

Danish Diabetes Register

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Background for a diabetes register

Population surveillance

- ▶ Monitor and describe:
 - ▶ Prevalence (no. and %)
 - ▶ Incidence (no. and rates)
 - ▶ Mortality and SMR

Health care surveillance

- ▶ Keep track of diabetes patients
- ▶ Predictions of likely future developments
- ▶ Match patients to treatment indicators (GPs)
- ▶ ... improve accuracy of treatment information

Results up to 31.12.2006 reported in:

Carstensen *et al.*: The Danish National Diabetes Register:

Trends in incidence, prevalence and mortality, Diabetologia, 2008.

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Danish Diabetes Register—how does it look?

Fictitious sample from a diabetes register

id	sex	doBth	doDth	doDM	doNDR	dpPod	doOAD	doIns	inc
OC25D	W	09NOV1935	.	12OCT2009	.	.	12OCT2009	.	oad
OCEC1	M	11SEP1919	22MAY1992	19APR1990	19APR1990	.	.	.	lpr
OCCE3	M	18MAR1936	.	01JUN2001	06JUN2007	23MAY2007	01JUN2001	.	oad
OC619	M	03JUL1944	.	09JAN2003	.	.	09JAN2003	.	oad
OC42	W	29MAR1941	.	01OCT2009	01OCT2009	.	22OCT2009	.	lpr
OC42B	M	01JUN1949	.	06OCT2005	.	.	06OCT2005	.	oad
OCBE4	M	15AUG1962	.	29SEP2009	.	.	29SEP2009	.	oad
OC2ED	W	02APR1949	.	08SEP2007	21JAN2009	19MAR2008	08SEP2007	.	oad
OC5FA	W	08OCT1901	20DEC1993	08AUG1992	08AUG1992	.	.	.	lpr
OCFB0	W	19APR1913	29AUG1992	23JAN1991	.	23JAN1991	.	.	pod
OC976	W	09MAR1913	20MAY1999	03APR1998	.	.	03APR1998	.	oad
OCB64	M	15APR1947	.	24APR2001	21MAY2001	.	24APR2001	.	oad
OCEE1	W	12DEC1940	.	16JUL2002	16JUL2002	.	13JAN2006	17JAN2006	lpr
OCB84	M	31DEC1916	28JUN1991	24MAY1991	24MAY1991	.	.	.	lpr
OCF20	W	21JUN1919	15NOV1993	16FEB1992	16FEB1992	20JAN1993	.	.	lpr
OCCB3	W	31DEC1944	.	05OCT1993	05OCT1993	21APR2004	05NOV1994	.	lpr
OC52A	W	16MAY1965	.	23NOV2005	22MAY2006	.	23NOV2005	.	oad
OC758	M	26JAN1932	.	05MAR2008	.	21MAY2008	05MAR2008	.	oad
OCBB4	M	16JUN1932	24APR2006	25FEB1998	25FEB1998	18NOV1998	03MAR2000	30JUL2002	lpr
OCA85	M	05MAR1957	.	27AUG2004	27AUG2004	.	11SEP2004	.	lpr

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Danish Diabetes Registers—short history

- ▶ **NDR** — established 2006, last year of update 2012
no T1D/T2D distinction
- ▶ **RUKS** — Started 2015, initially not available for linkage
has T1D/T2D distinction, based **only** on NPR & RMPS
- ▶ **DMreg** — established 2018 by SDCC Clinical Epidemiology
using Statistics Denmark, has T1D/T2D distinction, based on
DADD, NPR, NHSR, DiaBase & RMPS.
Covers **1996–2016** incl.

