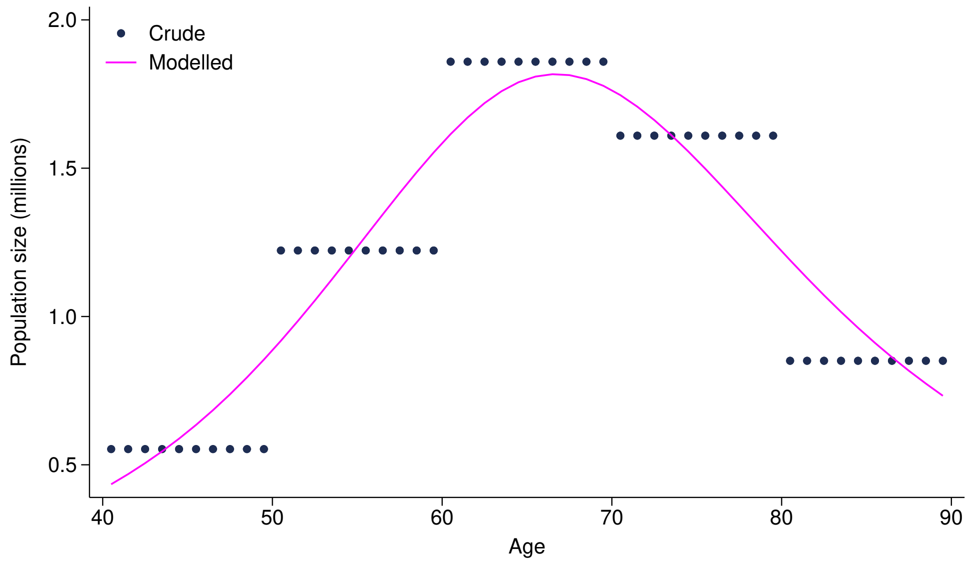
```
GPH/RCc_`c9´_`o9´_`d9´_`s9´_period.gph ///
GPH/RCc_`c10´_`o10´_`d10´_`s10´_period.gph ///
, graphregion(color(white)) cols(2) altshrink xsize(3)
```

We see that the models fit the data reasonably well (Figures 3.1- 3.4).

3.2 Age- and sex-standardised rates

We are going to calculate age-standardised mortality rates among people aged 40-89 years. We will first generate cause-specific mortality rates for people aged 40-89. Then, we will use direct standardisation to generate the age-standardised rates, using a reference population constructed by pooling the person-years among people with diabetes from all datasets. There will be two reference populations: first, one stratified by sex so that we can age and sex-standardise the overall results; second, one overall population to age-standardise the sex-stratified results to.

Figure 3.5: Pooled standard population




```
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
use `i´, clear
collapse (sum) pys_dm, by(age_dm)
save `i´_pysdm, replace
}
clear
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
append using `i´_pysdm
}
collapse (sum) pys_dm, by(age_dm)
drop if age_dm > 90 | age_dm == 35
expand 10
replace pys_dm=pys_dm/10
bysort age : replace age = age+_n-5.5
mkspline agesp = age, cubic knots(45 65 85)
glm pys_dm agesp*, family(gamma) link(log)
predict A
preserve
replace pys_dm = pys_dm/1000000
replace A = A/1000000
twoway ///
(scatter pys_dm age_dm, col(dknavy)) ///
(line A age_dm, col(magenta)) ///
, legend(symxsize(0.13cm) position(11) ring(0) region(lcolor(white) color(none)) ///
order(1 "Crude" ///
2 "Modelled") ///
```

Figure 3.6: Pooled standard population proportion

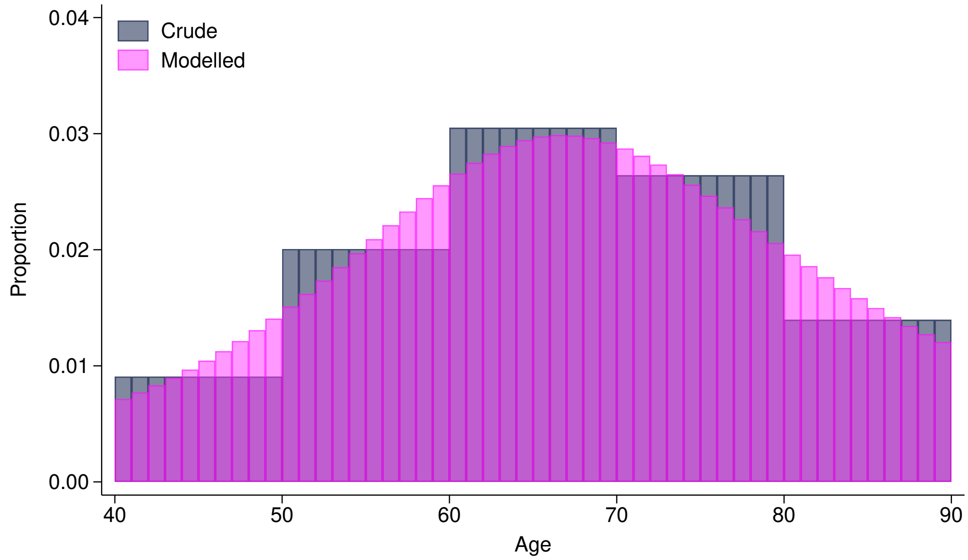
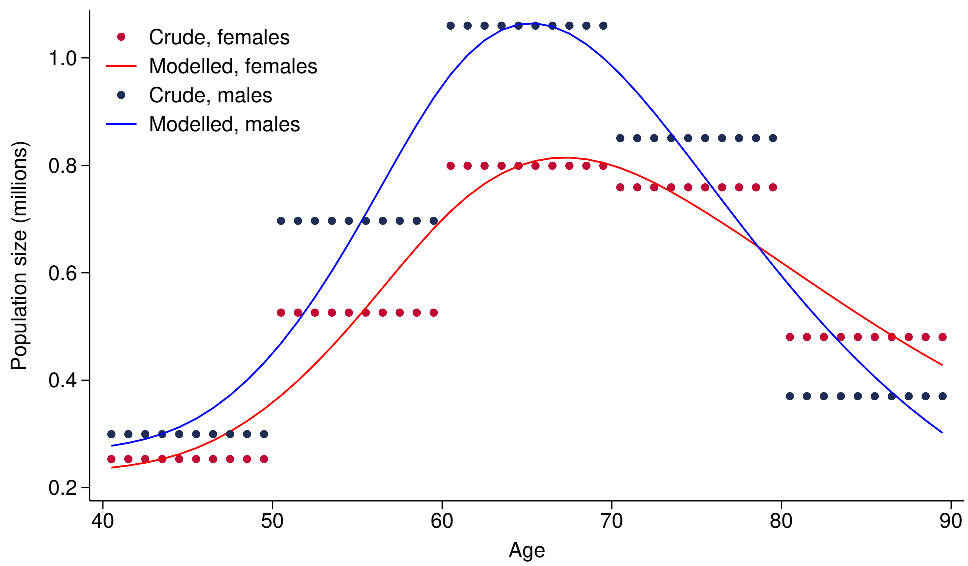


Figure 3.7: Pooled standard population by sex

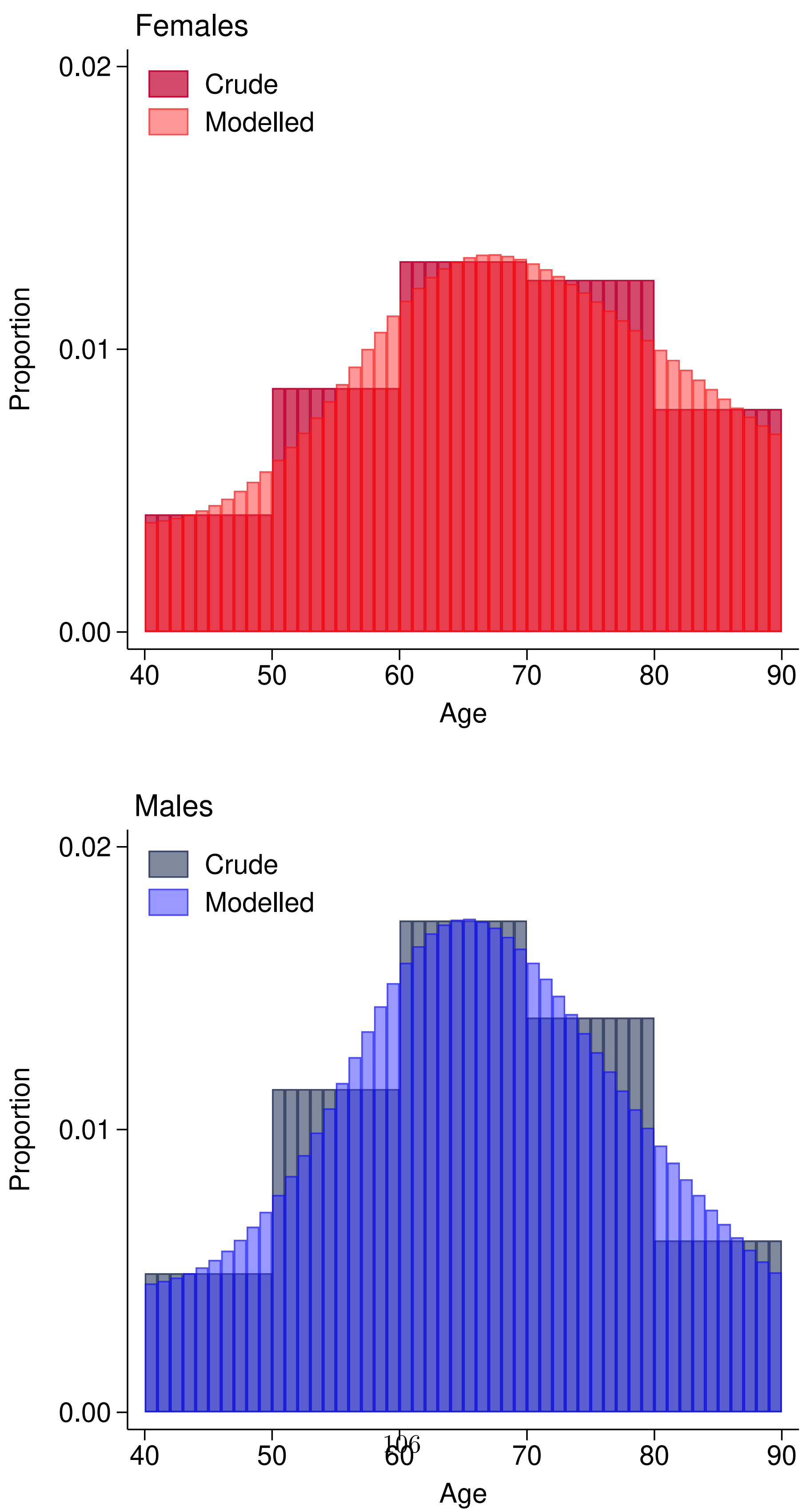



```
cols(1)) ///
graphregion(color(white)) ///
ylabel(, format(%9.1f) angle(0) nogrid) ///
ytitle("Population size (millions)") xtitle("Age") xlabel(, nogrid)
restore
su(pys_dm)
gen age_dm_prop = pys_dm/r(sum)
su(A)
gen B = A/r(sum)
twoway ///
```

```
(bar age_dm_prop age_dm, color(dknavy%70)) ///
(bar B age_dm, color(magenta%50)) ///
, legend(symxsize(0.13cm) position(11) ring(0) region(lcolor(white) color(none)) ///
order(1 "Crude" ///
2 "Modelled") ///
cols(1)) ///
ylabel(0(0.01)0.04, angle(0) format(%9.2f) nogrid) ///
graphregion(color(white)) ///
ytitle("Proportion") xtitle("Age") xlabel(, nogrid)
keep age_dm B
replace age_dm = age-0.5
rename age_dm age
save refpop, replace
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
use `i´, clear
collapse (sum) pys_dm, by(sex age_dm)
save `i´_pysdm_s, replace
}
clear
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
append using `i´_pysdm_s
}
collapse (sum) pys_dm, by(sex age_dm)
drop if age_dm > 90 | age_dm == 35
expand 10
replace pys_dm=pys_dm/10
bysort sex age : replace age = age+_n-5.5
mkspline agesp = age, cubic knots(35 45 60 75 90)
glm pys_dm agesp* if sex == 0, family(gamma) link(log)
predict A0 if sex == 0
glm pys_dm agesp* if sex == 1, family(gamma) link(log)
predict A1 if sex == 1
preserve
replace pys_dm = pys_dm/1000000
replace A0 = A0/1000000
replace A1 = A1/1000000
twoway ///
(scatter pys_dm age_dm if sex == 0, col(cranberry)) ///
(line A0 age_dm, col(red)) ///
(scatter pys_dm age_dm if sex == 1, col(dknavy)) ///
(line A1 age_dm, col(blue)) ///
, legend(symxsize(0.13cm) position(11) ring(0) region(lcolor(white) color(none)) ///
order(1 "Crude, females" ///
2 "Modelled, females" ///
3 "Crude, males" ///
4 "Modelled, males") ///
cols(1)) ///
graphregion(color(white)) ///
ylabel(, format(%9.1f) angle(0) nogrid) xlabel(, nogrid) ///
ytitle("Population size (millions)") xtitle("Age")
restore
su(pys_dm)
gen age_dm_prop = pys_dm/r(sum)
gen A = A0
replace A = A1 if A ==.
su(A)
gen B = A/r(sum)
twoway ///
(bar age_dm_prop age_dm if sex == 0, color(cranberry%90)) ///
(bar B age_dm if sex == 0, color(red%50)) ///
, legend(symxsize(0.13cm) position(11) ring(0) region(lcolor(white) color(none)) ///
order(1 "Crude" ///
2 "Modelled") ///
cols(1)) ///
ylabel(0(0.01)0.02, angle(0) format(%9.2f) nogrid) xlabel(, nogrid) ///
graphregion(color(white)) ///
ytitle("Proportion") xtitle("Age") ///
title("Females", col(black) placement(west) size(medium))
```

```
graph save stdprop_0, replace
twoway ///
(bar age_dm_prop age_dm if sex == 1, color(dknavy%70)) ///
(bar B age_dm if sex == 1, color(blue%50)) ///
, legend(symxsize(0.13cm) position(11) ring(0) region(lcolor(white) color(none)) ///
order(1 "Crude" ///
2 "Modelled") ///
cols(1)) ///
ylabel(0(0.01)0.02, angle(0) format(%9.2f) nogrid) xlabel(, nogrid) ///
graphregion(color(white)) ///
ytitle("Proportion") xtitle("Age") ///
title("Males", col(black) placement(west) size(medium))
graph save stdprop_1, replace
graph combine ///
stdprop_0.gph stdprop_1.gph ///
, graphregion(color(white)) altshrink cols(1) xsize(2.5)
keep sex age_dm B
replace age_dm = age-0.5
rename age_dm age
save refpops, replace
```

Figure 3.8: Pooled standard population proportion by sex



```
quietly {
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
foreach ii in can cvd res azd dmd inf flu ckd liv {
foreach iii in dm nondm {
if "`ii´" == "dmd" & "`iii´" == "nondm" {
}
else {
foreach iiii in 0 1 {
use `i´, clear
keep if sex == `iiii´
replace calendar = calendar-2009.5
gen coh = calendar-age_`iii´
centile(age_`iii´), centile(5 35 65 95)
local A1 = r(c_1)
local A2 = r(c_2)
local A3 = r(c_3)
local A4 = r(c_4)
mkspline agesp = age_`iii´, cubic knots(`A1´ `A2´ `A3´ `A4´)
su(calendar), detail
local rang = r(max)-r(min)
if `rang´ < 10 {
centile calendar, centile(25 75)
local CK1 = r(c_1)
local CK2 = r(c_2)
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´)
}
else if inrange(`rang´,10,14.9) {
centile calendar, centile(10 50 90)
local CK1 = r(c_1)
local CK2 = r(c_2)
local CK3 = r(c_3)
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´ `CK3´)
}
else {
centile calendar, centile(5 35 65 95)
local CK1 = r(c_1)
local CK2 = r(c_2)
local CK3 = r(c_3)
local CK4 = r(c_4)
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´ `CK3´ `CK4´)
}
centile(coh), centile(5 35 65 95)
local CO1 = r(c_1)
local CO2 = r(c_2)
local CO3 = r(c_3)
local CO4 = r(c_4)
mkspline cohsp = coh, cubic knots(`CO1´ `CO2´ `CO3´ `CO4´)
poisson `ii´_d_`iii´ agesp* timesp* cohsp*, exposure(pys_`iii´)
keep sex calendar pys_`iii´ age_`iii´
if "`i´" == "Scotland" & "`iii´" == "nondm" {
keep if inrange(age_`iii´,40,89)
expand 10 if age_`iii´!=87.5
expand 20 if age_`iii´==87.5
replace pys = pys/10 if age_`iii´!=87.5
replace pys = pys/20 if age_`iii´==87.5
bysort cal age : replace age = age+_n-6 if age_`iii´!=87.5
bysort cal age : replace age = age+_n-8.5 if age_`iii´==87.5
drop if age_`iii´ >= 90
}
else {
keep if inrange(age_`iii´,40,89)
expand 10
replace pys = pys/10
bysort cal age : replace age = age+_n-6
}
gen coh = calendar-age
mkspline agesp = age, cubic knots(`A1´ `A2´ `A3´ `A4´)
if `rang´ < 9.99 {
```

```
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´)
}
else if inrange(`rang´,10,14.99) {
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´ `CK3´)
}
else {
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´ `CK3´ `CK4´)
}
mkspline cohsp = coh, cubic knots(`CO1´ `CO2´ `CO3´ `CO4´)
predict _Rate, ir
save MD/STDi_`i´_`ii´_`iii´_`iiii´, replace
rename age_`iii´ age
merge m:1 age using refpop
drop _merge
gen double expdeath = _Rate*B
bysort cal : egen double expdeath1 = sum(expdeath)
gen stdrate = 1000*expdeath1
gen SEC1 = ((B^2)*(_Rate*(1-_Rate)))/pys_`iii´
bysort cal : egen double SEC2 = sum(SEC1)
gen double SE = sqrt(SEC2)
gen lb = 1000*(expdeath1-1.96*SE)
gen ub = 1000*(expdeath1+1.96*SE)
bysort cal (age) : keep if _n == 1
count if lb < 0
if r(N) != 0 {
noisily di "`i´" " " "`ii´" " " "`iii´" " " "`iiii´"
}
keep cal stdrate lb ub sex
gen country = "`i´"
gen OC = "`ii´"
gen DM = "`iii´"
replace cal = cal+2009.5
save MD/STD_`i´_`ii´_`iii´_`iiii´, replace
}
clear
append using MD/STDi_`i´_`ii´_`iii´_0 MD/STDi_`i´_`ii´_`iii´_1
rename age_`iii´ age
merge m:1 sex age using refpops
drop _merge
gen double expdeath = _Rate*B
bysort cal : egen double expdeath1 = sum(expdeath)
gen stdrate = 1000*expdeath1
gen SEC1 = ((B^2)*(_Rate*(1-_Rate)))/pys_`iii´
bysort cal : egen double SEC2 = sum(SEC1)
gen double SE = sqrt(SEC2)
gen lb = 1000*(expdeath1-1.96*SE)
gen ub = 1000*(expdeath1+1.96*SE)
bysort cal (age) : keep if _n == 1
count if lb < 0
if r(N) != 0 {
noisily di "`i´" " " "`ii´" " " "`iii´"
replace lb = 0.001 if lb < 0
}
keep cal stdrate lb ub
gen country = "`i´"
gen OC = "`ii´"
gen DM = "`iii´"
replace cal = cal+2009.5
save MD/STD_`i´_`ii´_`iii´, replace
}
}
}
}
}

. quietly {
Lithuania ckd dm 1
SKorea azd dm 1
```

The standardisation confidence interval crosses 0 for CKD deaths among males from Lithuania, reflecting extremely low numbers. I simply won't plot these. Similarly for Dementia deaths among males from South Korea.

```
clear
set obs 1
gen country = "Australia"
save MD/STD_Australia_ckd_nondm, replace
save MD/STD_Australia_ckd_dm, replace
save MD/STD_Australia_ckd_nondm_0, replace
save MD/STD_Australia_ckd_nondm_1, replace
save MD/STD_Australia_ckd_dm_0, replace
save MD/STD_Australia_ckd_dm_1, replace
clear
set obs 1
gen country = "Finland"
save MD/STD_Finland_flu_dm, replace
save MD/STD_Finland_flu_nondm, replace
save MD/STD_Finland_flu_nondm_0, replace
save MD/STD_Finland_flu_nondm_1, replace
save MD/STD_Finland_flu_dm_0, replace
save MD/STD_Finland_flu_dm_1, replace
clear
set obs 1
gen country = "Scotland"
save MD/STD_Scotland_ckd_nondm, replace
save MD/STD_Scotland_ckd_dm, replace
save MD/STD_Scotland_ckd_nondm_0, replace
save MD/STD_Scotland_ckd_nondm_1, replace
save MD/STD_Scotland_ckd_dm_0, replace
save MD/STD_Scotland_ckd_dm_1, replace
clear
set obs 1
gen country = "Lithuania"
save MD/STD_Lithuania_ckd_dm_1, replace
save MD/STD_Lithuania_azd_nondm, replace
save MD/STD_Lithuania_azd_dm, replace
save MD/STD_Lithuania_azd_nondm_0, replace
save MD/STD_Lithuania_azd_nondm_1, replace
save MD/STD_Lithuania_azd_dm_0, replace
save MD/STD_Lithuania_azd_dm_1, replace
clear
set obs 1
gen country = "SKorea"
save MD/STD_SKorea_azd_nondm, replace
save MD/STD_SKorea_azd_dm, replace
save MD/STD_SKorea_azd_nondm_0, replace
save MD/STD_SKorea_azd_nondm_1, replace
save MD/STD_SKorea_azd_dm_0, replace
save MD/STD_SKorea_azd_dm_1, replace

*ssc install palettes
*ssc install colrspace
foreach ii in can cvd res azd dmd inf flu ckd liv {
foreach iii in dm nondm {
if "`ii´" == "dmd" & "`iii´" == "nondm" {
}
else {
if "`ii´" == "can" {
local oo = "Cancer"
local ylab = "1 2 5 10 20 50"
local yform = "%9.0f"
local yrange = "0.9 50"
}
if "`ii´" == "cvd" {
local oo = "Cardiovascular disease"
local ylab = "1 2 5 10 20 50"
```

```
local yform = "%9.0f"
local yrange = "0.9 50"
}
if "`ii´" == "res" {
local oo = "Chronic lower respiratory disease"
local ylab = "0.01 0.02 0.05 0.1 0.2 0.5 1 2 5"
local yform = "%9.2f"
local yrange = "0.005 5"
}
if "`ii´" == "azd" {
local oo = "Dementia"
local ylab = "0.01 0.02 0.05 0.1 0.2 0.5 1 2 5"
local yform = "%9.2f"
local yrange = "0.005 5"
}
if "`ii´" == "dmd" {
local oo = "Diabetes"
local ylab = "1 2 5 10 20 50"
local yform = "%9.0f"
local yrange = "0.9 50"
}
if "`ii´" == "inf" {
local oo = "Infectious diseases"
local ylab = "0.01 0.02 0.05 0.1 0.2 0.5 1 2 5"
local yform = "%9.2f"
local yrange = "0.005 5"
}
if "`ii´" == "flu" {
local oo = "Influenza and pneumonia"
local ylab = "0.01 0.02 0.05 0.1 0.2 0.5 1 2 5"
local yform = "%9.2f"
local yrange = "0.005 5"
}
if "`ii´" == "ckd" {
local oo = "Kidney disease"
local ylab = "0.01 0.02 0.05 0.1 0.2 0.5 1 2 5"
local yform = "%9.2f"
local yrange = "0.005 5"
}
if "`ii´" == "liv" {
local oo = "Liver disease"
local ylab = "0.01 0.02 0.05 0.1 0.2 0.5 1 2 5"
local yform = "%9.2f"
local yrange = "0.005 5"
}
if "`iii´" == "dm" {
local w = "with"
}
if "`iii´" == "nondm" {
local w = "without"
}
clear
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
append using MD/STD_`i´_`ii´_`iii´
}
replace country = "Canada (Alberta)" if country == "Canada1"
replace country = "Canada (Ontario)" if country == "Canada2"
replace country = "South Korea" if country == "SKorea"
preserve
bysort country : keep if _n == 1
forval i = 1/9 {
local C`i´ = country[`i´]
}
restore
colorpalette hue, n(9) luminance(50) nograph
twoway ///
(rarea ub lb calendar if country == "`C1´", color("`r(p1)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C1´", color("`r(p1)´") lpattern(solid)) ///
```