DADD: Danish Adult Diabetes Database - quality register updated annually
NPR: Nation Patient Register
NHSR: National Health Services Register
RMPS: Register of Medicinal Products Statistics - Prescription register
DiaBase: Quality database for eye-screening of diabetes patients

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Danish Diabetes Register — sources

A side effect of a project at Statistics Denmark (DST), available
inside the project at DST — Clinical Epidemiology at SDCC

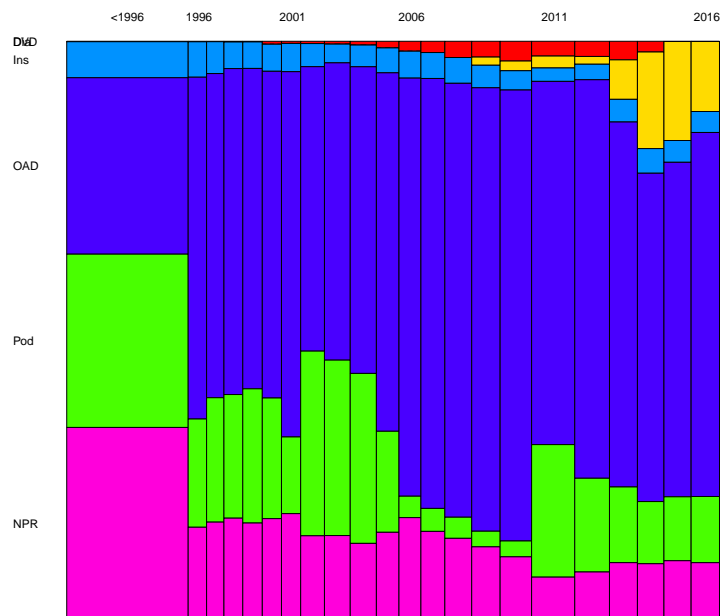
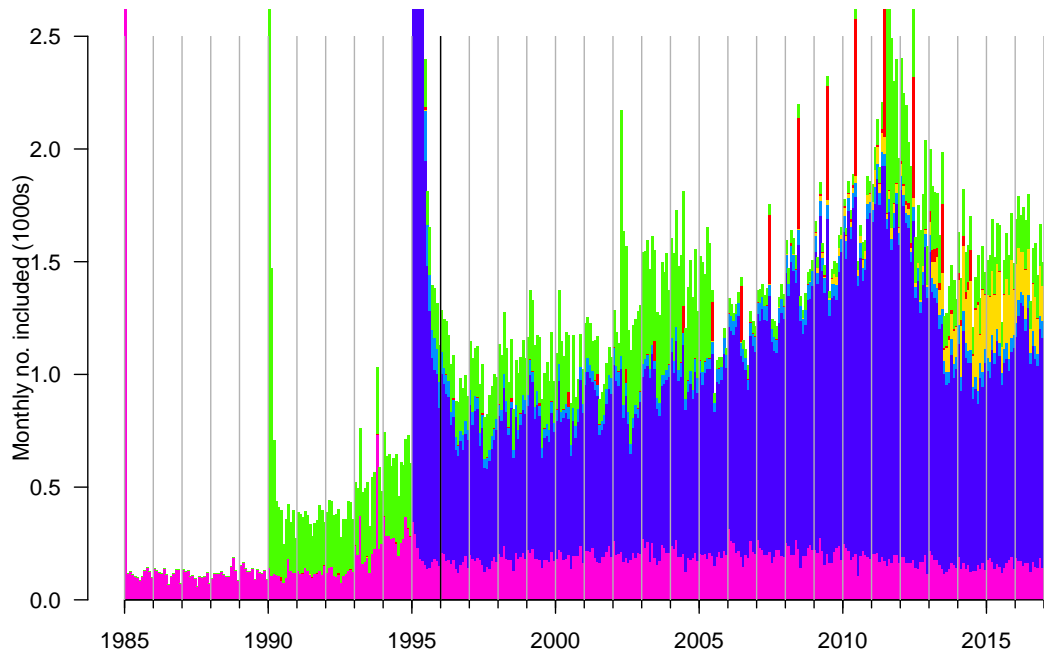
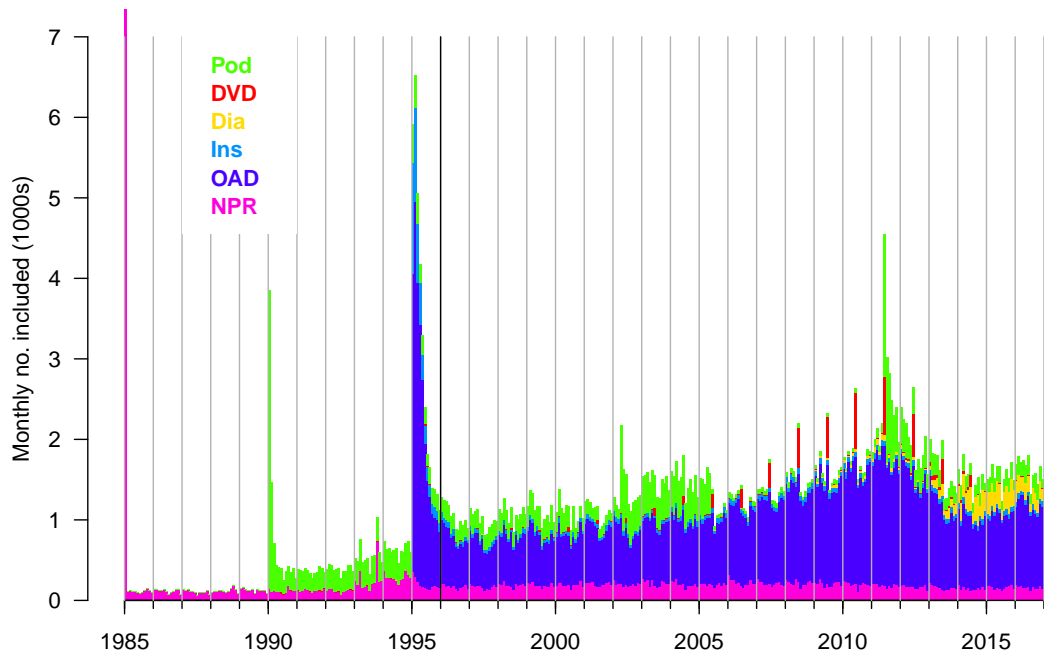
- ▶ NPR, National Patient Register
- ▶ RMPS, Register of Medicinal Product Statistics (prescription
reg.)
- ▶ NHSR, National Health Services Register
- ▶ DADD, Danish Adult Diabetes Database
— annual clinical status since 2005
— complete for T1D, not for T2D
- ▶ diaBase, Eye-screening database for diabetes patients
- ▶ Inclusion data is the first occurrence in any of these as a
diabetes patient

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Reconstructed Diabetes Register

- ▶ No blood glucose criteria used
- ▶ Podiatry (foot therapy) for DM patients (NHSR)
- ▶ GDM window –30 to 365 days
- ▶ PCOS: –30 days from NPR diagnosis or only metformin in the
age-range 20–40 years — excluded
- ▶ T1/T2 classification:
 - ▶ Based on DVDD (Danish Adult Diabetes Database)
 - ▶ Subsequently on NPR
 - ▶ Any OAD before age 15 → T1D
 - ▶ Any insulin before age 30 → T1D
 - ▶ Non-classifiable coded as T2D

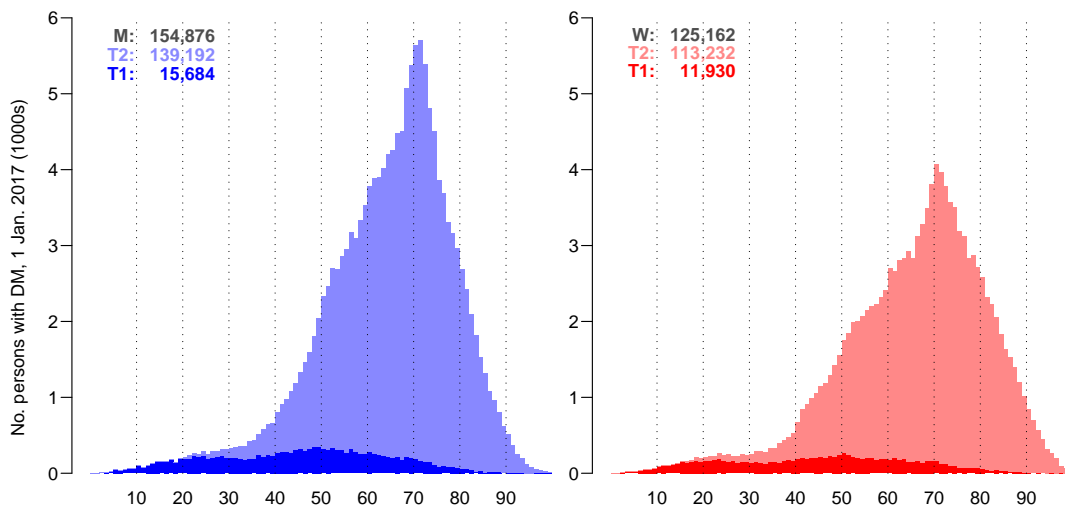
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Number of diabetes patients 2017-01-01



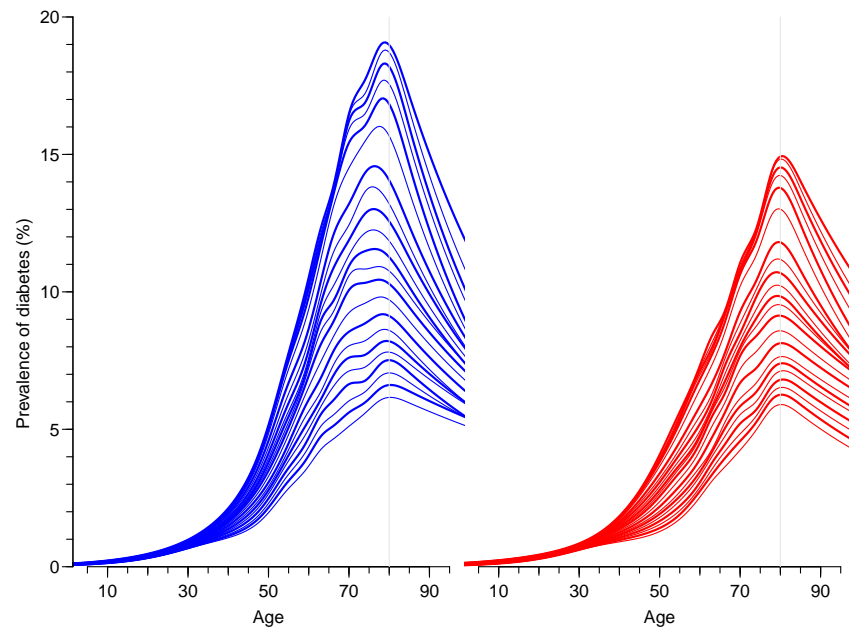
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Prevalence: Methods

- ▶ Prevalent cases by 1 Jan 1995, . . . , 2017 tabulated by sex and 1-year age.
- ▶ Corresponding population figures from Statistics Denmark.
- ▶ Prevalence analysed by a binomial model with log-link and the population size as denominator.
- ▶ Separate parametric terms used for each sex and date.
- ▶ One age-specific prevalence curve for each sex and year.

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Age-specific prevalences of DM according to the reconstructed register.



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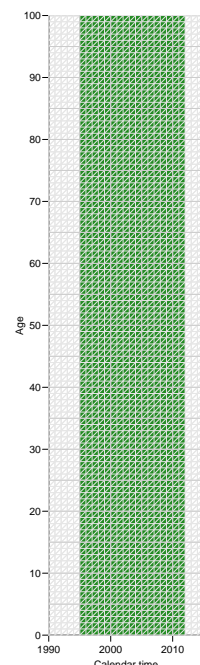
Incidence: New cases included