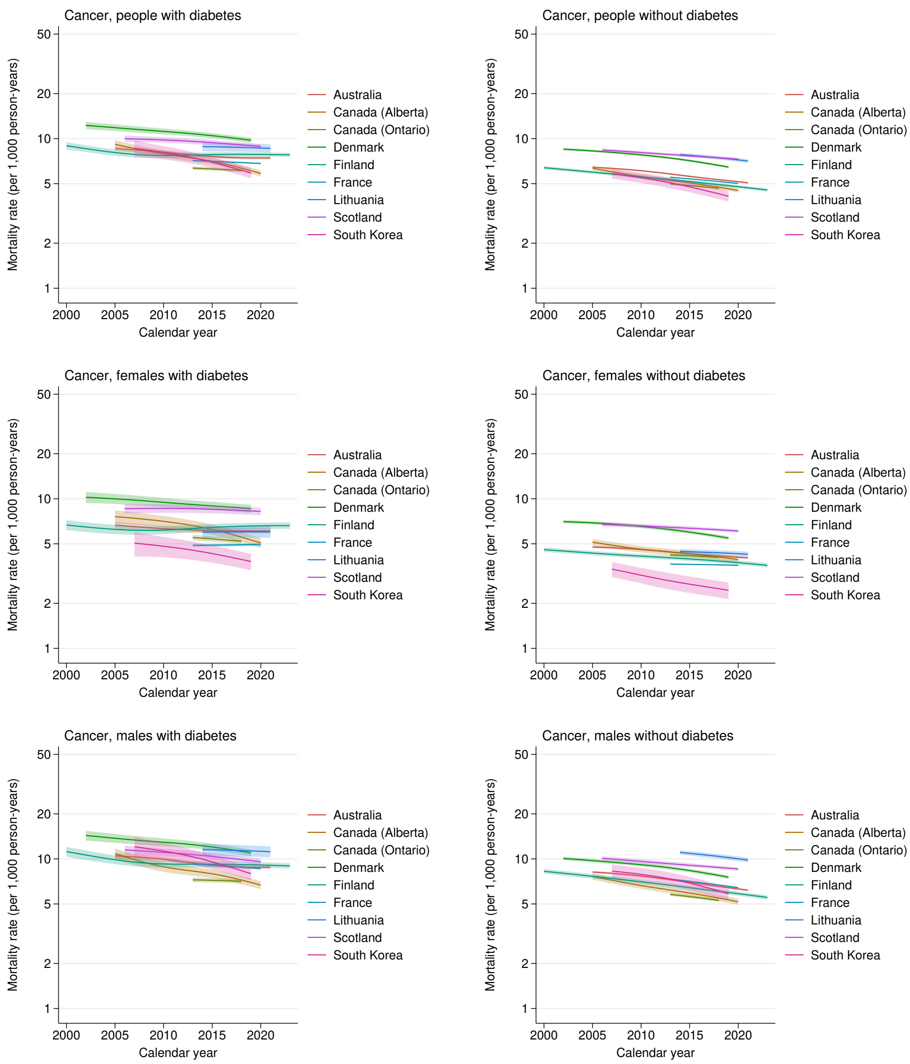
```
(rarea ub lb calendar if country == "`C2´", color("`r(p2)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C2´", color("`r(p2)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C3´", color("`r(p3)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C3´", color("`r(p3)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C4´", color("`r(p4)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C4´", color("`r(p4)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C5´", color("`r(p5)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C5´", color("`r(p5)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C6´", color("`r(p6)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C6´", color("`r(p6)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C7´", color("`r(p7)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C7´", color("`r(p7)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C8´", color("`r(p8)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C8´", color("`r(p8)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C9´", color("`r(p9)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C9´", color("`r(p9)´") lpattern(solid)) ///
, legend(symxsize(0.13cm) position(3) region(lcolor(white) color(none)) ///
order(2 "`C1´" ///
4 "`C2´" ///
6 "`C3´" ///
8 "`C4´" ///
10 "`C5´" ///
12 "`C6´" ///
14 "`C7´" ///
16 "`C8´" ///
18 "`C9´") ///
cols(1)) ///
graphregion(color(white)) ///
ylabel(`ylab´, format(`yform´) grid  glpattern(solid) glcolor(gs10%20) angle(0)) ///
yscale(log range(`yrange´)) ///
xscale(range(2000 2020)) ///
xlabel(2000(5)2020, nogrid) ///
ytitle("Mortality rate (per 1,000 person-years)", margin(a+2)) ///
xtitle("Calendar year") ///
title("`oo´, people `w´ diabetes", placement(west) color(black) size(medium))
graph save GPH/STD_GPH_`ii´_`iii´, replace
forval iiii = 0/1 {
if `iiii´ == 0 {
local s = "females"
}
if `iiii´ == 1 {
local s = "males"
}
clear
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
append using MD/STD_`i´_`ii´_`iii´_`iiii´
}
replace country = "Canada (Alberta)" if country == "Canada1"
replace country = "Canada (Ontario)" if country == "Canada2"
replace country = "South Korea" if country == "SKorea"
preserve
bysort country : keep if _n == 1
forval i = 1/9 {
local C`i´ = country[`i´]
}
restore
colorpalette hue, n(9) luminance(50) nograph
twoway ///
(rarea ub lb calendar if country == "`C1´", color("`r(p1)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C1´", color("`r(p1)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C2´", color("`r(p2)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C2´", color("`r(p2)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C3´", color("`r(p3)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C3´", color("`r(p3)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C4´", color("`r(p4)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C4´", color("`r(p4)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C5´", color("`r(p5)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C5´", color("`r(p5)´") lpattern(solid)) ///
```

```
(rarea ub lb calendar if country == "`C6´", color("`r(p6)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C6´", color("`r(p6)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C7´", color("`r(p7)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C7´", color("`r(p7)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C8´", color("`r(p8)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C8´", color("`r(p8)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C9´", color("`r(p9)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C9´", color("`r(p9)´") lpattern(solid)) ///
, legend(symxsize(0.13cm) position(3) region(lcolor(white) color(none)) ///
order(2 "`C1´" ///
4 "`C2´" ///
6 "`C3´" ///
8 "`C4´" ///
10 "`C5´" ///
12 "`C6´" ///
14 "`C7´" ///
16 "`C8´" ///
18 "`C9´") ///
cols(1)) ///
graphregion(color(white)) ///
ylabel(`ylab´, format(`yform´) grid  glpattern(solid) glcolor(gs10%20) angle(0)) ///
yscale(log range(`yrange´)) ///
xscale(range(2000 2020)) ///
xlabel(2000(5)2020, nogrid) ///
ytitle("Mortality rate (per 1,000 person-years)", margin(a+2)) ///
xtitle("Calendar year") ///
title("`oo´, `s´ `w´ diabetes", placement(west) color(black) size(medium))
graph save GPH/STD_GPH_`ii´_`iii´_`iiii´, replace
}
}
}
}
foreach ii in can cvd res azd dmd inf flu ckd liv {
foreach iii in dm nondm {
if "`ii´" == "dmd" & "`iii´" == "nondm" {
}
else {
if "`ii´" == "can" {
local oo = "Cancer"
}
if "`ii´" == "cvd" {
local oo = "Cardiovascular disease"
}
if "`ii´" == "res" {
local oo = "Chronic lower respiratory disease"
}
if "`ii´" == "azd" {
local oo = "Dementia"
}
if "`ii´" == "dmd" {
local oo = "Diabetes"
}
if "`ii´" == "inf" {
local oo = "Infectious diseases"
}
if "`ii´" == "flu" {
local oo = "Influenza and pneumonia"
}
if "`ii´" == "ckd" {
local oo = "Kidney disease"
}
if "`ii´" == "liv" {
local oo = "Liver disease"
}
if "`iii´" == "dm" {
local w = "with"
}
if "`iii´" == "nondm" {
```

```
local w = "without"
}
clear
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
append using MD/STD_`i´_`ii´_`iii´
}
replace country = "Canada (Alberta)" if country == "Canada1"
replace country = "Canada (Ontario)" if country == "Canada2"
replace country = "South Korea" if country == "SKorea"
preserve
bysort country : keep if _n == 1
forval i = 1/9 {
local C`i´ = country[`i´]
}
restore
colorpalette hue, n(9) luminance(50) nograph
if "`ii´" == "cvd" | "`ii´" == "can" | "`ii´" == "dmd" {
twoway ///
(rarea ub lb calendar if country == "`C1´", color("`r(p1)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C1´", color("`r(p1)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C2´", color("`r(p2)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C2´", color("`r(p2)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C3´", color("`r(p3)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C3´", color("`r(p3)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C4´", color("`r(p4)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C4´", color("`r(p4)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C5´", color("`r(p5)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C5´", color("`r(p5)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C6´", color("`r(p6)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C6´", color("`r(p6)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C7´", color("`r(p7)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C7´", color("`r(p7)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C8´", color("`r(p8)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C8´", color("`r(p8)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C9´", color("`r(p9)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C9´", color("`r(p9)´") lpattern(solid)) ///
, legend(symxsize(0.13cm) position(3) region(lcolor(white) color(none)) ///
order(2 "`C1´" ///
4 "`C2´" ///
6 "`C3´" ///
8 "`C4´" ///
10 "`C5´" ///
12 "`C6´" ///
14 "`C7´" ///
16 "`C8´" ///
18 "`C9´") ///
cols(1)) ///
graphregion(color(white)) ///
ylabel(1 2 5 10 20 50, format(%9.0f) grid glpattern(solid) glcolor(gs10%20) angle(0)) ///
yscale(log range(1 50)) ///
xscale(range(2000 2020)) ///
xlabel(2000(5)2020, nogrid) ///
ytitle("Mortality rate (per 1,000 person-years)", margin(a+2)) ///
xtitle("Calendar year") ///
title("`oo´", placement(west) color(black) size(medium))
}
else {
twoway ///
(rarea ub lb calendar if country == "`C1´", color("`r(p1)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C1´", color("`r(p1)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C2´", color("`r(p2)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C2´", color("`r(p2)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C3´", color("`r(p3)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C3´", color("`r(p3)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C4´", color("`r(p4)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C4´", color("`r(p4)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C5´", color("`r(p5)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C5´", color("`r(p5)´") lpattern(solid)) ///
```

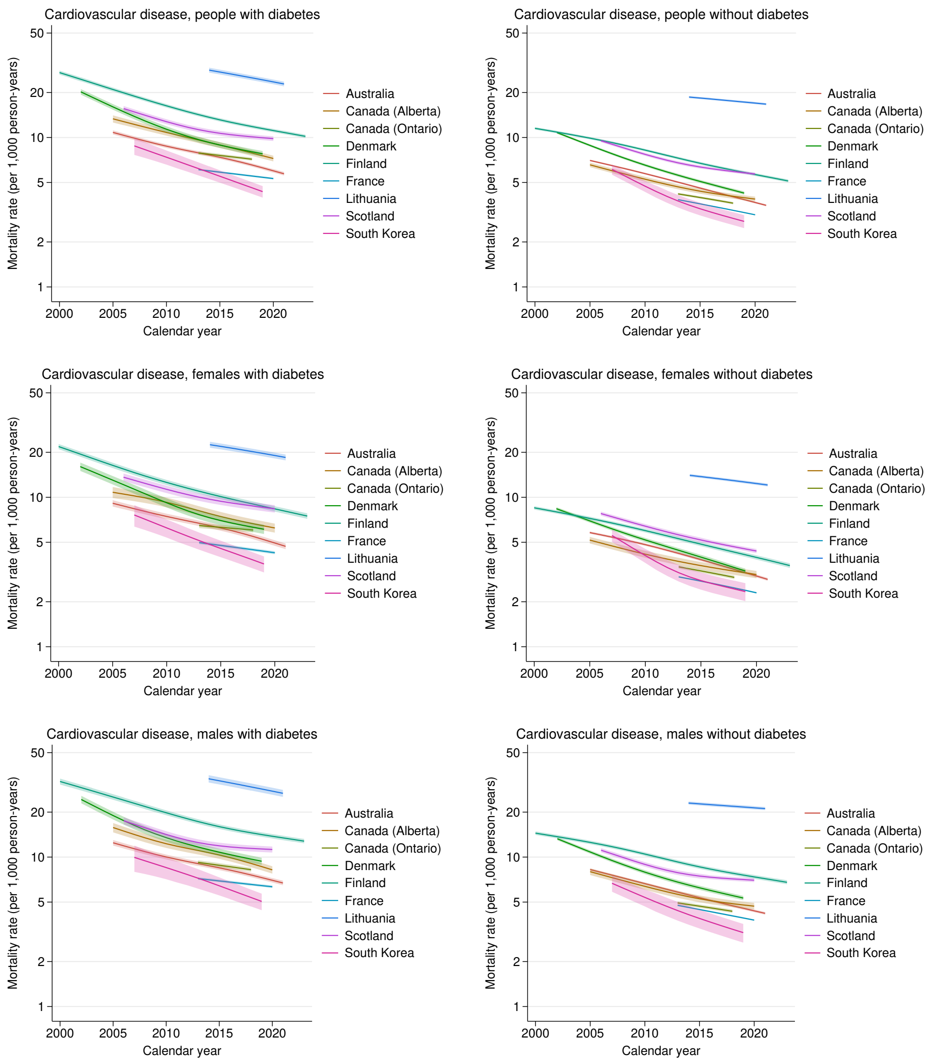
```
(rarea ub lb calendar if country == "`C6´", color("`r(p6)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C6´", color("`r(p6)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C7´", color("`r(p7)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C7´", color("`r(p7)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C8´", color("`r(p8)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C8´", color("`r(p8)´") lpattern(solid)) ///
(rarea ub lb calendar if country == "`C9´", color("`r(p9)´%30") fintensity(inten80) lwidth(none)) ///
(line stdrate calendar if country == "`C9´", color("`r(p9)´") lpattern(solid)) ///
, legend(symxsize(0.13cm) position(3) region(lcolor(white) color(none)) ///
order(2 "`C1´" ///
4 "`C2´" ///
6 "`C3´" ///
8 "`C4´" ///
10 "`C5´" ///
12 "`C6´" ///
14 "`C7´" ///
16 "`C8´" ///
18 "`C9´") ///
cols(1)) ///
graphregion(color(white)) ///
ylabel(0.01 "0.01" 0.02 "0.02" 0.05 "0.05" 0.1 "0.1" 0.2 "0.2" 0.5 "0.5" 1 2 5, grid glpattern(solid) glcolor(gs10%20) ang
yscale(log range(0.01 5)) ///
xscale(range(2000 2020)) ///
xlabel(2000(5)2020, nogrid) ///
ytitle("Mortality rate (per 1,000 person-years)", margin(a+2)) ///
xtitle("Calendar year") ///
title("`oo´", placement(west) color(black) size(medium))
}
graph save GPH/STD_GPH_`ii´_`iii´_F1, replace
}
}
}


foreach ii in can cvd res azd dmd inf flu ckd liv {
if "`ii´" == "can" {
local oo = "Cancer"
}
if "`ii´" == "cvd" {
local oo = "Cardiovascular disease"
}
if "`ii´" == "res" {
local oo = "Chronic lower respiratory disease"
}
if "`ii´" == "azd" {
local oo = "Dementia"
}
if "`ii´" == "dmd" {
local oo = "Diabetes"
}
if "`ii´" == "inf" {
local oo = "Infectious diseases"
}
if "`ii´" == "flu" {
local oo = "Influenza and pneumonia"
}
if "`ii´" == "ckd" {
local oo = "Kidney disease"
}
if "`ii´" == "liv" {
local oo = "Liver disease"
}
if "`ii´" == "dmd" {
graph combine ///
GPH/STD_GPH_`ii´_dm.gph ///
GPH/STD_GPH_`ii´_dm_0.gph ///
GPH/STD_GPH_`ii´_dm_1.gph ///
, graphregion(color(white)) cols(1) altshrink xsize(2)
}
```

Figure 3.9: Age-standardised mortality rate by cause of death, people aged 40-89. Cancer.




```
else {
graph combine ///
GPH/STD_GPH_`ii´_dm.gph ///
GPH/STD_GPH_`ii´_nondm.gph ///
GPH/STD_GPH_`ii´_dm_0.gph ///
GPH/STD_GPH_`ii´_nondm_0.gph ///
GPH/STD_GPH_`ii´_dm_1.gph ///
GPH/STD_GPH_`ii´_nondm_1.gph ///
, graphregion(color(white)) cols(2) altshrink xsize(4)
}
}
graph combine ///
GPH/STD_GPH_can_dm_F1.gph ///
GPH/STD_GPH_cvd_dm_F1.gph ///
GPH/STD_GPH_dmd_dm_F1.gph ///
GPH/STD_GPH_res_dm_F1.gph ///
GPH/STD_GPH_azd_dm_F1.gph ///
```

Figure 3.10: Age-standardised mortality rate by cause of death, people aged 40-89. Cardiovascular disease.




```
GPH/STD_GPH_inf_dm_F1.gph ///
GPH/STD_GPH_flu_dm_F1.gph ///
GPH/STD_GPH_ckd_dm_F1.gph ///
GPH/STD_GPH_liv_dm_F1.gph ///
, graphregion(color(white)) cols(3) altshrink xsize(7)
graph export "/home/jimb0w/Documents/CM/Figure_1.pdf", as(pdf) name("Graph") replace
```

Figure 3.11: Age-standardised mortality rate by cause of death, people aged 40-89. Chronic lower respiratory disease.

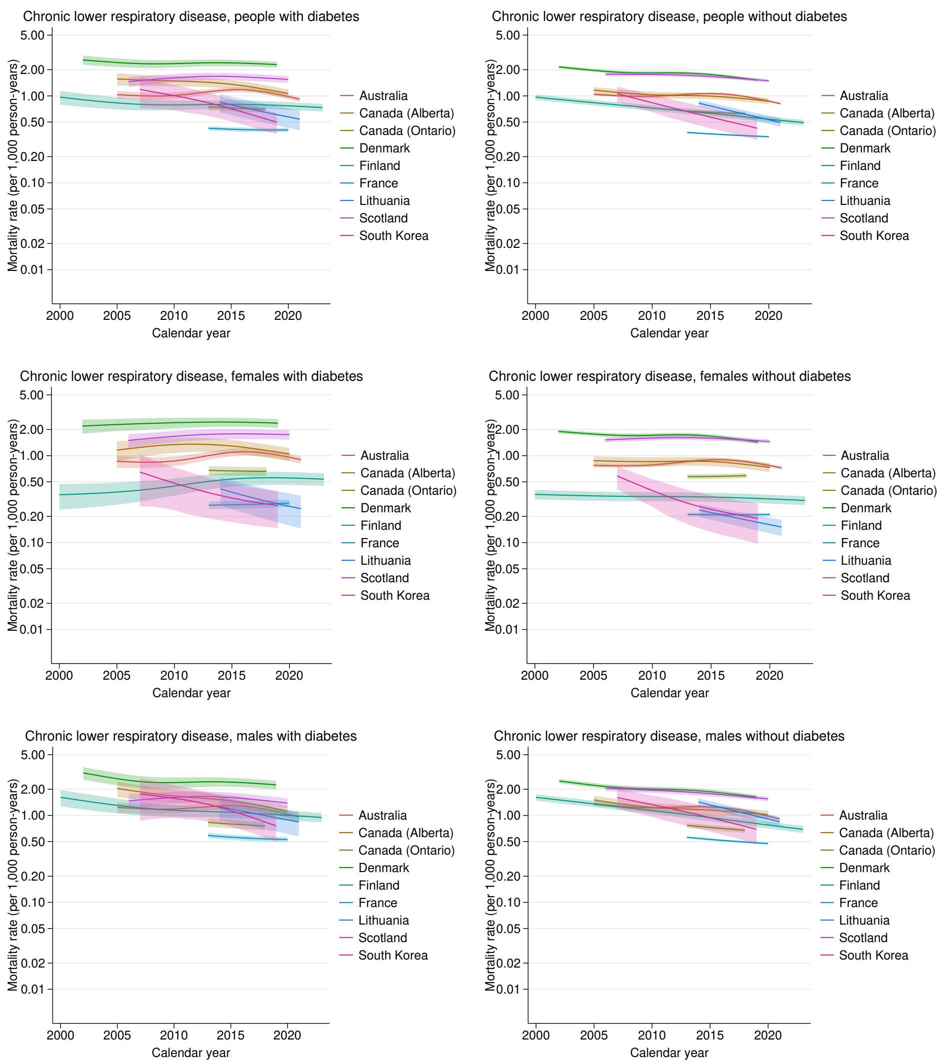


Figure 3.12: Age-standardised mortality rate by cause of death, people aged 40-89. Dementia.

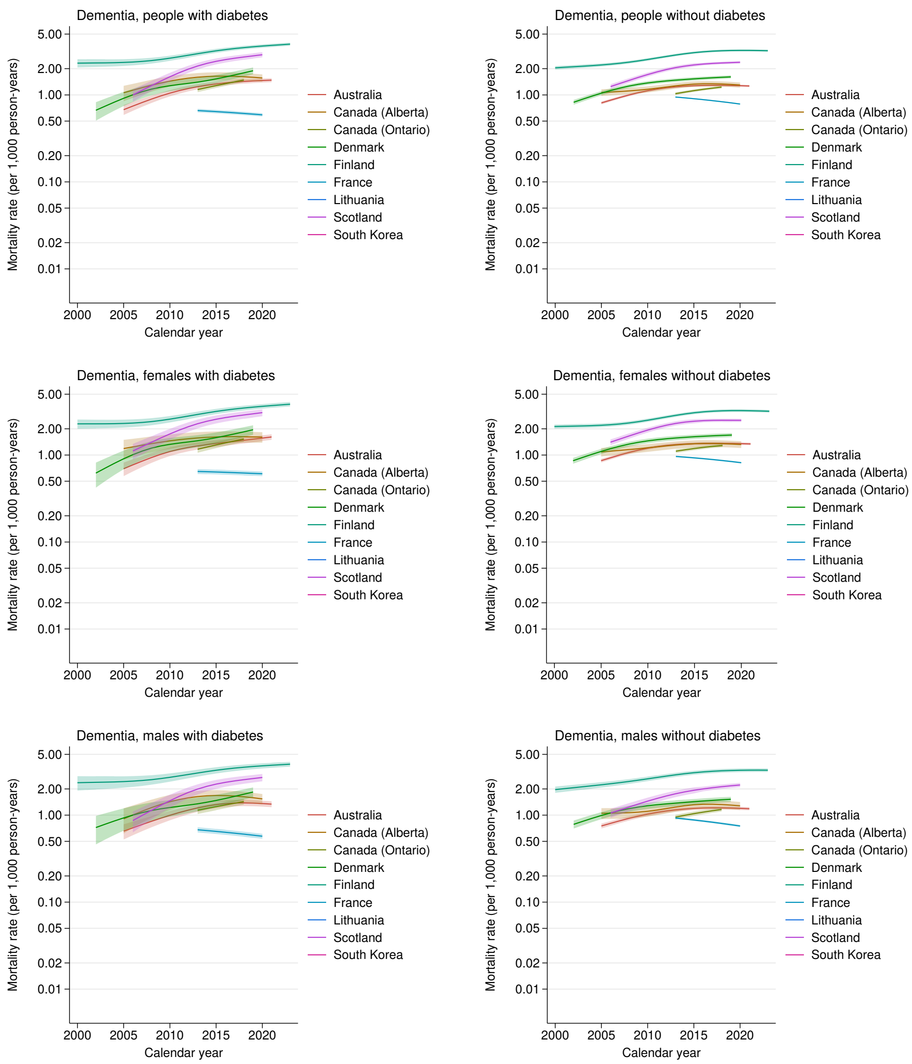


Figure 3.13: Age-standardised mortality rate by cause of death, people aged 40-89. Diabetes.