Period	T1D		T2D		All DM		
	M	W	M	W	M	W	M+W
1996	725	527	6,269	5,345	6,994	5,872	12,866
1997	649	528	6,192	5,264	6,841	5,792	12,633
1998	714	503	7,019	5,844	7,733	6,347	14,080
1999	654	451	7,415	6,203	8,069	6,654	14,723
2000	692	479	8,450	7,005	9,142	7,484	16,626
2001	655	455	7,391	6,090	8,046	6,545	14,591
2002	621	423	8,410	7,474	9,031	7,897	16,928
2003	588	412	9,468	8,140	10,056	8,552	18,608
2004	583	453	9,782	8,288	10,365	8,741	19,106
2005	585	427	9,163	7,621	9,748	8,048	17,796
2006	584	440	9,050	7,193	9,634	7,633	17,267
2007	585	450	9,636	7,966	10,221	8,416	18,637
2008	603	438	10,831	8,792	11,434	9,230	20,664
2009	596	392	10,962	8,509	11,558	8,901	20,459
2010	587	405	11,876	9,333	12,463	9,738	22,201
2011	537	401	13,363	11,084	13,900	11,485	25,385
2012	517	347	10,981	9,013	11,498	9,360	20,858
2013	495	398	8,650	6,829	9,145	7,227	16,372
2014	495	398	8,637	6,443	9,132	6,841	15,973
2015	520	406	9,569	7,354	10,089	7,760	17,849
2016	518	363	10,404	7,819	10,922	8,182	19,104
Sum	12,503	9,096	193,518	157,609	206,021	166,705	372,726

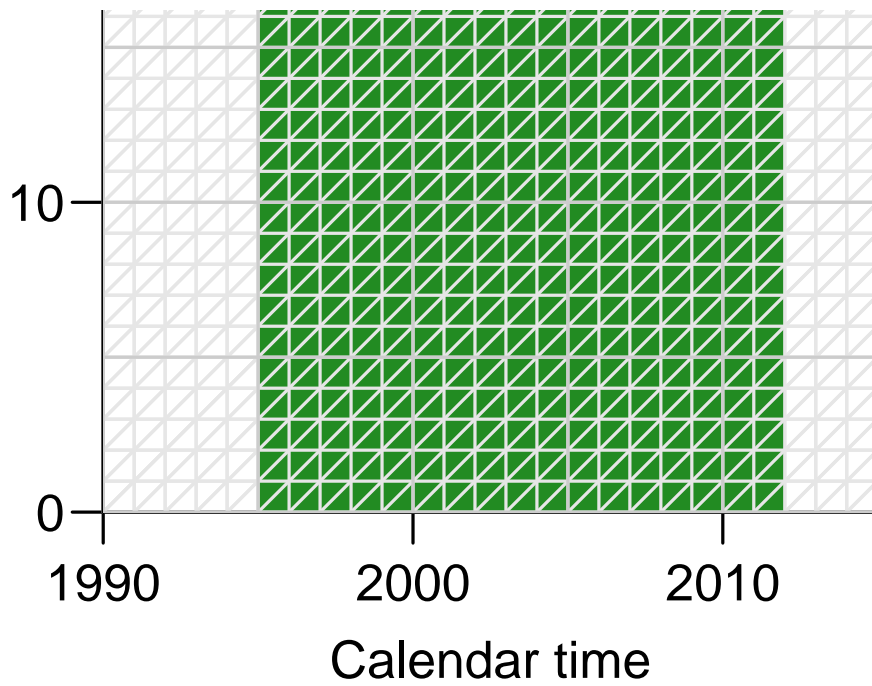
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Incidence: Methods

- ▶ New cases tabulated by age and date of diagnosis (1996-2016) and date of birth, in 1-year classes.
- ▶ Corresponding person-years figures from Statistics Denmark — person-years in the diabetes register subtracted.
- ▶ Incidence rates analysed by Poisson-regression with smooth parametric terms in age and date of diagnosis and date of birth, using log-person-years as offset.