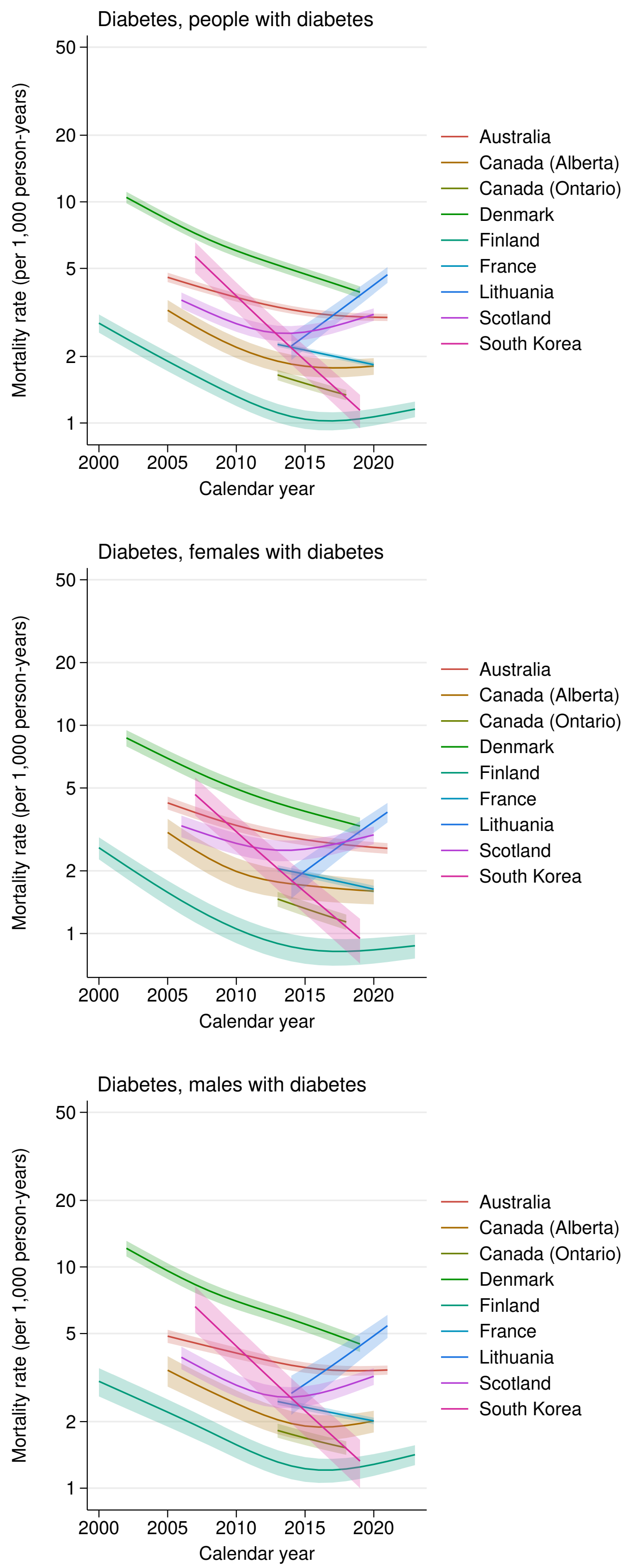


Figure 3.14: Age-standardised mortality rate by cause of death, people aged 40-89. Infectious diseases.

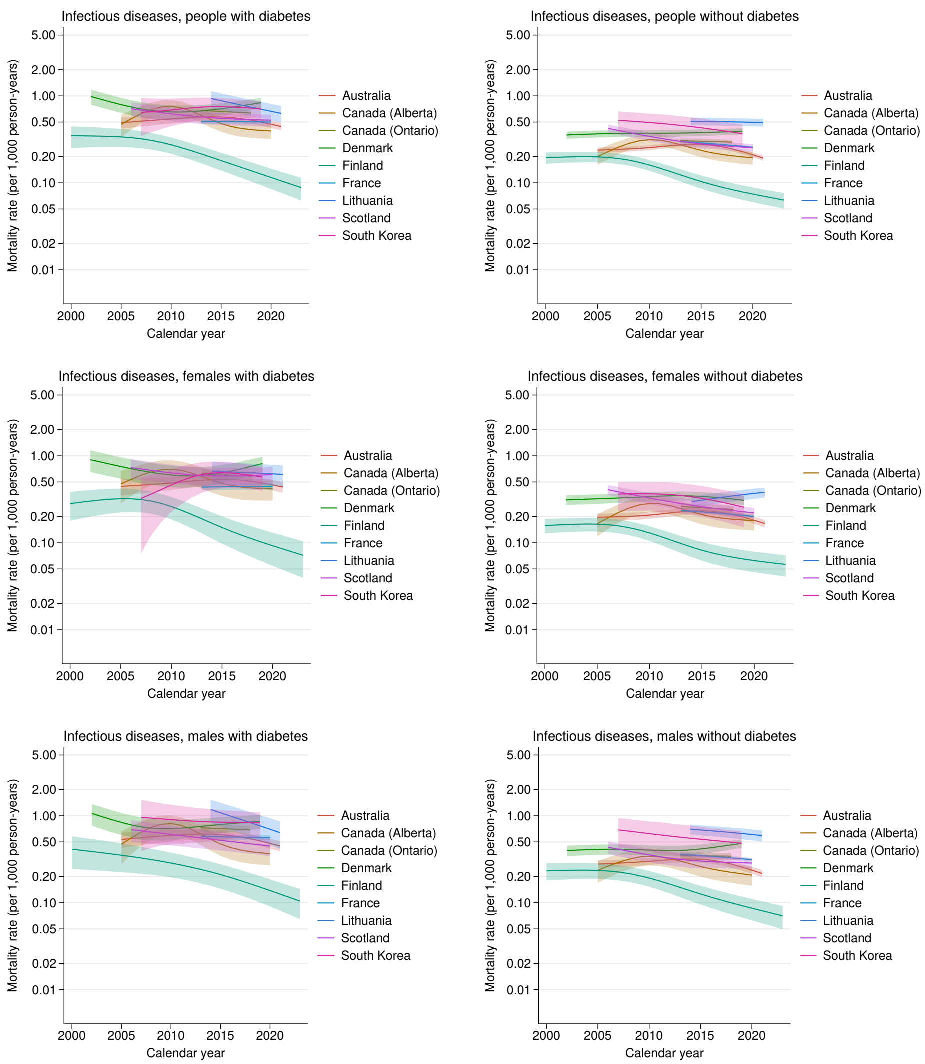


Figure 3.15: Age-standardised mortality rate by cause of death, people aged 40-89. Influenza and pneumonia.

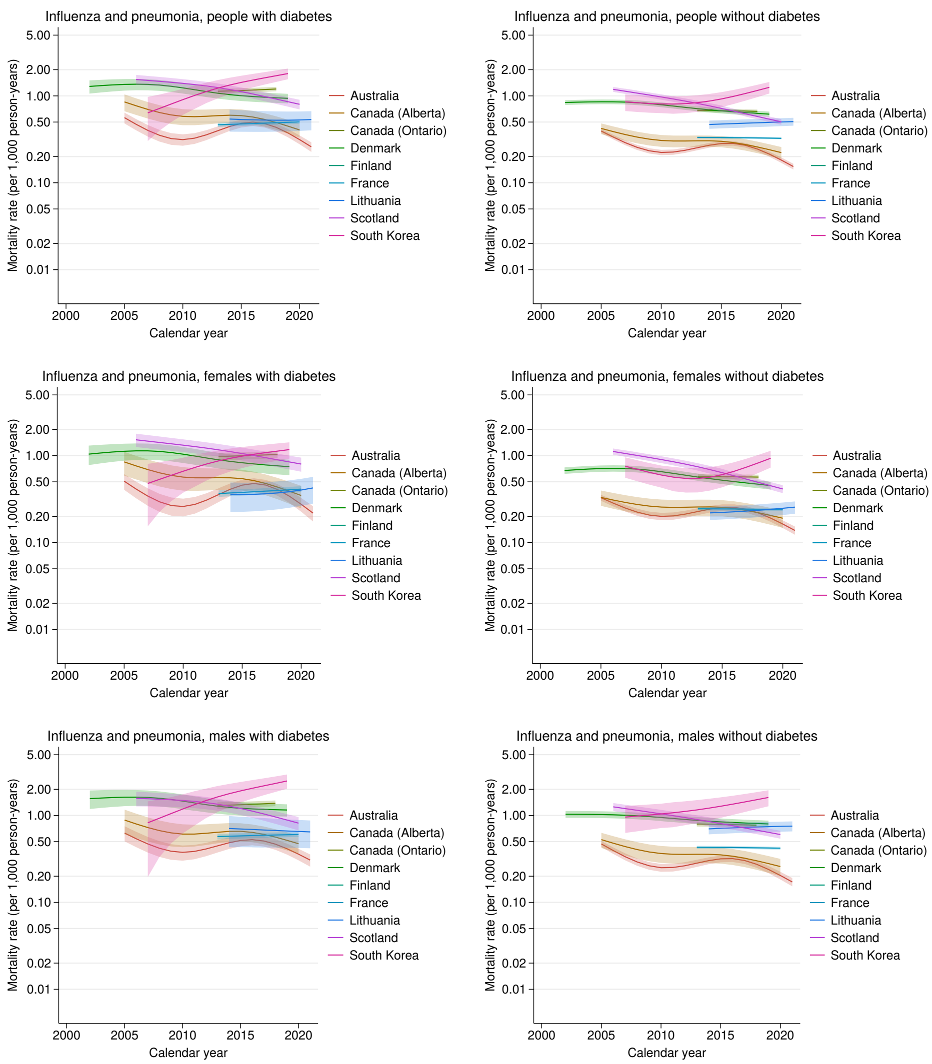


Figure 3.16: Age-standardised mortality rate by cause of death, people aged 40-89. Kidney disease.

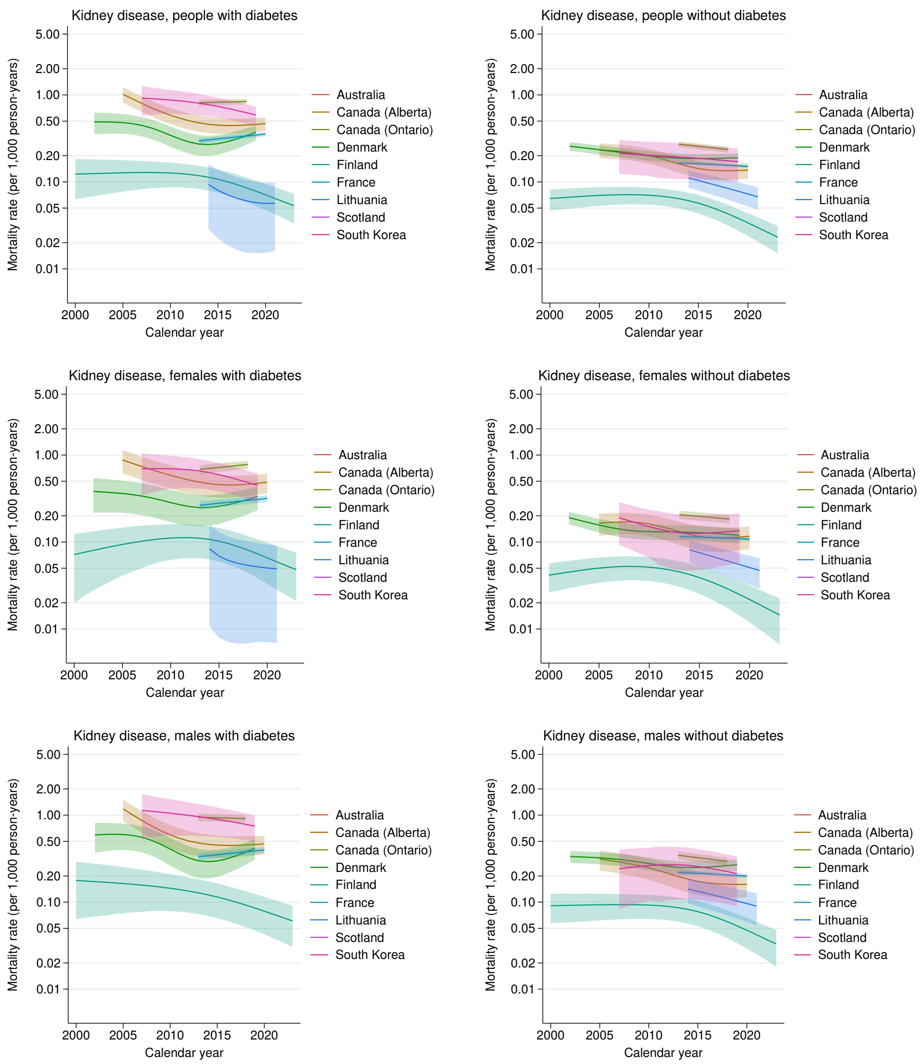


Figure 3.17: Age-standardised mortality rate by cause of death, people aged 40-89. Liver disease.

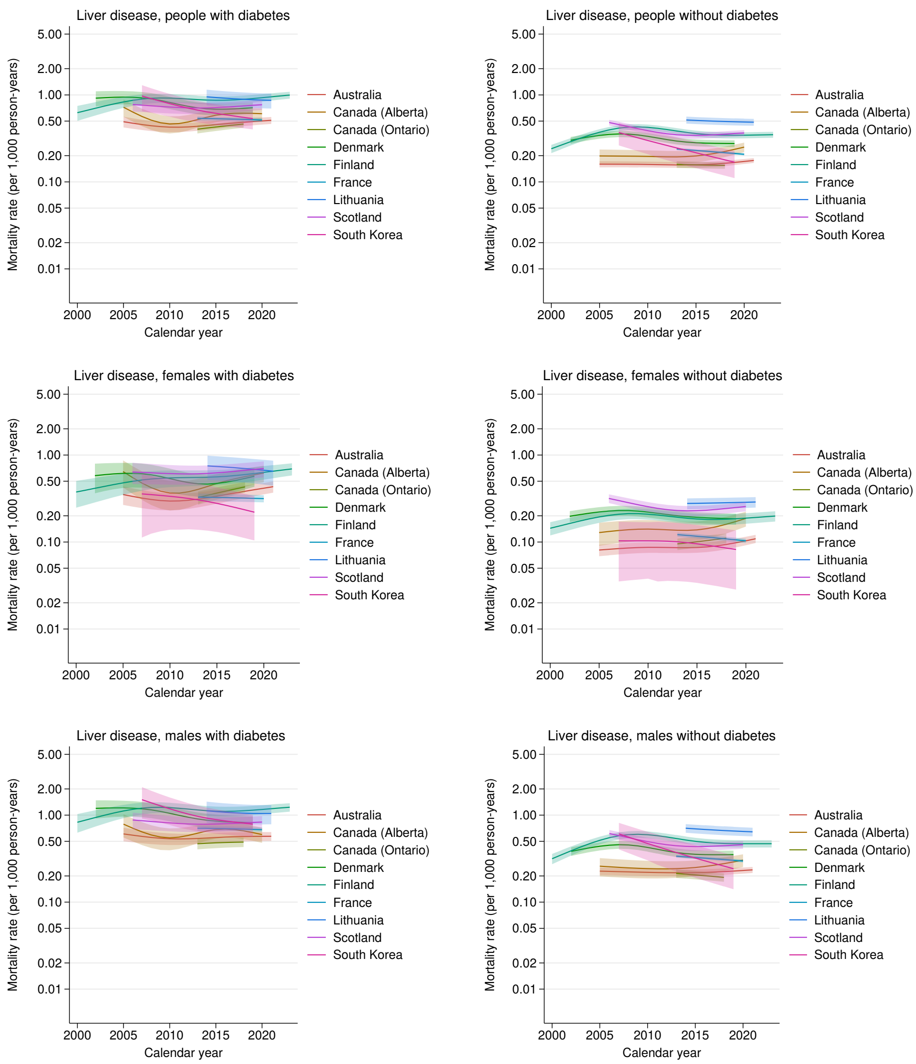
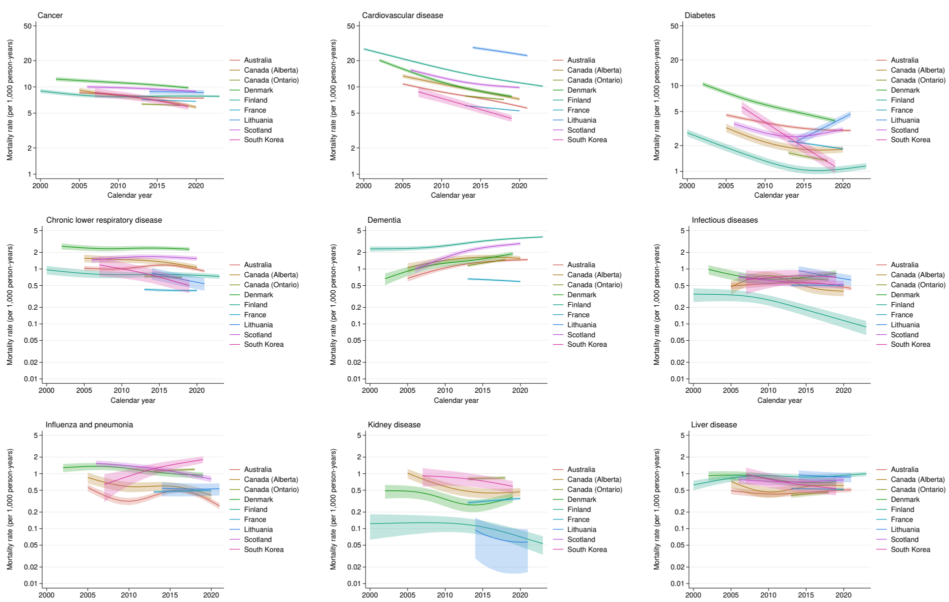


Figure 3.18: Age-standardised mortality rate by cause of death, people aged 40-89.



4 Cause-specific mortality rate ratios

To estimate the mortality rate ratios (MRRs) for people with vs. without diabetes by calendar time, I will fit a model with spline effects of age, a binary effect of sex, and an interaction between spline effects of calendar time and diabetes status.

```
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
use `i´, clear
expand 2
bysort cal age_dm sex : gen dm = _n-1
foreach ii in cvd_d can_d dmd_d inf_d flu_d res_d liv_d ckd_d azd_d pys age {
gen `ii´ = `ii´_dm if dm == 1
replace `ii´ = `ii´_nondm if dm == 0
drop `ii´_dm `ii´_nondm
}
drop if age==.
save `i´_long, replace
}
quietly {
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
foreach ii in can cvd res azd inf flu ckd liv {
use `i´_long, clear
replace calendar = calendar-2009.5
gen coh = calendar-age
centile(age), centile(5 35 65 95)
local A1 = r(c_1)
local A2 = r(c_2)
local A3 = r(c_3)
local A4 = r(c_4)
mkspline agesp = age, cubic knots(`A1´ `A2´ `A3´ `A4´)
su(calendar), detail
local rang = r(max)-r(min)
local minn = r(min)
if `rang´ < 10 {
centile calendar, centile(25 75)
local CK1 = r(c_1)
local CK2 = r(c_2)
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´)
preserve
clear
local rang1 = `rang´+1
set obs `rang1´
gen calendar = _n-1+`minn´
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´)
forval a = 1/`rang1´ {
local A1`a´ = timesp1[`a´]
}
restore
}
else if inrange(`rang´,10,14.9) {
centile calendar, centile(10 50 90)
local CK1 = r(c_1)
local CK2 = r(c_2)
local CK3 = r(c_3)
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´ `CK3´)
preserve
clear
local rang1 = `rang´+1
set obs `rang1´
gen calendar = _n-1+`minn´
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´ `CK3´)
forval a = 1/`rang1´ {
local A1`a´ = timesp1[`a´]
local A2`a´ = timesp2[`a´]
}
restore
```

```
}
else {
centile calendar, centile(5 35 65 95)
local CK1 = r(c_1)
local CK2 = r(c_2)
local CK3 = r(c_3)
local CK4 = r(c_4)
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´ `CK3´ `CK4´)
preserve
clear
local rang1 = `rang´+1
set obs `rang1´
gen calendar = _n-1+`minn´
mkspline timesp = calendar, cubic knots(`CK1´ `CK2´ `CK3´ `CK4´)
forval a = 1/`rang1´ {
local A1`a´ = timesp1[`a´]
local A2`a´ = timesp2[`a´]
local A3`a´ = timesp3[`a´]
}
restore
}
centile(coh), centile(5 35 65 95)
local CO1 = r(c_1)
local CO2 = r(c_2)
local CO3 = r(c_3)
local CO4 = r(c_4)
mkspline cohsp = coh, cubic knots(`CO1´ `CO2´ `CO3´ `CO4´)
preserve
poisson `ii´_d agesp* sex c.timesp*##i.dm, exposure(pys)
matrix A = (.,.,.)
if `rang´ < 10 {
forval a = 1/`rang1´ {
margins, dydx(dm) at(timesp1==`A1`a´´) predict(xb) atmeans
matrix A = (A\r(table)[1,2],r(table)[5,2],r(table)[6,2])
}
}
else if inrange(`rang´,10,14.9) {
forval a = 1/`rang1´ {
margins, dydx(dm) at(timesp1==`A1`a´´ timesp2==`A2`a´´) predict(xb) atmeans
matrix A = (A\r(table)[1,2],r(table)[5,2],r(table)[6,2])
}
}
else {
forval a = 1/`rang1´ {
margins, dydx(dm) at(timesp1==`A1`a´´ timesp2==`A2`a´´ timesp3==`A3`a´´) predict(xb) atmeans
matrix A = (A\r(table)[1,2],r(table)[5,2],r(table)[6,2])
}
}
local rang2 = `rang1´+1
mat A = A[2..`rang2´,1..3]
keep country cal
bysort cal : keep if _n == 1
svmat A
replace A1 = exp(A1)
replace A2 = exp(A2)
replace A3 = exp(A3)
gen OC = "`ii´"
replace cal = cal+2009.5
save MD/SMR_`i´_`ii´, replace
restore
forval iii = 0/1 {
preserve
su agesp1
local B1 = r(mean)
su agesp2
local B2 = r(mean)
su agesp3
local B3 = r(mean)
```

```
keep if sex == `iii´
poisson `ii´_d agesp* c.timesp*##i.dm, exposure(pys)
matrix A = (.,.,.)
if `rang´ < 10 {
forval a = 1/`rang1´ {
margins, dydx(dm) at(timesp1==`A1`a´´ agesp1==`B1´ agesp2==`B2´ agesp3==`B3´) predict(xb) atmeans
matrix A = (A\r(table)[1,2],r(table)[5,2],r(table)[6,2])
}
}
else if inrange(`rang´,10,14.9) {
forval a = 1/`rang1´ {
margins, dydx(dm) at(timesp1==`A1`a´´ timesp2==`A2`a´´ agesp1==`B1´ agesp2==`B2´ agesp3==`B3´) predict(xb) atmeans
matrix A = (A\r(table)[1,2],r(table)[5,2],r(table)[6,2])
}
}
else {
forval a = 1/`rang1´ {
margins, dydx(dm) at(timesp1==`A1`a´´ timesp2==`A2`a´´ timesp3==`A3`a´´ agesp1==`B1´ agesp2==`B2´ agesp3==`B3´) predict(x
matrix A = (A\r(table)[1,2],r(table)[5,2],r(table)[6,2])
}
}
local rang2 = `rang1´+1
mat A = A[2..`rang2´,1..3]
keep country cal
bysort cal : keep if _n == 1
svmat A
replace A1 = exp(A1)
replace A2 = exp(A2)
replace A3 = exp(A3)
gen OC = "`ii´"
replace cal = cal+2009.5
save MD/SMR_`i´_`ii´_`iii´, replace
restore
}
}
}
}
clear
set obs 1
gen country = "Australia"
save MD/SMR_Australia_ckd, replace
save MD/SMR_Australia_ckd_0, replace
save MD/SMR_Australia_ckd_1, replace
clear
set obs 1
gen country = "Finland"
save MD/SMR_Finland_flu, replace
save MD/SMR_Finland_flu_0, replace
save MD/SMR_Finland_flu_1, replace
clear
set obs 1
gen country = "Scotland"
save MD/SMR_Scotland_ckd, replace
save MD/SMR_Scotland_ckd_0, replace
save MD/SMR_Scotland_ckd_1, replace
clear
set obs 1
gen country = "Lithuania"
save MD/SMR_Lithuania_ckd_1, replace
save MD/SMR_Lithuania_azd, replace
save MD/SMR_Lithuania_azd_0, replace
save MD/SMR_Lithuania_azd_1, replace
clear
set obs 1
gen country = "SKorea"
save MD/SMR_SKorea_azd, replace
save MD/SMR_SKorea_azd_0, replace
save MD/SMR_SKorea_azd_1, replace
```

```
foreach ii in can cvd res azd inf flu ckd liv {
if "`ii´" == "can" {
local oo = "Cancer"
local ylab = "1 1.5 2"
local yform = "%9.1f"
local yrange = "1 2"
}
if "`ii´" == "cvd" {
local oo = "Cardiovascular disease"
local ylab = "1 1.5 2 2.5 3"
local yform = "%9.1f"
local yrange = "1 3"
}
if "`ii´" == "res" {
local oo = "Chronic lower respiratory disease"
local ylab = "0.5 1 1.5 2 2.5"
local yform = "%9.1f"
local yrange = "0.5 2.5"
}
if "`ii´" == "azd" {
local oo = "Dementia"
local ylab = "0.5 1 1.5"
local yform = "%9.1f"
local yrange = "0.3 1.5"
}
if "`ii´" == "inf" {
local oo = "Infectious diseases"
local ylab = "0.5 1 2 3 4 5"
local yform = "%9.1f"
local yrange = "0.5 5.5"
}
if "`ii´" == "flu" {
local oo = "Influenza and pneumonia"
local ylab = "0.5 1 2 3"
local yform = "%9.1f"
local yrange = "0.4 3.1"
}
if "`ii´" == "ckd" {
local oo = "Kidney disease"
local ylab = "0.5 1 2 5 10"
local yform = "%9.0f"
local yrange = "0.5 11"
}
if "`ii´" == "liv" {
local oo = "Liver disease"
local ylab = "1 2 5 10"
local yform = "%9.0f"
local yrange = "1 10"
}
clear
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
append using MD/SMR_`i´_`ii´
}
replace country = "Canada (Alberta)" if country == "Canada1"
replace country = "Canada (Ontario)" if country == "Canada2"
replace country = "South Korea" if country == "SKorea"
preserve
bysort country : keep if _n == 1
forval i = 1/9 {
local C`i´ = country[`i´]
}
restore
colorpalette hue, n(9) luminance(50) nograph
twoway ///
(rarea A3 A2 calendar if country == "`C1´", color("`r(p1)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C1´", color("`r(p1)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C2´", color("`r(p2)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C2´", color("`r(p2)´") lpattern(solid)) ///
```

```
(rarea A3 A2 calendar if country == "`C3´", color("`r(p3)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C3´", color("`r(p3)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C4´", color("`r(p4)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C4´", color("`r(p4)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C5´", color("`r(p5)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C5´", color("`r(p5)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C6´", color("`r(p6)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C6´", color("`r(p6)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C7´", color("`r(p7)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C7´", color("`r(p7)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C8´", color("`r(p8)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C8´", color("`r(p8)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C9´", color("`r(p9)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C9´", color("`r(p9)´") lpattern(solid)) ///
, legend(symxsize(0.13cm) position(3) region(lcolor(white) color(none)) ///
order(2 "`C1´" ///
4 "`C2´" ///
6 "`C3´" ///
8 "`C4´" ///
10 "`C5´" ///
12 "`C6´" ///
14 "`C7´" ///
16 "`C8´" ///
18 "`C9´") ///
cols(1)) ///
graphregion(color(white)) ///
ylabel(`ylab´, grid format(`yform´) angle(0)) ///
xscale(range(2000 2020)) ///
xlabel(2000(5)2020, nogrid) ///
yline(1, lcol(black)) yscale(log range(`yrange´)) ///
ytitle("Mortality rate ratio", margin(a+2)) ///
xtitle("Calendar year") ///
title("`oo´", placement(west) color(black) size(medium))
graph save GPH/SMR_`ii´, replace
forval iii = 0/1 {
if `iii´ == 0 {
local s = "females"
}
if `iii´ == 1 {
local s = "males"
}
clear
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
append using MD/SMR_`i´_`ii´_`iii´
}
replace country = "Canada (Alberta)" if country == "Canada1"
replace country = "Canada (Ontario)" if country == "Canada2"
replace country = "South Korea" if country == "SKorea"
preserve
bysort country : keep if _n == 1
forval i = 1/9 {
local C`i´ = country[`i´]
}
restore
colorpalette hue, n(9) luminance(50) nograph
twoway ///
(rarea A3 A2 calendar if country == "`C1´", color("`r(p1)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C1´", color("`r(p1)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C2´", color("`r(p2)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C2´", color("`r(p2)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C3´", color("`r(p3)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C3´", color("`r(p3)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C4´", color("`r(p4)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C4´", color("`r(p4)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C5´", color("`r(p5)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C5´", color("`r(p5)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C6´", color("`r(p6)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C6´", color("`r(p6)´") lpattern(solid)) ///
```

```
(rarea A3 A2 calendar if country == "`C7´", color("`r(p7)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C7´", color("`r(p7)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C8´", color("`r(p8)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C8´", color("`r(p8)´") lpattern(solid)) ///
(rarea A3 A2 calendar if country == "`C9´", color("`r(p9)´%30") fintensity(inten80) lwidth(none)) ///
(line A1 calendar if country == "`C9´", color("`r(p9)´") lpattern(solid)) ///
, legend(symxsize(0.13cm) position(3) region(lcolor(white) color(none)) ///
order(2 "`C1´" ///
4 "`C2´" ///
6 "`C3´" ///
8 "`C4´" ///
10 "`C5´" ///
12 "`C6´" ///
14 "`C7´" ///
16 "`C8´" ///
18 "`C9´") ///
cols(1)) ///
graphregion(color(white)) ///
ylabel(`ylab´, format(`yform´) grid angle(0)) ///
xscale(range(2000 2020)) ///
xlabel(2000(5)2020, nogrid) ///
yline(1, lcol(black)) yscale(log range(`yrange´)) ///
ytitle("Mortality rate ratio", margin(a+2)) ///
xtitle("Calendar year") ///
title("`oo´, `s´", placement(west) color(black) size(medium))
graph save GPH/SMR_`ii´_`iii´, replace
}
}


foreach ii in can cvd res azd inf flu ckd liv {
if "`ii´" == "cvd" {
local oo = "Cardiovascular disease"
}
if "`ii´" == "can" {
local oo = "Cancer"
}
if "`ii´" == "res" {
local oo = "Chronic lower respiratory disease"
}
if "`ii´" == "azd" {
local oo = "Dementia"
}
if "`ii´" == "dmd" {
local oo = "Diabetes"
}
if "`ii´" == "inf" {
local oo = "Infectious diseases"
}
if "`ii´" == "flu" {
local oo = "Influenza and pneumonia"
}
if "`ii´" == "liv" {
local oo = "Liver disease"
}
if "`ii´" == "ckd" {
local oo = "Kidney disease"
}
graph combine ///
GPH/SMR_`ii´.gph ///
GPH/SMR_`ii´_0.gph ///
GPH/SMR_`ii´_1.gph ///
, graphregion(color(white)) cols(1) altshrink xsize(2.5)
}
```

Figure 4.1: Mortality rate ratio by cause of death and sex. Cancer.

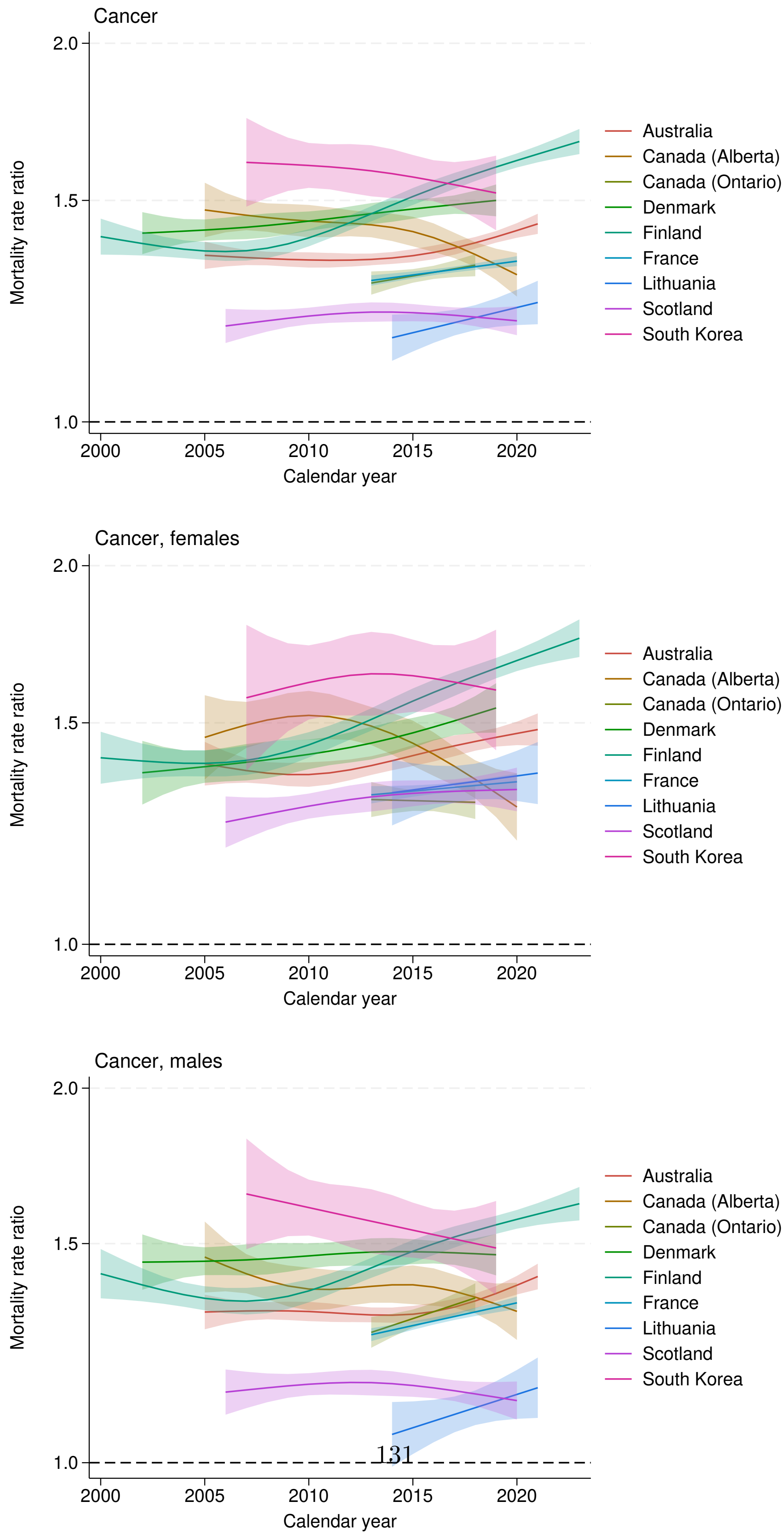


Figure 4.2: Mortality rate ratio by cause of death and sex. Cardiovascular disease.

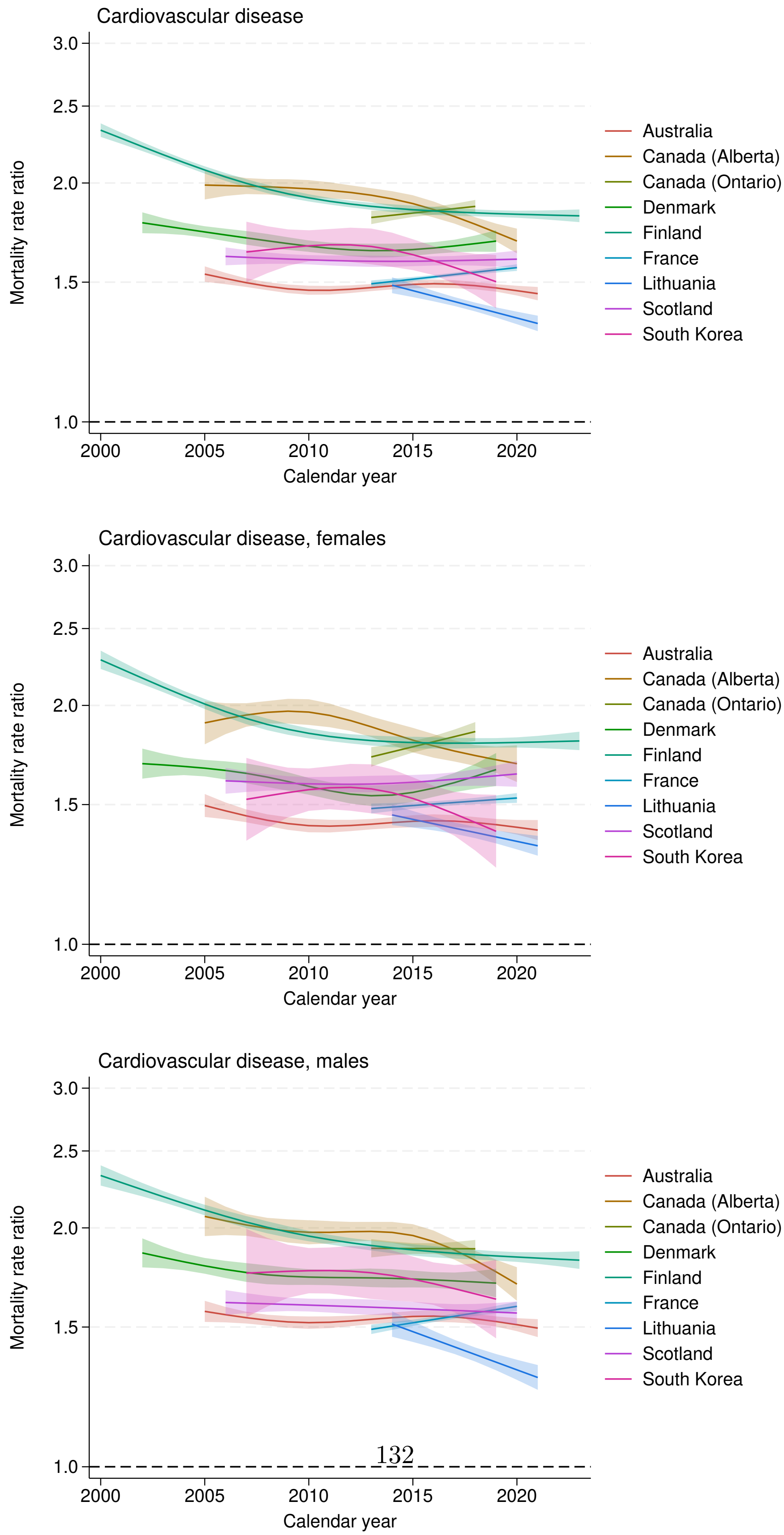


Figure 4.3: Mortality rate ratio by cause of death and sex. Chronic lower respiratory disease.

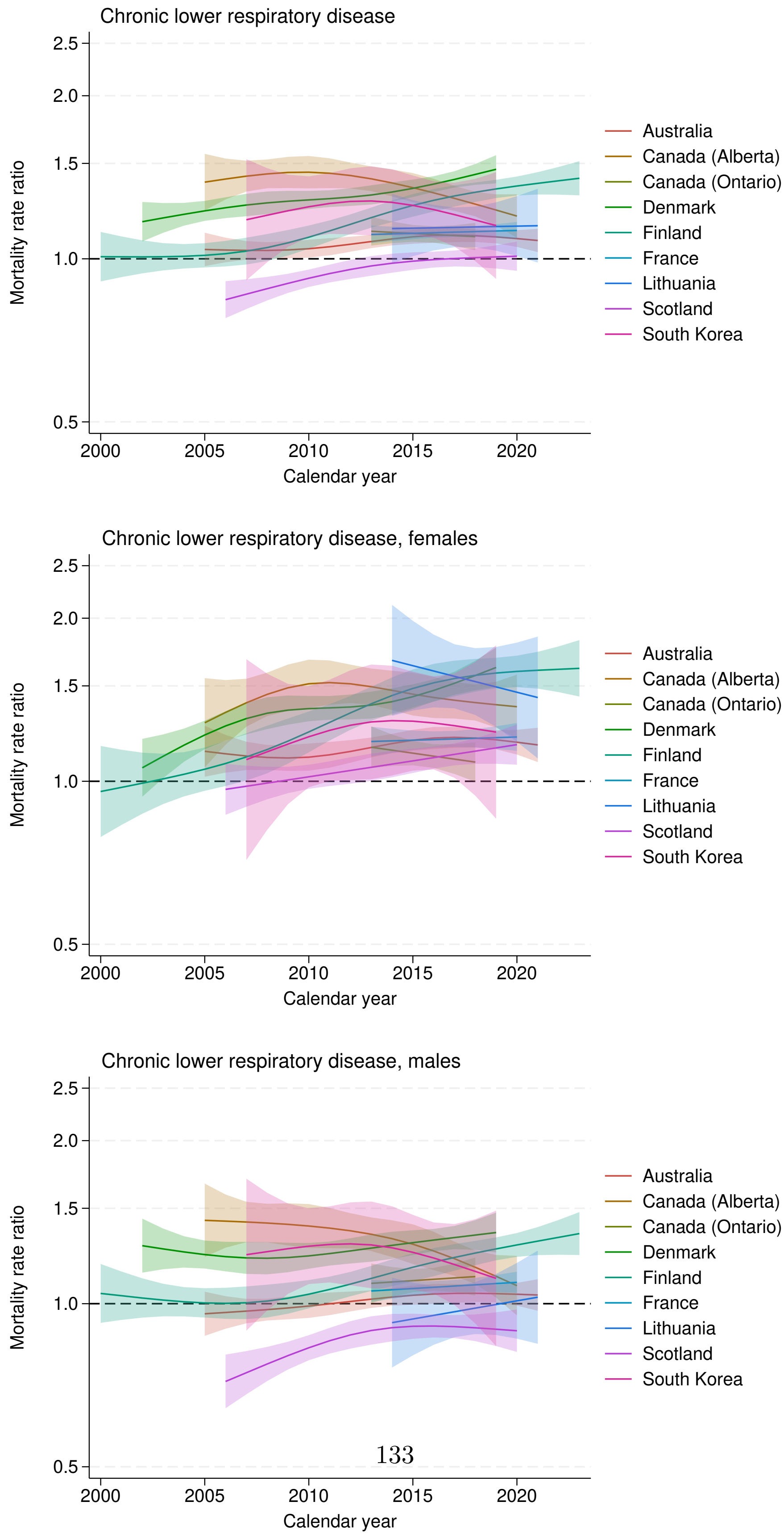
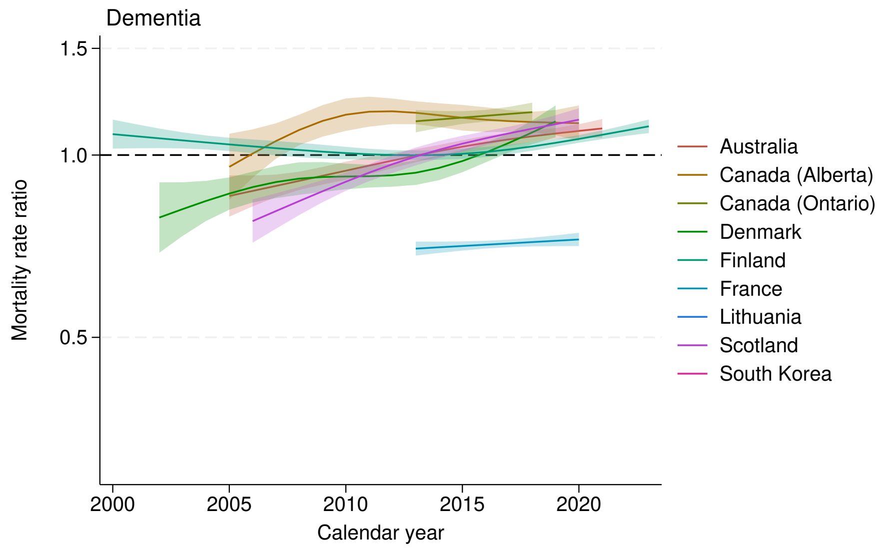
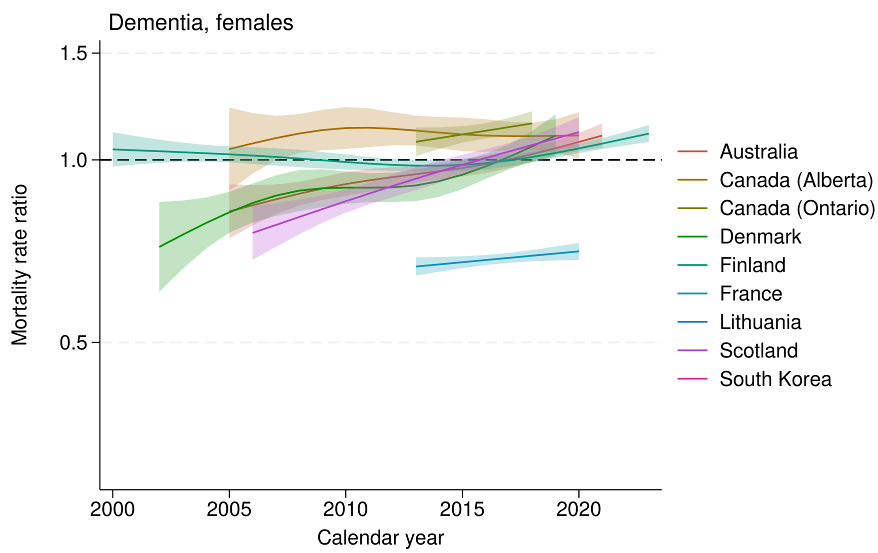


Figure 4.4: Mortality rate ratio by cause of death and sex. Dementia.





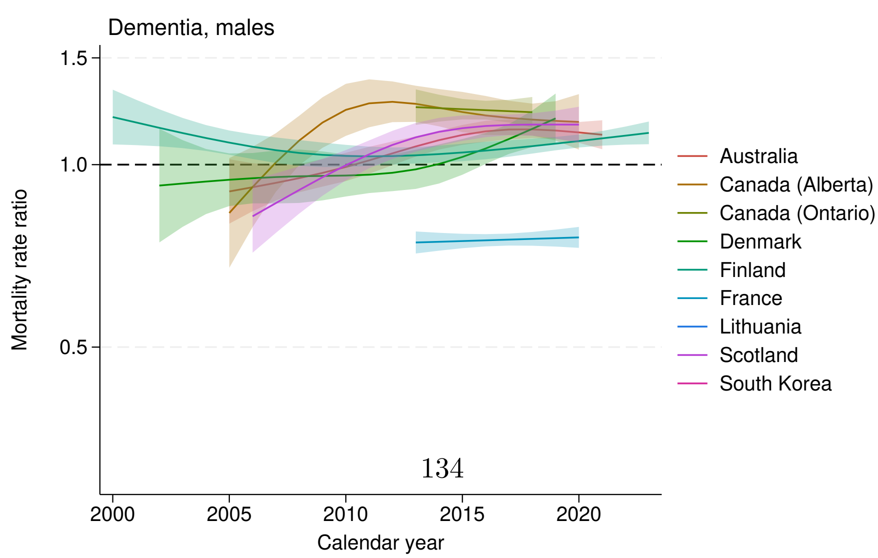


Figure 4.5: Mortality rate ratio by cause of death and sex. Infectious diseases.