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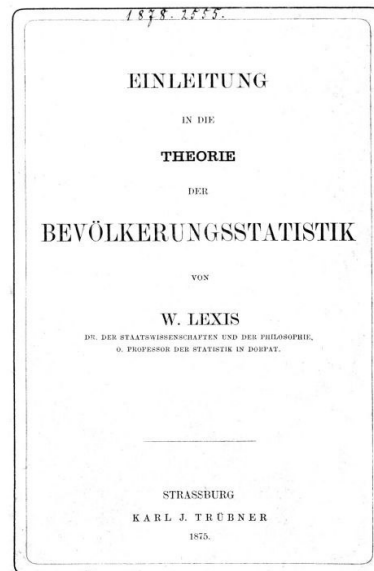


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Digression: Lexis diagram



Wilhelm Lexis (1837–1914)
German demographer, statistician and economist.

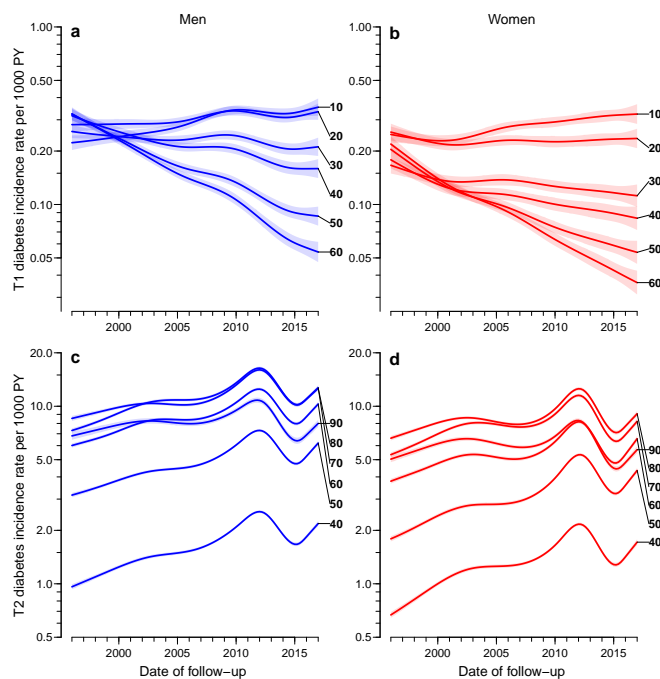


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Incidence rates in different ages.

Note the different *y*-axes for T1D and T2D.

T2D is 10 times more common than T1D.



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Methods: Mortality and SMR

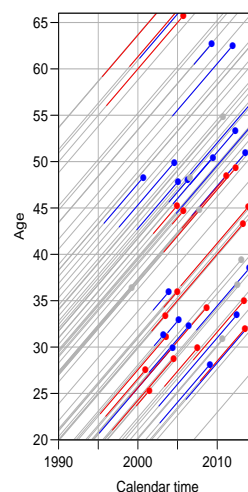
- ▶ Deaths and person-years of follow-up among diabetics tabulated by age and period at follow-up in 1-year classes.
- ▶ Corresponding mortality figures from Statistics Denmark. Deaths and person-years from the diabetes cohort subtracted.
- ▶ Mortality analysed by Poisson-regression of deaths with smooth parametric terms for current age, current date and current disease duration, using log-person-years as offset.
- ▶ SMR analysed using dataset amended by mortality among non-DM persons, using interaction between DM / non-DM and age / duration.

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Number of deaths — imbalance