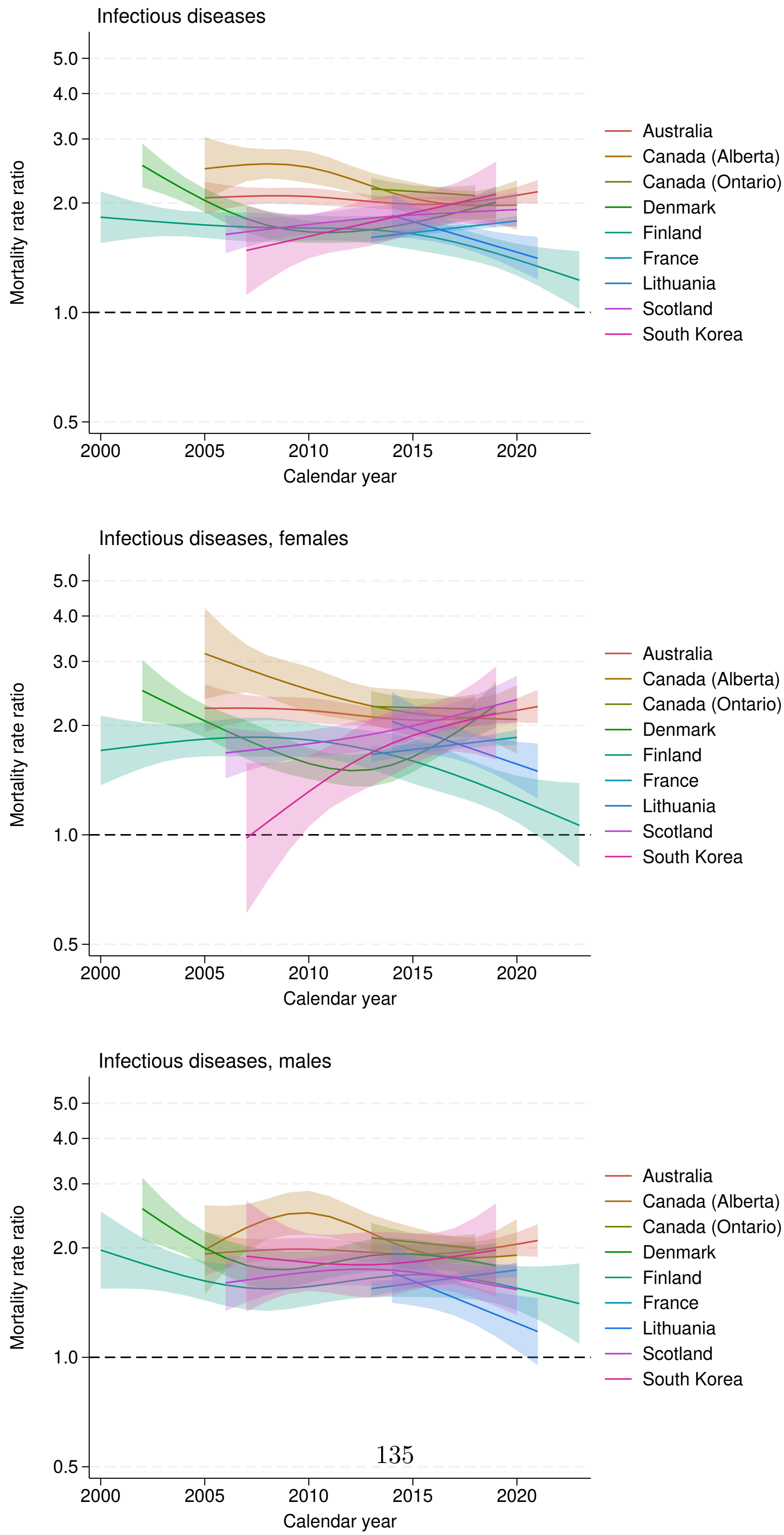
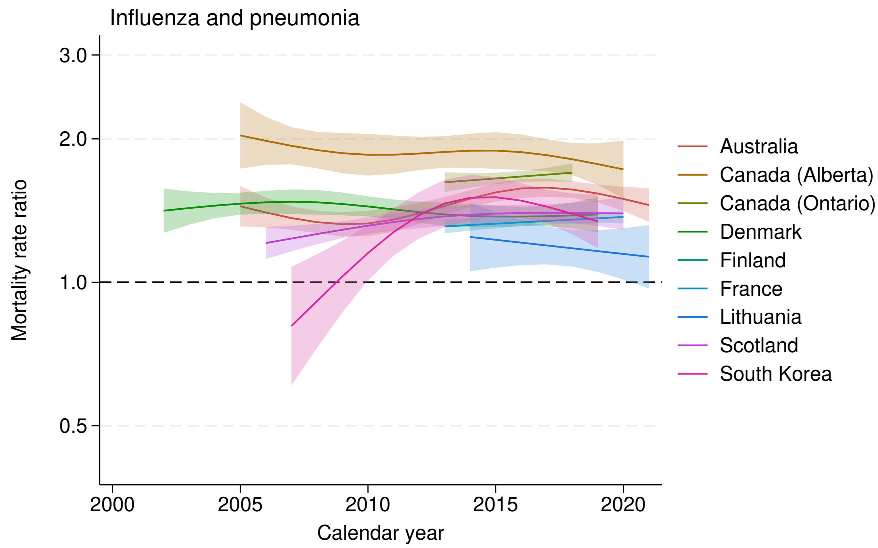
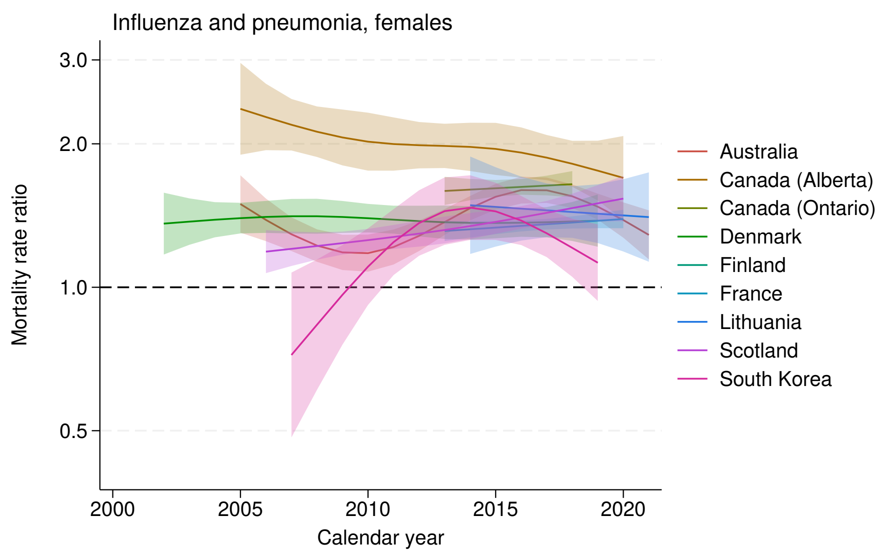


Figure 4.6: Mortality rate ratio by cause of death and sex. Influenza and pneumonia.





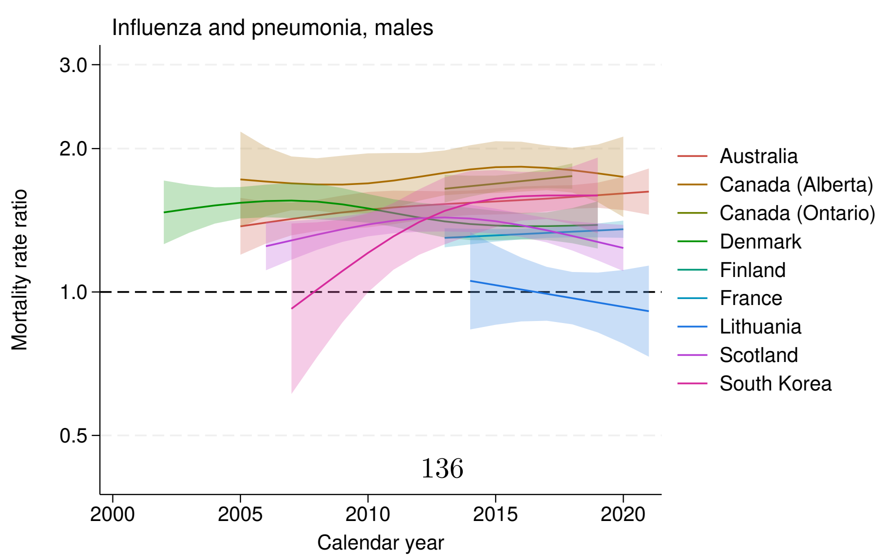


Figure 4.7: Mortality rate ratio by cause of death and sex. Kidney disease.

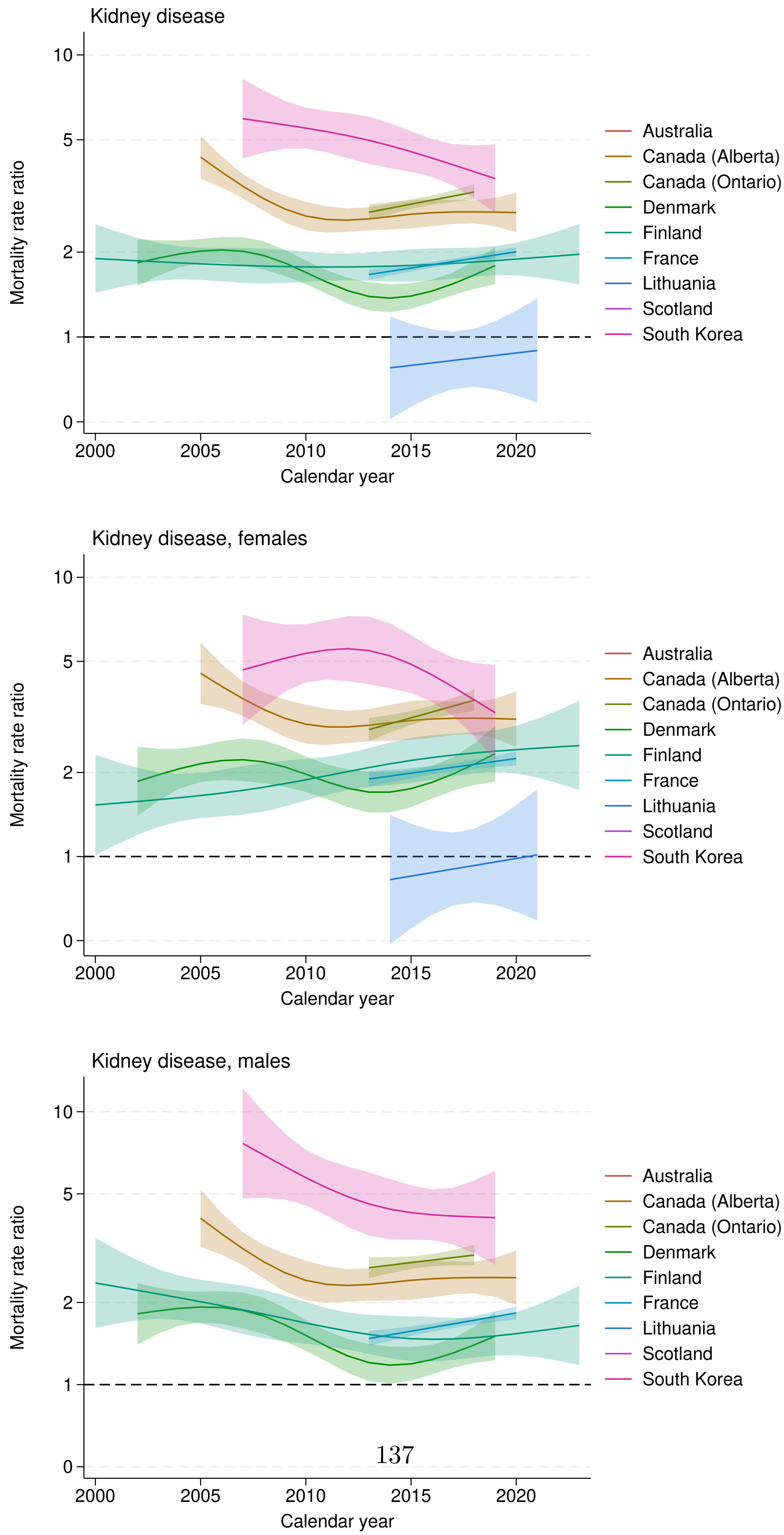
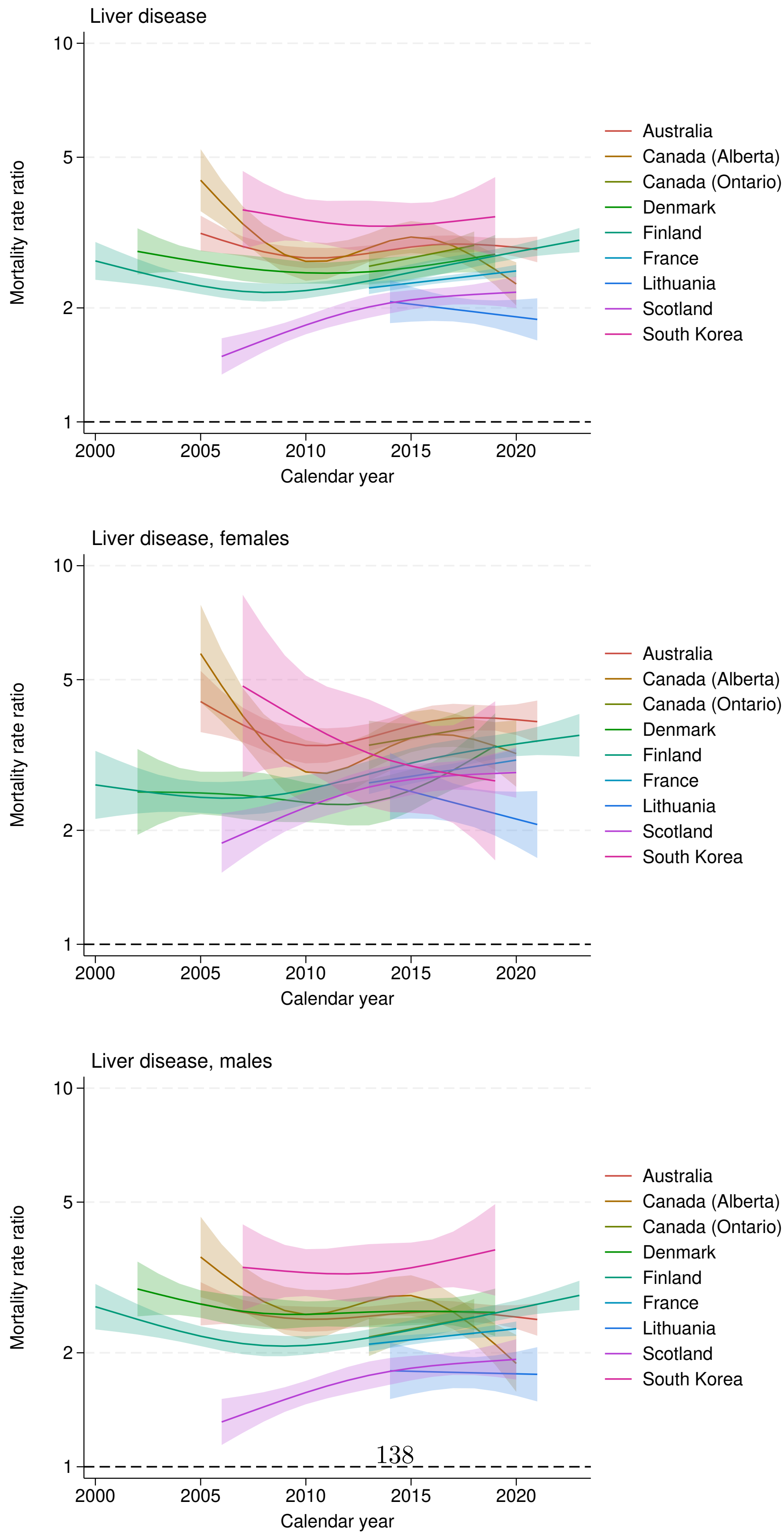


Figure 4.8: Mortality rate ratio by cause of death and sex. Liver disease.



5 Average 5-year percent changes

Finally, we will estimate the average 5-year percent change (A5PC) in both mortality rates and MRRs. For mortality rates, the A5PC comes from a model with a linear effect of calendar time (the A5PC is derived from the coefficient associated with this term in the model) , spline effects of age, a binary effect of sex, and the interaction between spline effects of age and binary effect of sex. For MRRs, the A5PC comes from a model with spline effects of age, a binary effect of sex, a linear effect of calendar time, a binary effect of diabetes status, and the interaction between calendar time and diabetes status (the A5PC is derived from the coefficient associated with this term in the model).

```
quietly {
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
foreach ii in can cvd res azd dmd inf flu ckd liv {
foreach iii in dm nondm {
if "`ii´" == "dmd" & "`iii´" == "nondm" {
}
else {
use `i´, clear
replace calendar = (calendar-2009.5)/5
gen coh = calendar-age_`iii´
centile(age_`iii´), centile(5 35 65 95)
local A1 = r(c_1)
local A2 = r(c_2)
local A3 = r(c_3)
local A4 = r(c_4)
mkspline agesp = age_`iii´, cubic knots(`A1´ `A2´ `A3´ `A4´)
poisson `ii´_d_`iii´ cal c.agesp*##sex, exposure(pys_`iii´)
matrix A_`i´_`ii´_`iii´ = (r(table)[1,1], r(table)[5,1], r(table)[6,1], r(table)[4,1])
foreach iiii in 0 1 {
use `i´, clear
keep if sex == `iiii´
replace calendar = (calendar-2009.5)/5
gen coh = calendar-age_`iii´
centile(age_`iii´), centile(5 35 65 95)
local A1 = r(c_1)
local A2 = r(c_2)
local A3 = r(c_3)
local A4 = r(c_4)
mkspline agesp = age_`iii´, cubic knots(`A1´ `A2´ `A3´ `A4´)
poisson `ii´_d_`iii´ cal c.agesp*, exposure(pys_`iii´)
matrix A_`i´_`ii´_`iii´_`iiii´ = (r(table)[1,1], r(table)[5,1], r(table)[6,1], r(table)[4,1])
}
}
}
}
}
}
matrix A = (.,.,.,.,.,.,.,.)
local a1 = 0
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
local a1 = `a1´+1
local a2 = 0
foreach ii in can cvd res azd dmd inf flu ckd liv {
local a2 = `a2´+1
local a3 = 0
foreach iii in dm nondm {
if "`ii´" == "dmd" & "`iii´" == "nondm" {
}
else {
local a3 = `a3´+1
matrix A = (A\0`a1´,`a2´,`a3´,2,A_`i´_`ii´_`iii´)
foreach iiii in 0 1 {
matrix A = (A\0`a1´,`a2´,`a3´,`iiii´,A_`i´_`ii´_`iii´_`iiii´)
```

```
}
}
}
}
}
clear
svmat A
sort A1 A2 A3 A4
drop if A1==.
tostring A2-A3, replace format(%9.0f) force
gen country=""
local a1 = 0
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
local a1 = `a1´+1
replace country = "`i´" if A1 == `a1´
local a2 = 0
foreach ii in can cvd res azd dmd inf flu ckd liv {
local a2 = `a2´+1
replace A2 = "`ii´" if A2 == "`a2´"
local a3 = 0
foreach iii in dm nondm {
local a3 = `a3´+1
replace A3 = "`iii´" if A3 == "`a3´"
}
}
}
replace A2 = "dmd" if A2 == "13"
replace A5 = 100*(exp(A5)-1)
replace A6 = 100*(exp(A6)-1)
replace A7 = 100*(exp(A7)-1)
forval i = 5/8 {
replace A`i´ = . if country == "Australia" & A2 == "ckd"
replace A`i´ = . if country == "Finland" & A2 == "flu"
replace A`i´ = . if country == "Scotland" & A2 == "ckd"
replace A`i´ = . if country == "Lithuania" & A2 == "ckd" & A3 == "dm" & A4 == 1
replace A`i´ = . if country == "Lithuania" & A2 == "azd"
replace A`i´ = . if country == "SKorea" & A2 == "azd"
}
save APCs, replace
quietly {
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
foreach ii in can cvd res azd inf flu ckd liv {
use `i´_long, clear
replace calendar = (calendar-2009.5)/5
centile(age), centile(5 35 65 95)
local A1 = r(c_1)
local A2 = r(c_2)
local A3 = r(c_3)
local A4 = r(c_4)
mkspline agesp = age, cubic knots(`A1´ `A2´ `A3´ `A4´)
poisson `ii´_d agesp* sex c.cal*##i.dm, exposure(pys)
matrix A_`i´_`ii´ = (r(table)[1,9], r(table)[5,9], r(table)[6,9], r(table)[4,9])
foreach iii in 0 1 {
use `i´_long, clear
keep if sex == `iii´
replace calendar = (calendar-2009.5)/5
centile(age), centile(5 35 65 95)
local A1 = r(c_1)
local A2 = r(c_2)
local A3 = r(c_3)
local A4 = r(c_4)
mkspline agesp = age, cubic knots(`A1´ `A2´ `A3´ `A4´)
poisson `ii´_d agesp* sex c.cal*##i.dm, exposure(pys)
matrix A_`i´_`ii´_`iii´ = (r(table)[1,9], r(table)[5,9], r(table)[6,9], r(table)[4,9])
}
}
}
}
```

```
matrix A = (.,.,.,.,.,.,.)
local a1 = 0
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
local a1 = `a1´+1
local a2 = 0
foreach ii in can cvd res azd inf flu ckd liv {
local a2 = `a2´+1
matrix A = (A\0`a1´,`a2´,2,A_`i´_`ii´)
foreach iii in 0 1 {
matrix A = (A\0`a1´,`a2´,`iii´,A_`i´_`ii´_`iii´)
}
}
}
clear
svmat A
sort A1 A2 A3
drop if A1==.
tostring A2, replace format(%9.0f) force
gen country=""
local a1 = 0
foreach i in Australia Canada1 Canada2 Denmark Finland France Lithuania Scotland SKorea {
local a1 = `a1´+1
replace country = "`i´" if A1 == `a1´
local a2 = 0
foreach ii in can cvd res azd inf flu ckd liv {
local a2 = `a2´+1
replace A2 = "`ii´" if A2 == "`a2´"
}
}
replace A4 = 100*(exp(A4)-1)
replace A5 = 100*(exp(A5)-1)
replace A6 = 100*(exp(A6)-1)
forval i = 4/7 {
replace A`i´ = . if country == "Australia" & A2 == "ckd"
replace A`i´ = . if country == "Finland" & A2 == "flu"
replace A`i´ = . if country == "Scotland" & A2 == "ckd"
replace A`i´ = . if country == "Lithuania" & A2 == "ckd" & A3 == 1
replace A`i´ = . if country == "Lithuania" & A2 == "azd"
replace A`i´ = . if country == "SKorea" & A2 == "azd"
}
save SMR_APCs, replace
foreach i in can cvd res azd dmd inf flu ckd liv {
if "`i´" == "can" {
local ii = "cancer"
}
if "`i´" == "cvd" {
local ii = "cardiovascular disease"
}
if "`i´" == "res" {
local ii = "chronic lower respiratory disease"
}
if "`i´" == "azd" {
local ii = "dementia"
}
if "`i´" == "dmd" {
local ii = "diabetes"
}
if "`i´" == "inf" {
local ii = "infectious diseases"
}
if "`i´" == "flu" {
local ii = "influenza and pneumonia"
}
if "`i´" == "liv" {
local ii = "liver disease"
}
if "`i´" == "ckd" {
local ii = "kidney disease"
```

```
}
use APCs, clear
gen AA = -A1+0.15 if A3 == "dm"
replace AA = -A1-0.15 if A3 == "nondm"
replace country = "Canada (Alberta)" if country == "Canada1"
replace country = "Canada (Ontario)" if country == "Canada2"
replace country = "South Korea" if country == "SKorea"
preserve
bysort A1 : keep if _n == 1
forval c = 1/9 {
local C`c´ = country[`c´]
}
restore
twoway ///
(rcap A7 A6 AA if A2 == "`i´" & A3 == "dm" & A4 == 2, horizontal col(blue)) ///
(scatter AA A5 if A2 == "`i´" & A3 == "dm" & A4 == 2, col(blue)) ///
(rcap A7 A6 AA if A2 == "`i´" & A3 == "nondm" & A4 == 2, horizontal col(green)) ///
(scatter AA A5 if A2 == "`i´" & A3 == "nondm" & A4 == 2, col(green)) ///
, graphregion(color(white)) legend(order( ///
2 "Diabetes" 4 "No diabetes") cols(1) ///
region(lcolor(none) color(none)) position(3)) ///
ylabel( ///
-1 "`C1´" ///
-2 "`C2´" ///
-3 "`C3´" ///
-4 "`C4´" ///
-5 "`C5´" ///
-6 "`C6´" ///
-7 "`C7´" ///
-8 "`C8´" ///
-9 "`C9´" ///
, angle(0) nogrid) ytitle("") xline(0, lcol(black)) ///
xlabel(, format(%9.0f)) xtitle(5-year percent change) ///
title("Mortality rate, `ii´", placement(west) col(black) size(medium))
graph save GPH/APCo_`i´, replace
use APCs, clear
gen AA = -A1-0.1 if A4 == 0
replace AA = -A1-0.25 if A4 == 1
replace AA = AA + 0.35 if A3=="nondm"
replace country = "Canada (Alberta)" if country == "Canada1"
replace country = "Canada (Ontario)" if country == "Canada2"
replace country = "South Korea" if country == "SKorea"
preserve
bysort A1 : keep if _n == 1
forval c = 1/9 {
local C`c´ = country[`c´]
}
restore
twoway ///
(rcap A7 A6 AA if A2 == "`i´" & A3 == "nondm" & A4 == 0, horizontal col(red)) ///
(scatter AA A5 if A2 == "`i´" & A3 == "nondm" & A4 == 0, col(red) msize(small) msymbol(S)) ///
(rcap A7 A6 AA if A2 == "`i´" & A3 == "nondm" & A4 == 1, horizontal col(blue)) ///
(scatter AA A5 if A2 == "`i´" & A3 == "nondm" & A4 == 1, col(blue) msize(small) msymbol(S)) ///
(rcap A7 A6 AA if A2 == "`i´" & A3 == "dm" & A4 == 0, horizontal col(red)) ///
(scatter AA A5 if A2 == "`i´" & A3 == "dm" & A4 == 0, col(red) msize(small)) ///
(rcap A7 A6 AA if A2 == "`i´" & A3 == "dm" & A4 == 1, horizontal col(blue)) ///
(scatter AA A5 if A2 == "`i´" & A3 == "dm" & A4 == 1, col(blue) msize(small)) ///
, graphregion(color(white)) legend(order( ///
2 "Females without diabetes" 4 "Males without diabetes" ///
6 "Females with diabetes" 8 "Males with diabetes" ///
) cols(1) ///
region(lcolor(none) color(none)) position(3)) ///
ylabel( ///
-1 "`C1´" ///
-2 "`C2´" ///
-3 "`C3´" ///
-4 "`C4´" ///
-5 "`C5´" ///
```

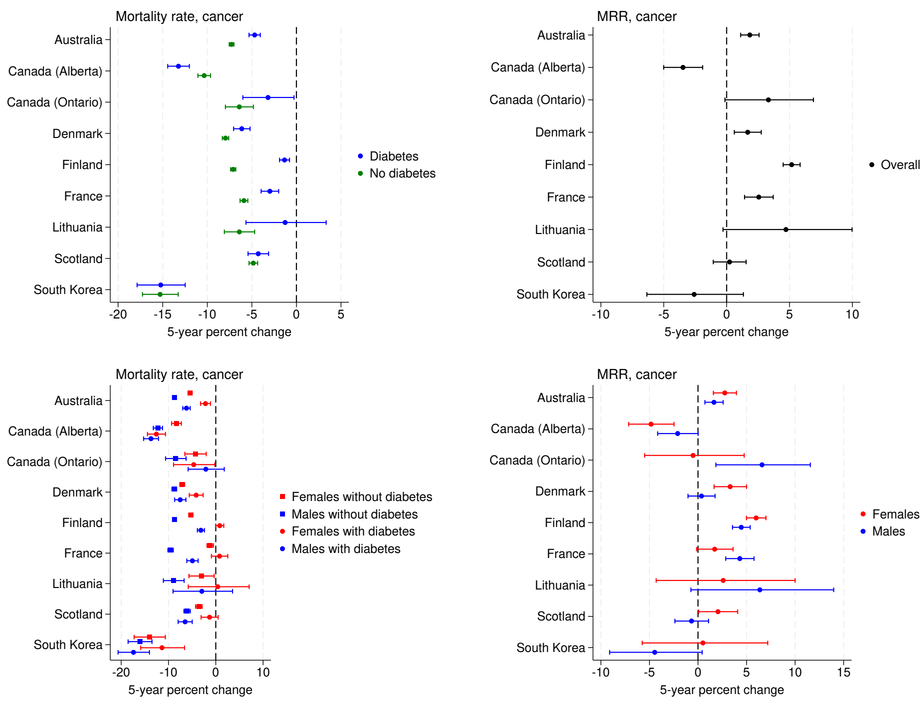
```
-6 "`C6´" ///
-7 "`C7´" ///
-8 "`C8´" ///
-9 "`C9´" ///
, angle(0) nogrid) ytitle("") xline(0, lcol(black)) ///
xlabel(, format(%9.0f)) xtitle(5-year percent change) ///
title("Mortality rate, `ii´", placement(west) col(black) size(medium))
graph save GPH/APCs_`i´, replace
if "`i´" != "dmd" {
use SMR_APCs, clear
gen AA = -A1
replace country = "Canada (Alberta)" if country == "Canada1"
replace country = "Canada (Ontario)" if country == "Canada2"
replace country = "South Korea" if country == "SKorea"
preserve
bysort A1 : keep if _n == 1
forval c = 1/9 {
local C`c´ = country[`c´]
}
restore
twoway ///
(rcap A6 A5 AA if A2 == "`i´" & A3 == 2, horizontal col(black)) ///
(scatter AA A4 if A2 == "`i´" & A3 == 2, col(black)) ///
, graphregion(color(white)) legend(order( ///
2 "Overall") cols(1) ///
region(lcolor(none) color(none)) position(3)) ///
ylabel( ///
-1 "`C1´" ///
-2 "`C2´" ///
-3 "`C3´" ///
-4 "`C4´" ///
-5 "`C5´" ///
-6 "`C6´" ///
-7 "`C7´" ///
-8 "`C8´" ///
-9 "`C9´" ///
, angle(0) nogrid) ytitle("") xline(0, lcol(black)) ///
xlabel(, format(%9.0f)) xtitle(5-year percent change) ///
title("MRR, `ii´", placement(west) col(black) size(medium))
graph save GPH/SAPCo_`i´, replace
use SMR_APCs, clear
gen AA = -A1+0.15 if A3 == 0
replace AA = -A1-0.15 if A3 == 1
replace country = "Canada (Alberta)" if country == "Canada1"
replace country = "Canada (Ontario)" if country == "Canada2"
replace country = "South Korea" if country == "SKorea"
preserve
bysort A1 : keep if _n == 1
forval c = 1/9 {
local C`c´ = country[`c´]
}
restore
twoway ///
(rcap A6 A5 AA if A2 == "`i´" & A3 == 0, horizontal col(red)) ///
(scatter AA A4 if A2 == "`i´" & A3 == 0, col(red)) ///
(rcap A6 A5 AA if A2 == "`i´" & A3 == 1, horizontal col(blue)) ///
(scatter AA A4 if A2 == "`i´" & A3 == 1, col(blue)) ///
, graphregion(color(white)) legend(order( ///
2 "Females" 4 "Males") cols(1) ///
region(lcolor(none) color(none)) position(3)) ///
ylabel( ///
-1 "`C1´" ///
-2 "`C2´" ///
-3 "`C3´" ///
-4 "`C4´" ///
-5 "`C5´" ///
-6 "`C6´" ///
-7 "`C7´" ///
```

```
-8 "`C8´" ///
-9 "`C9´" ///
, angle(0) nogrid) ytitle("") xline(0, lcol(black)) ///
xlabel(, format(%9.0f)) xtitle(5-year percent change) ///
title("MRR, `ii´", placement(west) col(black) size(medium))
graph save GPH/SAPCs_`i´, replace
}
}
foreach i in can cvd res azd dmd inf flu ckd liv {
if "`i´" == "can" {
local ii = "Cancer"
}
if "`i´" == "cvd" {
local ii = "Cardiovascular disease"
}
if "`i´" == "res" {
local ii = "Chronic lower respiratory disease"
}
if "`i´" == "azd" {
local ii = "Dementia"
}
if "`i´" == "dmd" {
local ii = "Diabetes"
}
if "`i´" == "inf" {
local ii = "Infectious diseases"
}
if "`i´" == "flu" {
local ii = "Influenza and pneumonia"
}
if "`i´" == "liv" {
local ii = "Liver disease"
}
if "`i´" == "ckd" {
local ii = "Kidney disease"
}
use APCs, clear
gen AA = -A1+0.15 if A3 == "dm"
replace AA = -A1-0.15 if A3 == "nondm"
set obs 461
replace A7 = -5 in 460
replace A7 = -5 in 461
replace A6 = 5 in 460
replace A6 = 5 in 461
replace AA = -9.2 in 460
replace AA = -0.8 in 461
replace country = "Canada (Alberta)" if country == "Canada1"
replace country = "Canada (Ontario)" if country == "Canada2"
replace country = "South Korea" if country == "SKorea"
preserve
bysort A1 : keep if _n == 1
forval c = 1/9 {
local C`c´ = country[`c´]
}
restore
twoway ///
(rarea A7 A6 AA if A1==., horizontal color(black%20) fintensity(inten50) lwidth(none)) ///
(rcap A7 A6 AA if A2 == "`i´" & A3 == "dm" & A4 == 2, horizontal col(blue)) ///
(scatter AA A5 if A2 == "`i´" & A3 == "dm" & A4 == 2, col(blue)) ///
(rcap A7 A6 AA if A2 == "`i´" & A3 == "nondm" & A4 == 2, horizontal col(green)) ///
(scatter AA A5 if A2 == "`i´" & A3 == "nondm" & A4 == 2, col(green)) ///
, graphregion(color(white)) legend(order( ///
2 "Diabetes" 4 "No diabetes") cols(1) ///
region(lcolor(none) color(none)) position(3)) ///
ylabel( ///
-1 "`C1´" ///
-2 "`C2´" ///
-3 "`C3´" ///
```

```
-4 "`C4´" ///
-5 "`C5´" ///
-6 "`C6´" ///
-7 "`C7´" ///
-8 "`C8´" ///
-9 "`C9´" ///
, angle(0) nogrid) ytitle("") xscale(range(0)) xline(0, lcol(black) lstyle(solid)) ///
xlabel(, format(%9.0f)) xtitle(5-year percent change) ///
title("`ii´", placement(west) col(black) size(medium))
graph save GPH/APCo_`i´_F2, replace
if "`i´" != "dmd" {
use SMR_APCs, clear
gen AA = -A1
set obs 218
replace A7 = -5 in 217
replace A7 = -5 in 218
replace A6 = 5 in 217
replace A6 = 5 in 218
replace AA = -9.2 in 217
replace AA = -0.8 in 218
replace country = "Canada (Alberta)" if country == "Canada1"
replace country = "Canada (Ontario)" if country == "Canada2"
replace country = "South Korea" if country == "SKorea"
preserve
bysort A1 : keep if _n == 1
forval c = 1/9 {
local C`c´ = country[`c´]
}
restore
twoway ///
(rarea A7 A6 AA if A1==., horizontal color(black%20) fintensity(inten50) lwidth(none)) ///
(rcap A6 A5 AA if A2 == "`i´" & A3 == 2, horizontal col(black)) ///
(scatter AA A4 if A2 == "`i´" & A3 == 2, col(black)) ///
, graphregion(color(white)) legend(off) ///
ylabel( ///
-1 "`C1´" ///
-2 "`C2´" ///
-3 "`C3´" ///
-4 "`C4´" ///
-5 "`C5´" ///
-6 "`C6´" ///
-7 "`C7´" ///
-8 "`C8´" ///
-9 "`C9´" ///
, angle(0) nogrid) ytitle("") xscale(range(0)) xline(0, lcol(black)) ///
xlabel(, format(%9.0f)) xtitle(5-year percent change) ///
title("`ii´", placement(west) col(black) size(medium))
graph save GPH/SAPCo_`i´_F3, replace
}
}
foreach i in can cvd res azd dmd inf flu ckd liv {
use SMR_APCs, clear
keep if A2 == "`i´"
tostring A4-A6, force replace format(%9.2f)
gen AA = A4 + " (" + A5 + ", " + A6 + ")"
replace AA = "" if AA == ". (., .)"
keep A3 country AA
rename A3 A4
save MD/SMR_APC_`i´, replace
use APCs, clear
keep if A2 == "`i´"
tostring A5-A7, force replace format(%9.2f)
gen A = A5 + " (" + A6 + ", " + A7 + ")"
replace A = "" if A == ". (., .)"
keep A3 A4 A country
reshape wide A, i(country A4) j(A3) string
merge 1:1 country A4 using MD/SMR_APC_`i´
drop _merge
```

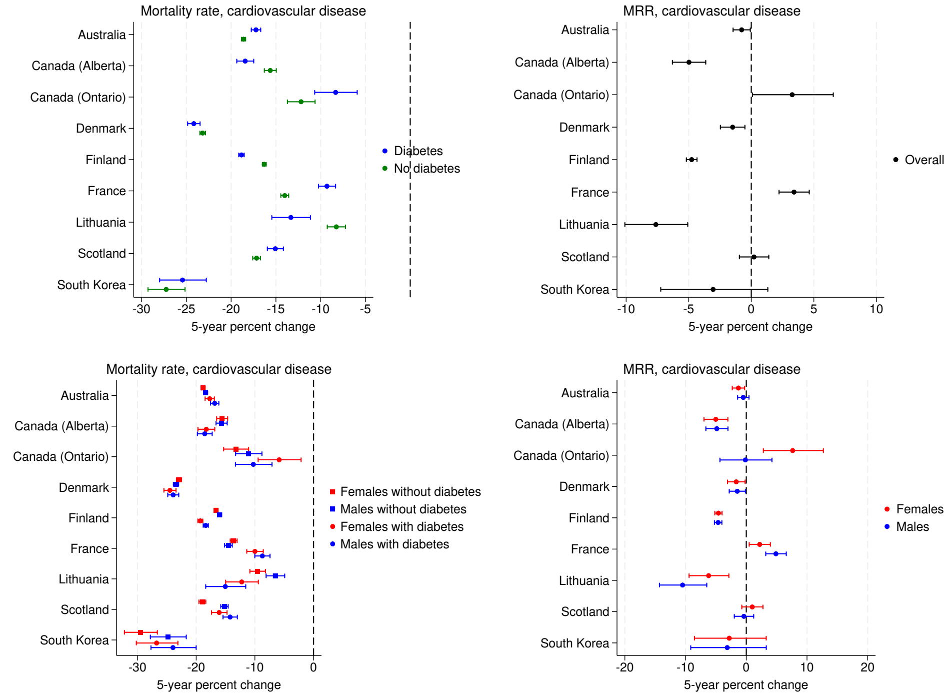
```
bysort country (A4) : replace country = "" if _n!=1
tostring A4, replace force
replace A4 = "Females" if A4 == "0"
replace A4 = "Males" if A4 == "1"
replace A4 = "Overall" if A4 == "2"
order country A4
replace country = "Canada (Alberta)" if country == "Canada1"
replace country = "Canada (Ontario)" if country == "Canada2"
replace country = "South Korea" if country == "SKorea"
if "`i´" == "dmd" {
drop AA
}
export delimited using CSV/APCt_`i´.csv, delimiter(":") novarnames replace
}
```

Figure 5.1: Average 5-year percent change in mortality rate and mortality rate ratio (MRR) by country. Overall (top) and by sex (bottom). Cancer.



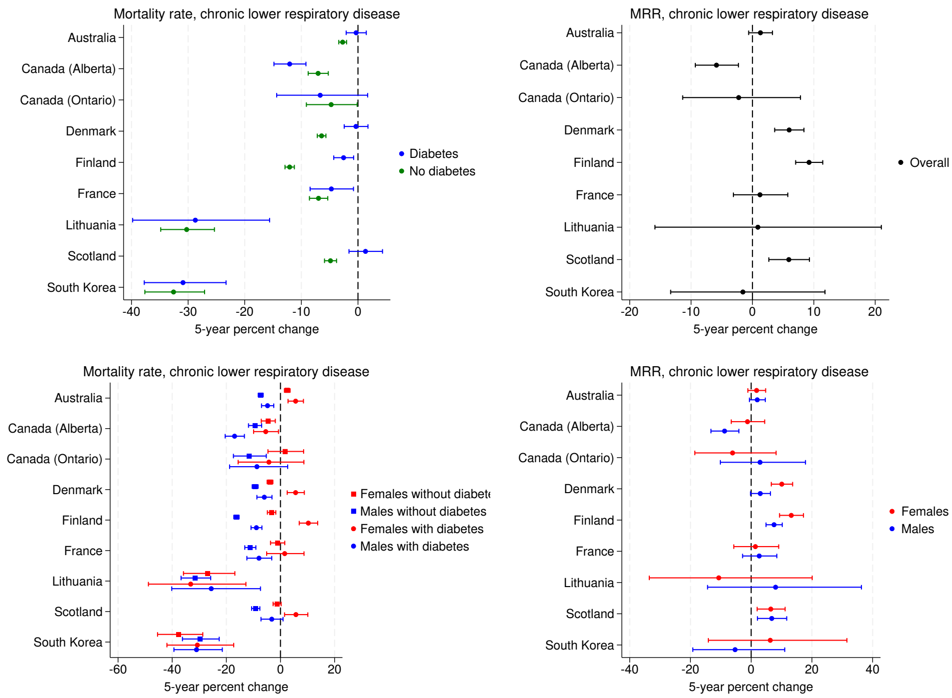

```
foreach ii in can cvd res azd dmd inf flu ckd liv {
if "`ii´" == "can" {
local oo = "Cancer"
}
if "`ii´" == "cvd" {
local oo = "Cardiovascular disease"
}
if "`ii´" == "res" {
local oo = "Chronic lower respiratory disease"
}
if "`ii´" == "azd" {
local oo = "Dementia"
}
if "`ii´" == "dmd" {
local oo = "Diabetes"
```

Figure 5.2: Average 5-year percent change in mortality rate and mortality rate ratio (MRR) by country. Overall (top) and by sex (bottom). Cardiovascular disease.




```
}
if "`ii´" == "inf" {
local oo = "Infectious diseases"
}
if "`ii´" == "flu" {
local oo = "Influenza and pneumonia"
}
if "`ii´" == "ckd" {
local oo = "Kidney disease"
}
if "`ii´" == "liv" {
local oo = "Liver disease"
}
if "`ii´" == "dmd" {
local ii = "dmd"
graph combine ///
GPH/APCo_`ii´.gph ///
GPH/APCs_`ii´.gph ///
, graphregion(color(white)) cols(1) altshrink xsize(3)
}
else {
graph combine ///
GPH/APCo_`ii´.gph ///
GPH/SAPCo_`ii´.gph ///
GPH/APCs_`ii´.gph ///
GPH/SAPCs_`ii´.gph ///
, graphregion(color(white)) cols(2) altshrink xsize(6)
}
}
graph combine ///
GPH/APCo_can_F2.gph ///
```

Figure 5.3: Average 5-year percent change in mortality rate and mortality rate ratio (MRR) by country. Overall (top) and by sex (bottom). Chronic lower respiratory disease.




```
GPH/APCo_cvd_F2.gph ///
GPH/APCo_dmd_F2.gph ///
GPH/APCo_res_F2.gph ///
GPH/APCo_azd_F2.gph ///
GPH/APCo_inf_F2.gph ///
GPH/APCo_flu_F2.gph ///
GPH/APCo_ckd_F2.gph ///
GPH/APCo_liv_F2.gph ///
, graphregion(color(white)) cols(3) altshrink xsize(7)
graph export "/home/jimb0w/Documents/CM/Figure_2.pdf", as(pdf) name("Graph") replace
graph combine ///
GPH/SAPCo_can_F3.gph ///
GPH/SAPCo_cvd_F3.gph ///
GPH/SAPCo_res_F3.gph ///
GPH/SAPCo_azd_F3.gph ///
GPH/SAPCo_inf_F3.gph ///
GPH/SAPCo_flu_F3.gph ///
GPH/SAPCo_ckd_F3.gph ///
GPH/SAPCo_liv_F3.gph ///
, graphregion(color(white)) cols(2) altshrink xsize(3)
graph export "/home/jimb0w/Documents/CM/Figure_3.pdf", as(pdf) name("Graph") replace
```

Figure 5.4: Average 5-year percent change in mortality rate and mortality rate ratio (MRR) by country. Overall (top) and by sex (bottom). Dementia.

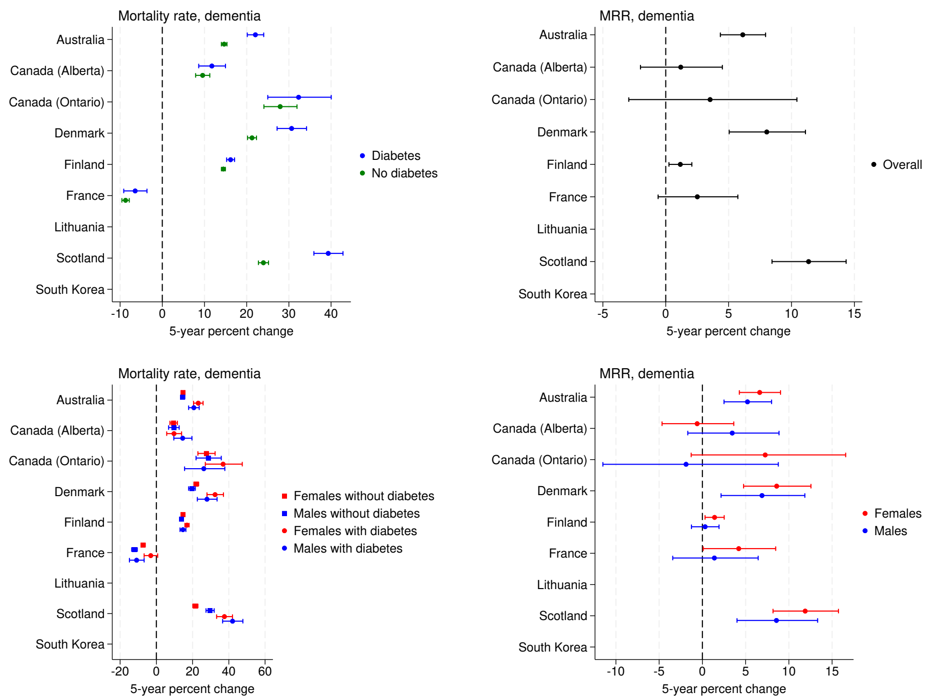
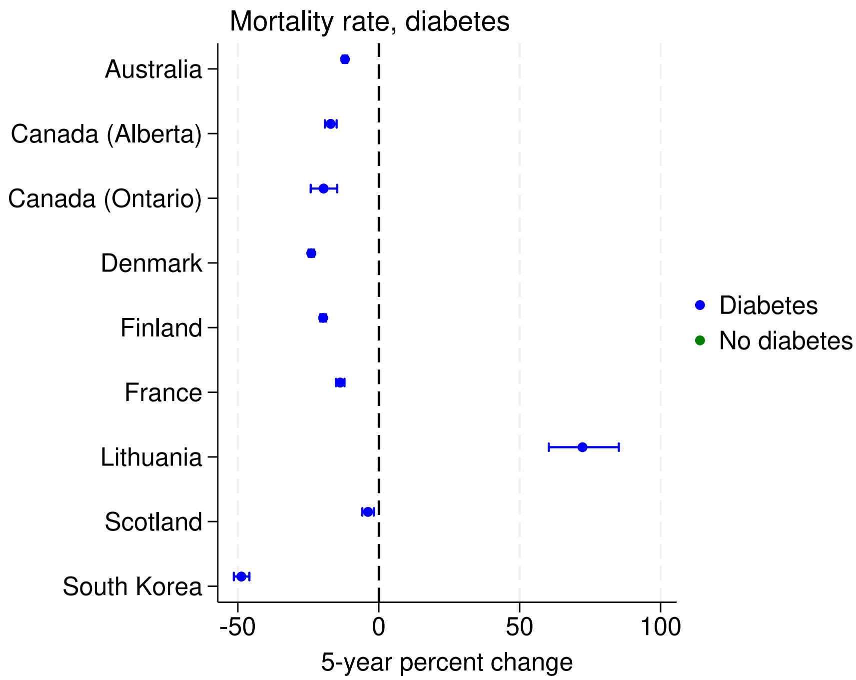


Figure 5.5: Average 5-year percent change in mortality rate by country. Overall (top) and by sex (bottom). Diabetes.



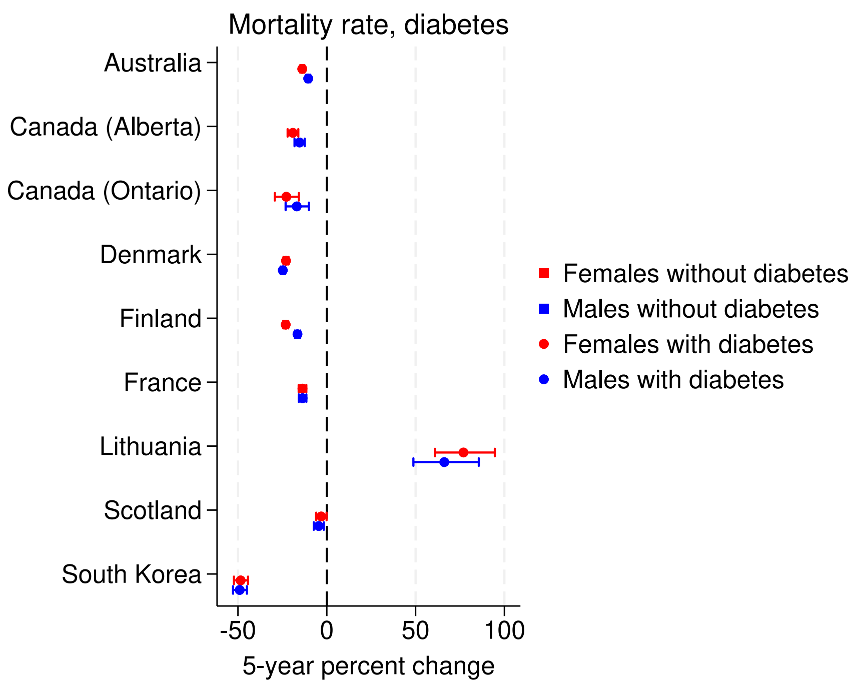


Figure 5.6: Average 5-year percent change in mortality rate and mortality rate ratio (MRR) by country. Overall (top) and by sex (bottom). Infectious diseases.

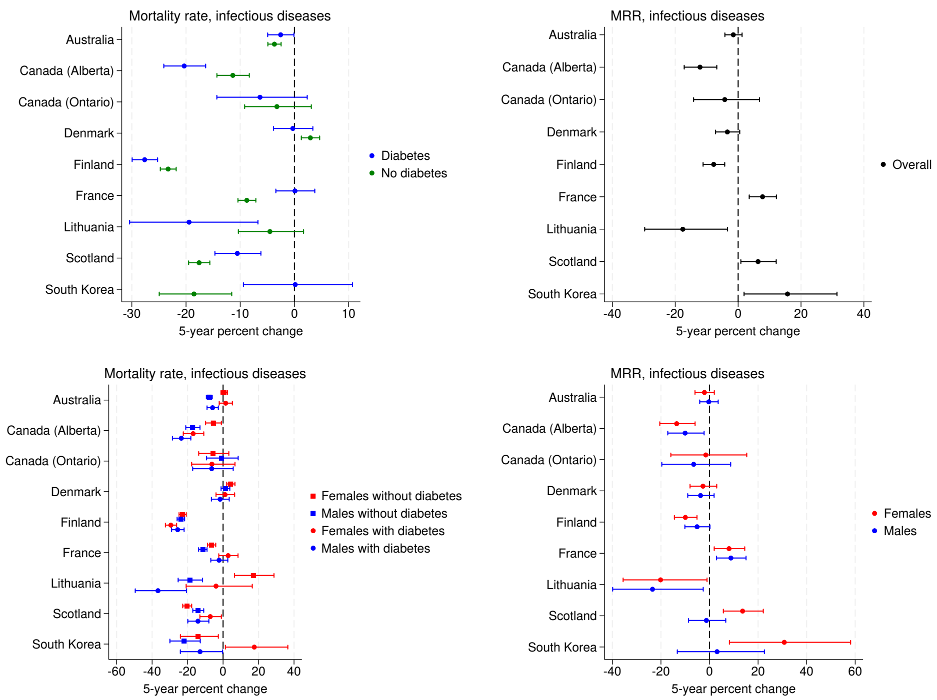


Figure 5.7: Average 5-year percent change in mortality rate and mortality rate ratio (MRR) by country. Overall (top) and by sex (bottom). Influenza and pneumonia.

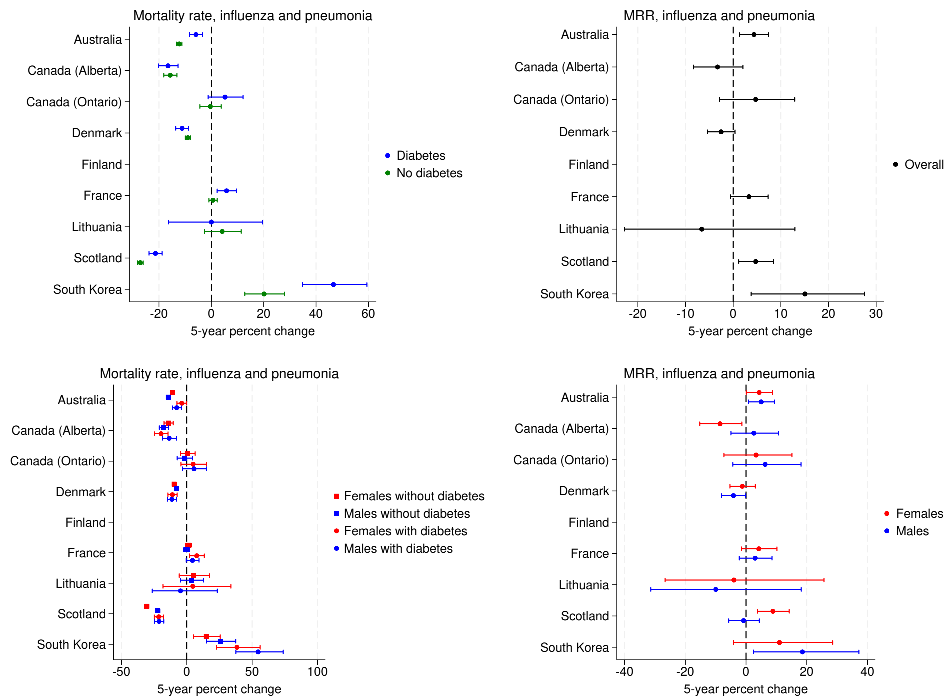


Figure 5.8: Average 5-year percent change in mortality rate and mortality rate ratio (MRR) by country. Overall (top) and by sex (bottom). Kidney disease.

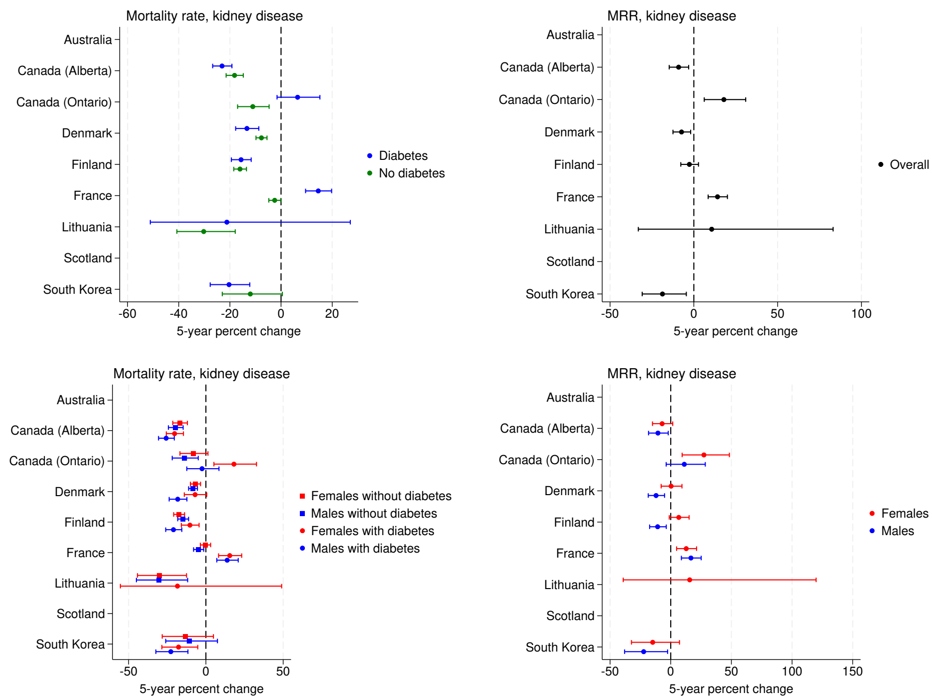


Figure 5.9: Average 5-year percent change in mortality rate and mortality rate ratio (MRR) by country. Overall (top) and by sex (bottom). Liver disease.

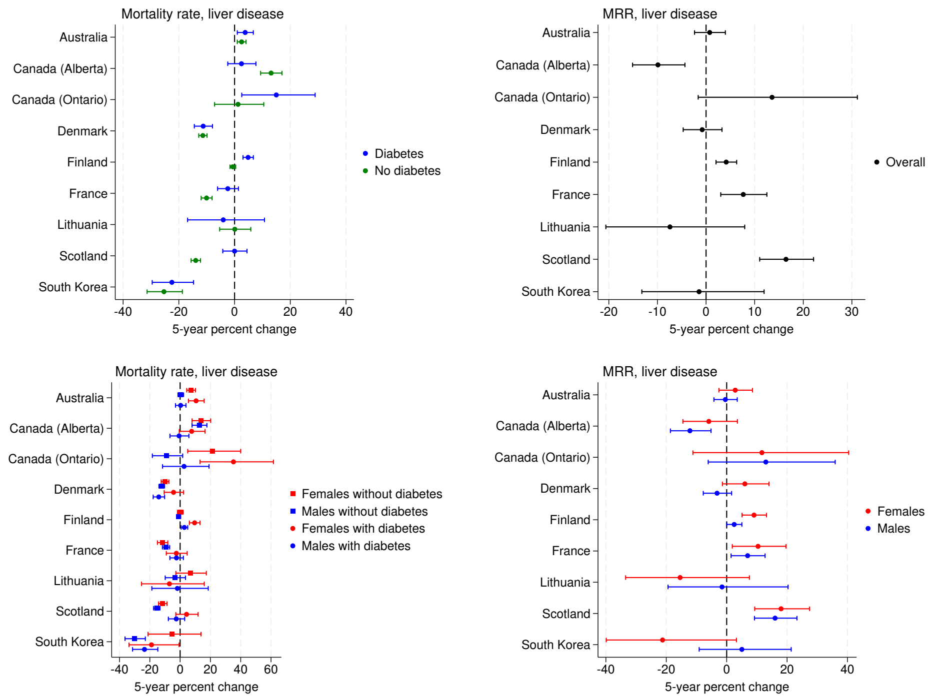


Figure 5.10: Average 5-year percent change in mortality rate by country.

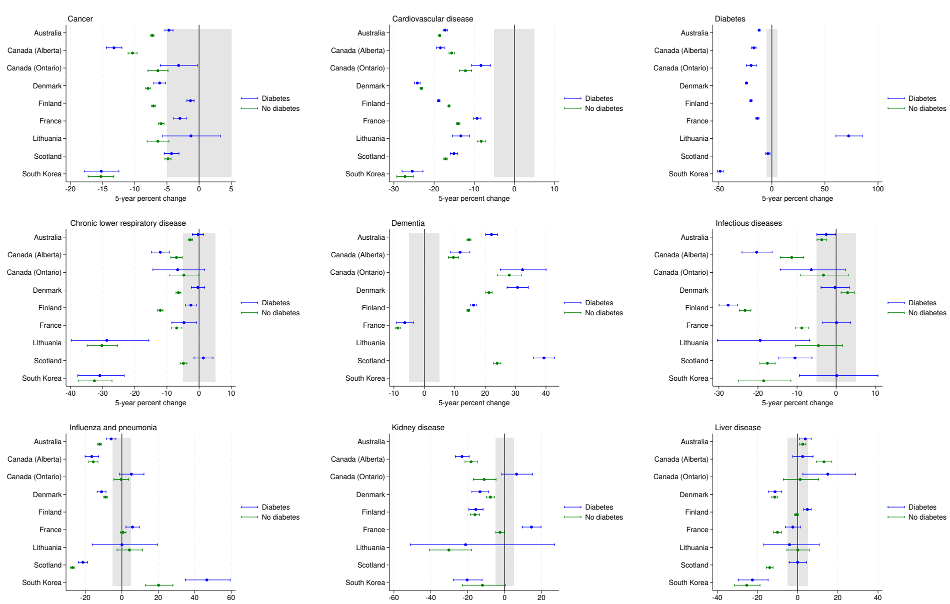


Figure 5.11: Average 5-year percent change in mortality rate ratio (MRR) by country.

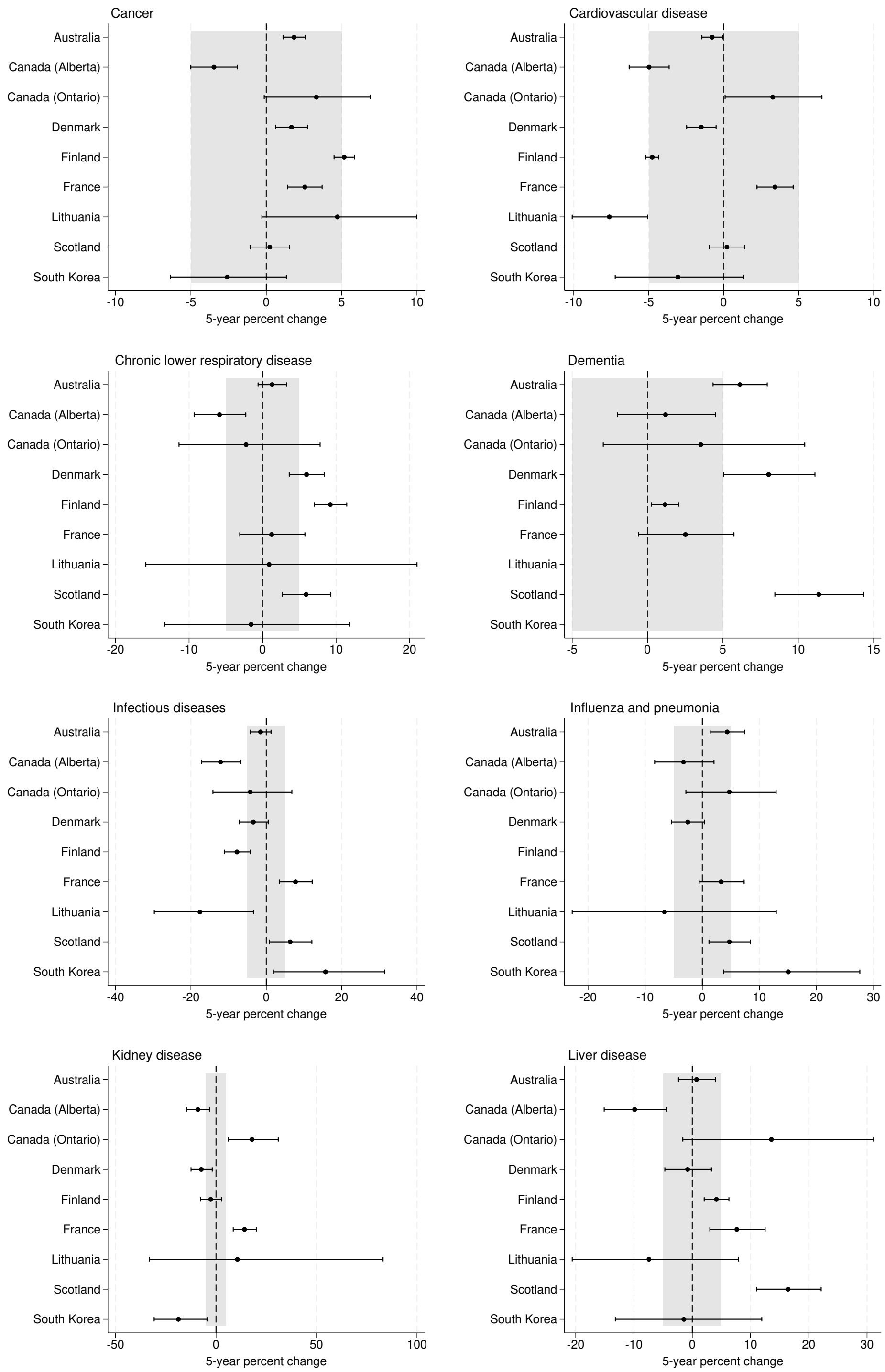


Table 5.1: Average 5-year percent change in mortality rates and mortality rate ratios, by country and sex. Cancer.

Country	Sex	Mortality rate in people with diabetes	Mortality rate in people without diabetes	Mortality rate ratio for people with vs. without diabetes
Australia	Females	-2.18 (-3.22, -1.12)	-5.41 (-5.81, -5.01)	2.76 (1.58, 3.96)
	Males	-6.20 (-6.99, -5.41)	-8.76 (-9.11, -8.41)	1.65 (0.71, 2.59)
	Overall	-4.69 (-5.32, -4.05)	-7.27 (-7.54, -7.01)	1.85 (1.11, 2.58)
Canada (Alberta)	Females	-12.56 (-14.45, -10.64)	-8.32 (-9.35, -7.28)	-4.83 (-7.14, -2.47)
	Males	-13.70 (-15.26, -12.11)	-12.25 (-13.21, -11.27)	-2.09 (-4.16, 0.01)
	Overall	-13.23 (-14.44, -12.01)	-10.35 (-11.05, -9.64)	-3.47 (-5.01, -1.91)
Canada (Ontario)	Females	-4.66 (-8.93, -0.20)	-4.31 (-6.55, -2.01)	-0.50 (-5.50, 4.76)
	Males	-2.10 (-5.84, 1.79)	-8.47 (-10.62, -6.27)	6.59 (1.84, 11.57)
	Overall	-3.18 (-6.01, -0.27)	-6.41 (-7.96, -4.83)	3.32 (-0.14, 6.90)
Denmark	Females	-4.15 (-5.60, -2.67)	-7.10 (-7.61, -6.59)	3.31 (1.65, 5.00)
	Males	-7.52 (-8.70, -6.32)	-8.78 (-9.27, -8.28)	0.36 (-1.03, 1.76)
	Overall	-6.13 (-7.05, -5.20)	-7.95 (-8.31, -7.60)	1.68 (0.61, 2.75)
Finland	Females	0.84 (0.00, 1.69)	-5.29 (-5.71, -4.86)	5.99 (4.99, 7.00)
	Males	-3.15 (-3.89, -2.40)	-8.75 (-9.14, -8.35)	4.46 (3.55, 5.38)
	Overall	-1.34 (-1.89, -0.78)	-7.09 (-7.38, -6.80)	5.17 (4.50, 5.85)
France	Females	0.79 (-0.92, 2.54)	-1.18 (-1.86, -0.50)	1.72 (-0.14, 3.61)
	Males	-4.94 (-6.13, -3.74)	-9.56 (-10.12, -9.00)	4.30 (2.85, 5.77)
	Overall	-2.98 (-3.96, -1.99)	-5.89 (-6.32, -5.45)	2.56 (1.42, 3.70)
Lithuania	Females	0.41 (-5.82, 7.06)	-3.04 (-5.67, -0.34)	2.60 (-4.31, 10.00)
	Males	-2.95 (-9.03, 3.54)	-8.92 (-11.09, -6.69)	6.37 (-0.73, 13.97)
	Overall	-1.26 (-5.66, 3.34)	-6.40 (-8.08, -4.69)	4.72 (-0.29, 9.98)
South Korea	Females	-11.37 (-15.89, -6.61)	-14.03 (-17.27, -10.67)	0.51 (-5.75, 7.18)
	Males	-17.41 (-20.65, -14.03)	-16.05 (-18.54, -13.49)	-4.45 (-9.10, 0.43)
	Overall	-15.21 (-17.87, -12.47)	-15.29 (-17.27, -13.26)	-2.58 (-6.34, 1.33)
Scotland	Females	-1.31 (-3.10, 0.52)	-3.58 (-4.27, -2.89)	2.06 (0.07, 4.08)
	Males	-6.48 (-7.96, -4.98)	-6.06 (-6.73, -5.39)	-0.66 (-2.38, 1.08)
	Overall	-4.28 (-5.43, -3.12)	-4.84 (-5.32, -4.35)	0.24 (-1.06, 1.55)

Table 5.2: Average 5-year percent change in mortality rates and mortality rate ratios, by country and sex. Cardiovascular disease.

Country	Sex	Mortality rate in people with diabetes	Mortality rate in people without diabetes	Mortality rate ratio for people with vs. without diabetes
Australia	Females	-17.70 (-18.48, -16.91)	-18.81 (-19.12, -18.49)	-1.30 (-2.31, -0.28)
	Males	-16.85 (-17.55, -16.14)	-18.39 (-18.73, -18.05)	-0.49 (-1.43, 0.45)
	Overall	-17.22 (-17.75, -16.70)	-18.61 (-18.84, -18.38)	-0.77 (-1.45, -0.08)
Canada (Alberta)	Females	-18.28 (-19.70, -16.84)	-15.58 (-16.52, -14.64)	-5.02 (-6.97, -3.03)
	Males	-18.54 (-19.79, -17.27)	-15.67 (-16.62, -14.72)	-4.86 (-6.66, -3.02)
	Overall	-18.43 (-19.37, -17.48)	-15.63 (-16.29, -14.96)	-4.98 (-6.30, -3.64)
Canada (Ontario)	Females	-5.86 (-9.45, -2.13)	-13.22 (-15.32, -11.07)	7.64 (2.81, 12.70)
	Males	-10.25 (-13.31, -7.08)	-11.07 (-13.29, -8.80)	-0.15 (-4.34, 4.23)
	Overall	-8.33 (-10.67, -5.93)	-12.19 (-13.72, -10.63)	3.27 (0.09, 6.55)
Denmark	Females	-24.47 (-25.50, -23.43)	-22.93 (-23.36, -22.50)	-1.65 (-3.09, -0.19)
	Males	-23.91 (-24.84, -22.97)	-23.44 (-23.88, -23.00)	-1.48 (-2.81, -0.14)
	Overall	-24.17 (-24.86, -23.47)	-23.18 (-23.49, -22.87)	-1.49 (-2.47, -0.51)
Finland	Females	-19.29 (-19.71, -18.87)	-16.59 (-16.88, -16.30)	-4.59 (-5.18, -3.99)
	Males	-18.37 (-18.81, -17.93)	-15.98 (-16.28, -15.68)	-4.64 (-5.25, -4.02)
	Overall	-18.85 (-19.15, -18.54)	-16.30 (-16.51, -16.09)	-4.76 (-5.19, -4.34)
France	Females	-9.99 (-11.39, -8.57)	-13.62 (-14.20, -13.03)	2.21 (0.48, 3.97)
	Males	-8.73 (-10.01, -7.42)	-14.51 (-15.16, -13.86)	4.88 (3.21, 6.59)
	Overall	-9.30 (-10.25, -8.34)	-14.01 (-14.45, -13.58)	3.42 (2.22, 4.63)
Lithuania	Females	-12.24 (-14.98, -9.41)	-9.54 (-10.85, -8.20)	-6.20 (-9.42, -2.87)
	Males	-15.04 (-18.38, -11.56)	-6.52 (-8.09, -4.92)	-10.49 (-14.30, -6.51)
	Overall	-13.33 (-15.46, -11.14)	-8.25 (-9.27, -7.23)	-7.62 (-10.10, -5.07)
South Korea	Females	-26.75 (-30.21, -23.12)	-29.48 (-32.23, -26.62)	-2.81 (-8.54, 3.28)
	Males	-23.95 (-27.70, -20.01)	-24.81 (-27.81, -21.69)	-3.13 (-9.15, 3.29)
	Overall	-25.42 (-27.99, -22.77)	-27.24 (-29.28, -25.15)	-3.05 (-7.24, 1.32)
Scotland	Females	-16.08 (-17.39, -14.75)	-18.95 (-19.53, -18.37)	0.99 (-0.74, 2.75)
	Males	-14.22 (-15.43, -12.99)	-15.19 (-15.82, -14.55)	-0.39 (-1.98, 1.22)
	Overall	-15.06 (-15.96, -14.16)	-17.16 (-17.59, -16.73)	0.22 (-0.95, 1.40)

Table 5.3: Average 5-year percent change in mortality rates and mortality rate ratios, by country and sex. Chronic lower respiratory disease.

Country	Sex	Mortality rate in people with diabetes	Mortality rate in people without diabetes	Mortality rate ratio for people with vs. without diabetes
Australia	Females	5.61 (2.80, 8.49)	2.51 (1.47, 3.56)	1.79 (-1.10, 4.76)
	Males	-4.76 (-7.00, -2.48)	-7.30 (-8.21, -6.39)	2.00 (-0.57, 4.65)
	Overall	-0.32 (-2.09, 1.47)	-2.70 (-3.39, -2.01)	1.30 (-0.61, 3.26)
Canada (Alberta)	Females	-5.44 (-9.92, -0.73)	-4.54 (-7.10, -1.90)	-1.21 (-6.56, 4.44)
	Males	-16.95 (-20.43, -13.32)	-9.41 (-11.81, -6.95)	-8.76 (-13.25, -4.04)
	Overall	-12.06 (-14.84, -9.19)	-7.04 (-8.79, -5.24)	-5.86 (-9.31, -2.28)
Canada (Ontario)	Females	-4.26 (-15.64, 8.65)	1.76 (-4.63, 8.56)	-6.12 (-18.56, 8.21)
	Males	-8.69 (-18.78, 2.67)	-11.52 (-17.38, -5.24)	2.92 (-10.14, 17.88)
	Overall	-6.67 (-14.36, 1.71)	-4.73 (-9.11, -0.14)	-2.24 (-11.37, 7.82)
Denmark	Females	5.61 (2.49, 8.82)	-3.87 (-4.93, -2.81)	10.08 (6.63, 13.65)
	Males	-5.96 (-8.70, -3.14)	-9.37 (-10.45, -8.27)	3.01 (-0.22, 6.34)
	Overall	-0.36 (-2.43, 1.76)	-6.43 (-7.18, -5.66)	5.98 (3.62, 8.39)
Finland	Females	10.30 (6.94, 13.75)	-3.29 (-4.84, -1.72)	13.21 (9.34, 17.21)
	Males	-8.89 (-10.88, -6.85)	-16.26 (-17.23, -15.29)	7.53 (4.89, 10.24)
	Overall	-2.54 (-4.28, -0.77)	-12.07 (-12.89, -11.24)	9.22 (7.04, 11.45)
France	Females	1.57 (-5.10, 8.70)	-1.07 (-3.67, 1.59)	1.39 (-5.73, 9.06)
	Males	-7.93 (-12.41, -3.22)	-11.16 (-13.18, -9.09)	2.66 (-2.83, 8.45)
	Overall	-4.70 (-8.46, -0.79)	-6.97 (-8.57, -5.34)	1.23 (-3.11, 5.76)
Lithuania	Females	-33.16 (-48.79, -12.76)	-26.96 (-35.83, -16.85)	-10.67 (-33.55, 20.09)
	Males	-25.56 (-40.17, -7.38)	-31.47 (-36.73, -25.77)	8.04 (-14.37, 36.31)
	Overall	-28.72 (-39.80, -15.61)	-30.26 (-34.84, -25.35)	0.89 (-15.89, 21.00)
South Korea	Females	-30.70 (-41.94, -17.27)	-37.61 (-45.41, -28.69)	6.29 (-14.10, 31.53)
	Males	-31.00 (-39.36, -21.49)	-29.75 (-36.21, -22.63)	-5.29 (-19.23, 11.05)
	Overall	-30.90 (-37.74, -23.30)	-32.57 (-37.64, -27.09)	-1.55 (-13.33, 11.82)
Scotland	Females	5.72 (1.51, 10.10)	-1.25 (-2.72, 0.25)	6.47 (1.97, 11.18)
	Males	-3.21 (-7.19, 0.95)	-9.15 (-10.65, -7.61)	6.77 (2.06, 11.70)
	Overall	1.33 (-1.59, 4.33)	-4.85 (-5.91, -3.78)	5.93 (2.67, 9.28)

Table 5.4: Average 5-year percent change in mortality rates and mortality rate ratios, by country and sex. Dementia.

Country	Sex	Mortality rate in people with diabetes	Mortality rate in people without diabetes	Mortality rate ratio for people with vs. without diabetes
Australia	Females	23.13 (20.54, 25.78)	14.73 (13.92, 15.54)	6.63 (4.27, 9.03)
	Males	20.70 (17.81, 23.66)	14.53 (13.38, 15.70)	5.22 (2.50, 8.00)
	Overall	22.07 (20.13, 24.03)	14.66 (14.00, 15.33)	6.13 (4.34, 7.94)
Canada (Alberta)	Females	9.74 (5.71, 13.93)	9.52 (7.49, 11.59)	-0.61 (-4.67, 3.63)
	Males	14.52 (9.63, 19.63)	9.63 (6.75, 12.59)	3.45 (-1.69, 8.86)
	Overall	11.76 (8.63, 14.98)	9.56 (7.90, 11.25)	1.19 (-2.01, 4.50)
Canada (Ontario)	Females	36.84 (27.03, 47.41)	27.59 (22.93, 32.43)	7.27 (-1.29, 16.57)
	Males	26.20 (15.58, 37.80)	28.68 (21.90, 35.83)	-1.89 (-11.51, 8.78)
	Overall	32.30 (25.00, 40.04)	27.94 (24.08, 31.92)	3.53 (-2.94, 10.43)
Denmark	Females	32.41 (27.94, 37.03)	22.03 (20.75, 23.32)	8.59 (4.76, 12.55)
	Males	27.95 (22.62, 33.53)	19.65 (17.82, 21.50)	6.89 (2.16, 11.85)
	Overall	30.65 (27.21, 34.19)	21.26 (20.21, 22.32)	8.03 (5.04, 11.11)
Finland	Females	16.92 (15.77, 18.07)	14.74 (14.18, 15.30)	1.41 (0.31, 2.52)
	Males	14.67 (13.06, 16.30)	13.88 (13.04, 14.72)	0.32 (-1.27, 1.92)
	Overall	16.18 (15.25, 17.12)	14.48 (14.01, 14.95)	1.16 (0.25, 2.07)
France	Females	-3.08 (-6.75, 0.73)	-7.24 (-8.29, -6.17)	4.20 (0.10, 8.48)
	Males	-10.90 (-14.86, -6.75)	-12.09 (-13.62, -10.54)	1.39 (-3.43, 6.45)
	Overall	-6.43 (-9.14, -3.64)	-8.71 (-9.58, -7.83)	2.51 (-0.61, 5.73)
Lithuania	Females			
	Males			
	Overall			
South Korea	Females			
	Males			
	Overall			
Scotland	Females	37.57 (33.26, 42.03)	21.52 (20.12, 22.94)	11.89 (8.17, 15.73)
	Males	42.05 (36.56, 47.75)	29.65 (27.41, 31.92)	8.56 (4.00, 13.32)
	Overall	39.33 (35.93, 42.83)	23.97 (22.78, 25.18)	11.36 (8.45, 14.34)

Table 5.5: Average 5-year percent change in mortality rates, by country and sex. Diabetes.

Country	Sex	Mortality rate in people with diabetes
Australia	Females	-13.80 (-15.01, -12.57)
	Males	-10.45 (-11.62, -9.27)
	Overall	-12.00 (-12.85, -11.15)
Canada (Alberta)	Females	-19.09 (-22.05, -16.03)
	Males	-15.33 (-18.16, -12.41)
	Overall	-17.06 (-19.12, -14.95)
Canada (Ontario)	Females	-22.78 (-29.24, -15.73)
	Males	-16.89 (-23.19, -10.07)
	Overall	-19.59 (-24.16, -14.74)
Denmark	Females	-22.95 (-24.39, -21.48)
	Males	-24.75 (-26.01, -23.46)
	Overall	-23.95 (-24.90, -22.98)
Finland	Females	-23.12 (-24.51, -21.69)
	Males	-16.48 (-17.95, -14.99)
	Overall	-19.74 (-20.75, -18.71)
France	Females	-13.70 (-15.82, -11.53)
	Males	-13.65 (-15.75, -11.50)
	Overall	-13.68 (-15.17, -12.15)
Lithuania	Females	76.97 (60.93, 94.61)
	Males	66.16 (48.77, 85.60)
	Overall	72.31 (60.33, 85.19)
South Korea	Females	-48.47 (-52.28, -44.35)
	Males	-49.02 (-52.77, -44.98)
	Overall	-48.75 (-51.45, -45.90)
Scotland	Females	-3.10 (-6.00, -0.12)
	Males	-4.51 (-7.29, -1.64)
	Overall	-3.82 (-5.84, -1.77)

Table 5.6: Average 5-year percent change in mortality rates and mortality rate ratios, by country and sex. Infectious diseases.

Country	Sex	Mortality rate in people with diabetes	Mortality rate in people without diabetes	Mortality rate ratio for people with vs. without diabetes
Australia	Females	1.48 (-2.16, 5.26)	0.62 (-1.17, 2.45)	-2.08 (-5.98, 1.98)
	Males	-5.91 (-9.04, -2.68)	-7.76 (-9.39, -6.10)	-0.30 (-4.03, 3.57)
	Overall	-2.55 (-4.94, -0.10)	-3.69 (-4.90, -2.46)	-1.52 (-4.22, 1.25)
Canada (Alberta)	Females	-16.85 (-22.43, -10.88)	-5.51 (-9.87, -0.95)	-13.51 (-20.47, -5.94)
	Males	-23.53 (-28.53, -18.17)	-17.11 (-21.01, -13.01)	-10.02 (-17.18, -2.23)
	Overall	-20.33 (-24.10, -16.38)	-11.36 (-14.30, -8.33)	-12.12 (-17.16, -6.79)
Canada (Ontario)	Females	-6.29 (-17.72, 6.72)	-5.63 (-13.74, 3.25)	-1.53 (-15.93, 15.33)
	Males	-6.40 (-17.13, 5.71)	-0.79 (-9.30, 8.51)	-6.53 (-19.64, 8.72)
	Overall	-6.35 (-14.31, 2.35)	-3.23 (-9.19, 3.11)	-4.25 (-14.15, 6.80)
Denmark	Females	1.14 (-3.98, 6.53)	4.34 (2.04, 6.69)	-2.68 (-8.02, 2.97)
	Males	-1.67 (-6.55, 3.47)	1.31 (-1.13, 3.80)	-3.69 (-8.96, 1.89)
	Overall	-0.30 (-3.86, 3.40)	2.94 (1.26, 4.65)	-3.42 (-7.19, 0.50)
Finland	Females	-29.41 (-32.49, -26.19)	-22.81 (-24.81, -20.76)	-9.93 (-14.46, -5.16)
	Males	-25.58 (-29.02, -21.97)	-23.83 (-25.91, -21.69)	-5.11 (-10.14, 0.19)
	Overall	-27.63 (-29.94, -25.25)	-23.29 (-24.74, -21.82)	-7.77 (-11.15, -4.26)
France	Females	2.86 (-2.41, 8.43)	-6.46 (-8.74, -4.13)	8.05 (1.94, 14.52)
	Males	-2.24 (-6.92, 2.67)	-11.43 (-13.76, -9.03)	8.80 (2.90, 15.04)
	Overall	0.10 (-3.43, 3.75)	-8.78 (-10.42, -7.12)	7.77 (3.52, 12.18)
Lithuania	Females	-3.96 (-20.80, 16.47)	17.05 (6.45, 28.71)	-20.15 (-35.58, -1.02)
	Males	-36.69 (-49.50, -20.62)	-18.74 (-25.32, -11.58)	-23.47 (-39.88, -2.59)
	Overall	-19.43 (-30.41, -6.73)	-4.52 (-10.35, 1.68)	-17.60 (-29.72, -3.38)
South Korea	Females	17.61 (1.33, 36.52)	-14.01 (-24.03, -2.66)	30.80 (8.20, 58.12)
	Males	-12.98 (-24.07, -0.27)	-21.88 (-29.97, -12.85)	3.13 (-13.26, 22.61)
	Overall	0.15 (-9.41, 10.71)	-18.53 (-24.95, -11.57)	15.72 (1.88, 31.45)
Scotland	Females	-7.21 (-13.06, -0.96)	-20.26 (-22.75, -17.69)	13.63 (5.70, 22.15)
	Males	-14.14 (-19.87, -7.99)	-14.04 (-17.06, -10.91)	-1.27 (-8.64, 6.70)
	Overall	-10.53 (-14.67, -6.18)	-17.59 (-19.52, -15.61)	6.34 (0.86, 12.11)

Table 5.7: Average 5-year percent change in mortality rates and mortality rate ratios, by country and sex. Influenza and pneumonia.

Country	Sex	Mortality rate in people with diabetes	Mortality rate in people without diabetes	Mortality rate ratio for people with vs. without diabetes
Australia	Females	-3.82 (-7.50, 0.01)	-10.81 (-12.16, -9.44)	4.32 (0.06, 8.77)
	Males	-7.68 (-11.04, -4.19)	-14.17 (-15.67, -12.63)	5.01 (0.80, 9.39)
	Overall	-5.86 (-8.36, -3.30)	-12.26 (-13.26, -11.24)	4.37 (1.37, 7.45)
Canada (Alberta)	Females	-19.65 (-24.64, -14.34)	-13.97 (-17.40, -10.40)	-8.56 (-15.23, -1.37)
	Males	-13.44 (-18.71, -7.82)	-17.57 (-21.07, -13.91)	2.56 (-4.97, 10.67)
	Overall	-16.54 (-20.19, -12.71)	-15.67 (-18.14, -13.13)	-3.28 (-8.33, 2.05)
Canada (Ontario)	Females	4.87 (-4.45, 15.10)	0.66 (-4.76, 6.38)	3.32 (-7.28, 15.13)
	Males	5.57 (-3.19, 15.11)	-1.61 (-7.37, 4.51)	6.30 (-4.34, 18.12)
	Overall	5.24 (-1.22, 12.13)	-0.38 (-4.36, 3.76)	4.73 (-2.87, 12.93)
Denmark	Females	-10.97 (-14.41, -7.39)	-9.71 (-11.05, -8.35)	-1.22 (-5.29, 3.03)
	Males	-11.35 (-14.68, -7.90)	-8.04 (-9.54, -6.52)	-4.15 (-8.05, -0.09)
	Overall	-11.17 (-13.57, -8.70)	-8.96 (-9.96, -7.95)	-2.53 (-5.36, 0.39)
Finland	Females			
	Males			
	Overall			
France	Females	7.64 (2.21, 13.35)	1.34 (-0.77, 3.49)	4.21 (-1.45, 10.19)
	Males	4.35 (-0.44, 9.37)	-0.20 (-2.51, 2.16)	3.01 (-2.26, 8.56)
	Overall	5.83 (2.21, 9.57)	0.65 (-0.91, 2.23)	3.31 (-0.55, 7.33)
Lithuania	Females	4.62 (-18.18, 33.78)	5.22 (-5.81, 17.55)	-4.00 (-26.67, 25.69)
	Males	-4.78 (-26.46, 23.29)	3.52 (-4.89, 12.67)	-9.94 (-31.36, 18.16)
	Overall	0.05 (-16.27, 19.55)	4.14 (-2.63, 11.40)	-6.60 (-22.78, 12.95)
South Korea	Females	38.40 (22.72, 56.10)	14.81 (4.99, 25.55)	11.01 (-4.15, 28.57)
	Males	54.61 (37.59, 73.75)	25.73 (14.96, 37.51)	18.59 (2.50, 37.19)
	Overall	46.64 (34.87, 59.44)	20.16 (12.80, 28.01)	15.06 (3.76, 27.59)
Scotland	Females	-21.46 (-24.86, -17.91)	-30.44 (-31.77, -29.09)	8.85 (3.75, 14.20)
	Males	-21.21 (-24.72, -17.53)	-22.35 (-24.06, -20.59)	-0.80 (-5.68, 4.34)
	Overall	-21.34 (-23.80, -18.80)	-27.12 (-28.18, -26.05)	4.74 (1.17, 8.44)

Table 5.8: Average 5-year percent change in mortality rates and mortality rate ratios, by country and sex. Kidney disease.

Country	Sex	Mortality rate in people with diabetes	Mortality rate in people without diabetes	Mortality rate ratio for people with vs. without diabetes
Australia	Females			
	Males			
	Overall			
Canada (Alberta)	Females	-20.25 (-25.60, -14.51)	-16.83 (-21.43, -11.97)	-7.07 (-15.04, 1.65)
	Males	-25.70 (-30.62, -20.43)	-19.62 (-24.25, -14.70)	-10.53 (-18.27, -2.06)
	Overall	-23.05 (-26.72, -19.21)	-18.18 (-21.47, -14.75)	-9.07 (-14.68, -3.10)
Canada (Ontario)	Females	18.18 (5.21, 32.74)	-8.16 (-16.77, 1.35)	27.40 (9.40, 48.36)
	Males	-2.50 (-12.35, 8.47)	-13.77 (-21.76, -4.95)	11.21 (-3.74, 28.48)
	Overall	6.48 (-1.56, 15.18)	-11.04 (-16.99, -4.66)	17.92 (6.20, 30.94)
Denmark	Females	-6.98 (-13.96, 0.57)	-6.78 (-9.99, -3.45)	0.33 (-7.88, 9.27)
	Males	-18.21 (-23.75, -12.27)	-8.36 (-11.16, -5.46)	-12.06 (-18.52, -5.09)
	Overall	-13.34 (-17.74, -8.70)	-7.66 (-9.79, -5.49)	-7.32 (-12.45, -1.90)
Finland	Females	-10.32 (-15.88, -4.40)	-17.38 (-20.82, -13.79)	6.65 (-1.21, 15.14)
	Males	-20.96 (-25.98, -15.60)	-14.77 (-18.21, -11.20)	-10.78 (-17.37, -3.66)
	Overall	-15.62 (-19.41, -11.66)	-16.04 (-18.49, -13.53)	-2.65 (-7.78, 2.77)
France	Females	15.45 (8.21, 23.17)	-0.31 (-3.57, 3.06)	12.79 (4.87, 21.30)
	Males	13.78 (7.06, 20.93)	-4.74 (-7.95, -1.41)	16.66 (8.79, 25.10)
	Overall	14.56 (9.59, 19.76)	-2.48 (-4.78, -0.12)	14.15 (8.54, 20.05)
Lithuania	Females	-18.40 (-55.32, 49.03)	-30.16 (-44.24, -12.53)	15.64 (-39.16, 119.78)
	Males		-30.32 (-44.95, -11.79)	
	Overall	-21.17 (-51.10, 27.08)	-30.23 (-40.72, -17.90)	10.65 (-33.13, 83.10)
South Korea	Females	-17.67 (-28.46, -5.25)	-13.24 (-28.23, 4.88)	-14.83 (-32.35, 7.22)
	Males	-22.67 (-32.35, -11.61)	-10.80 (-25.97, 7.49)	-22.28 (-38.01, -2.58)
	Overall	-20.33 (-27.69, -12.23)	-12.01 (-22.96, 0.50)	-18.71 (-30.81, -4.48)
Scotland	Females			
	Males			
	Overall			

Table 5.9: Average 5-year percent change in mortality rates and mortality rate ratios, by country and sex. Liver disease.

Country	Sex	Mortality rate in people with diabetes	Mortality rate in people without diabetes	Mortality rate ratio for people with vs. without diabetes
Australia	Females	10.55 (5.49, 15.85)	7.22 (4.36, 10.17)	2.84 (-2.57, 8.55)
	Males	0.33 (-3.05, 3.83)	0.42 (-1.41, 2.28)	-0.43 (-4.22, 3.51)
	Overall	3.82 (0.99, 6.73)	2.53 (0.98, 4.10)	0.75 (-2.37, 3.97)
Canada (Alberta)	Females	7.60 (-0.58, 16.45)	13.84 (7.86, 20.15)	-5.90 (-14.50, 3.56)
	Males	-0.66 (-6.72, 5.78)	12.66 (7.86, 17.67)	-12.16 (-18.62, -5.18)
	Overall	2.49 (-2.44, 7.66)	13.12 (9.36, 17.02)	-9.89 (-15.12, -4.35)
Canada (Ontario)	Females	35.21 (13.13, 61.60)	21.25 (5.03, 39.97)	11.67 (-11.18, 40.40)
	Males	2.61 (-11.60, 19.10)	-8.87 (-18.34, 1.70)	12.97 (-6.11, 35.94)
	Overall	15.00 (2.58, 28.92)	1.27 (-7.18, 10.48)	13.58 (-1.62, 31.13)
Denmark	Females	-4.33 (-10.53, 2.31)	-10.00 (-12.50, -7.44)	6.03 (-1.40, 14.01)
	Males	-14.09 (-17.78, -10.23)	-12.14 (-13.96, -10.29)	-3.17 (-7.75, 1.63)
	Overall	-11.25 (-14.45, -7.93)	-11.39 (-12.86, -9.89)	-0.79 (-4.70, 3.28)
Finland	Females	9.56 (6.12, 13.13)	0.12 (-1.76, 2.03)	9.06 (5.09, 13.19)
	Males	2.81 (0.64, 5.02)	-0.93 (-2.13, 0.29)	2.50 (0.02, 5.03)
	Overall	4.86 (3.02, 6.74)	-0.62 (-1.64, 0.40)	4.15 (2.05, 6.29)
France	Females	-2.48 (-9.12, 4.64)	-11.63 (-14.98, -8.14)	10.40 (1.86, 19.64)
	Males	-2.39 (-6.75, 2.17)	-9.32 (-11.68, -6.90)	6.94 (1.46, 12.72)
	Overall	-2.42 (-6.09, 1.39)	-10.06 (-11.99, -8.08)	7.66 (3.02, 12.51)
Lithuania	Females	-7.05 (-25.48, 15.95)	6.77 (-2.80, 17.30)	-15.41 (-33.46, 7.53)
	Males	-1.81 (-18.67, 18.55)	-3.38 (-9.85, 3.56)	-1.54 (-19.43, 20.33)
	Overall	-4.05 (-16.86, 10.74)	0.08 (-5.35, 5.83)	-7.43 (-20.61, 7.95)
South Korea	Females	-18.90 (-33.74, -0.73)	-5.29 (-21.18, 13.79)	-21.22 (-39.88, 3.23)
	Males	-23.51 (-31.39, -14.73)	-29.98 (-36.38, -22.94)	5.04 (-9.10, 21.37)
	Overall	-22.50 (-29.57, -14.71)	-25.34 (-31.41, -18.73)	-1.43 (-13.21, 11.94)
Scotland	Females	4.24 (-2.83, 11.83)	-11.50 (-14.24, -8.67)	18.02 (9.28, 27.46)
	Males	-2.52 (-7.76, 3.01)	-15.42 (-17.50, -13.29)	16.03 (9.21, 23.27)
	Overall	0.02 (-4.24, 4.46)	-13.93 (-15.60, -12.23)	16.45 (11.03, 22.12)

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