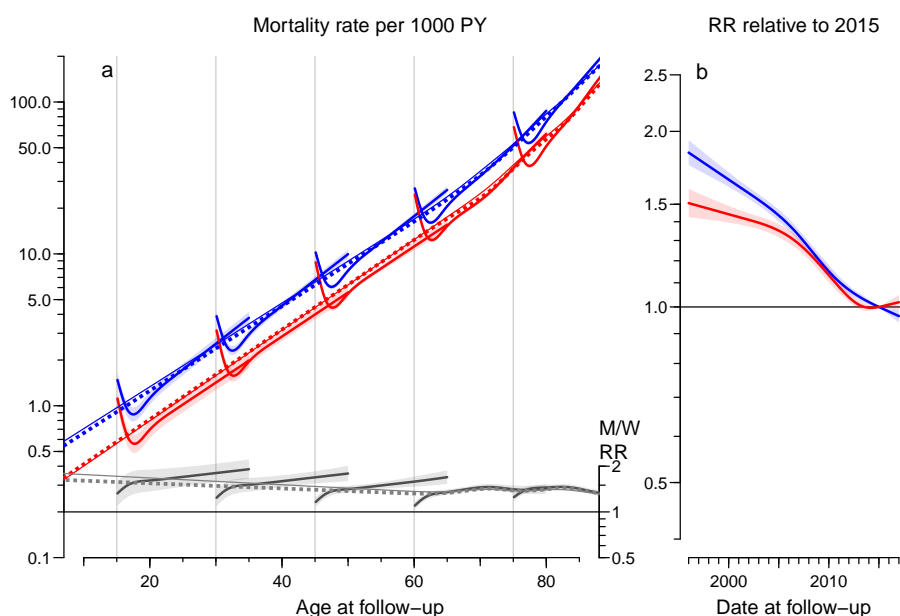
Year	New cases	Deaths	Surplus
1996	12,866	6,116	6,750
1997	12,633	6,306	6,327
1998	14,080	6,397	7,683
1999	14,723	6,841	7,882
2000	16,626	6,947	9,679
2001	14,591	7,054	7,537
2002	16,928	7,406	9,522
2003	18,608	7,747	10,861
2004	19,106	7,609	11,497
2005	17,796	7,902	9,894
2006	17,267	8,000	9,267
2007	18,637	8,158	10,479
2008	20,664	8,034	12,630
2009	20,459	8,716	11,743
2010	22,201	8,808	13,393
2011	25,385	8,839	16,546
2012	20,858	9,158	11,700
2013	16,372	9,431	6,941
2014	15,973	9,746	6,227
2015	17,849	10,079	7,770
2016	19,104	10,259	8,845

Incident cases Mortality



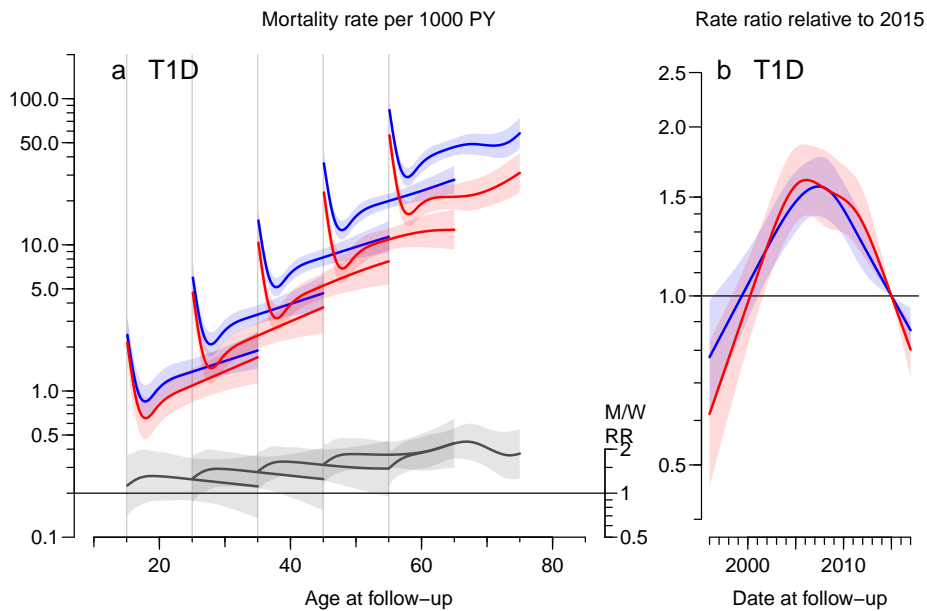
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Mortality among DM patients

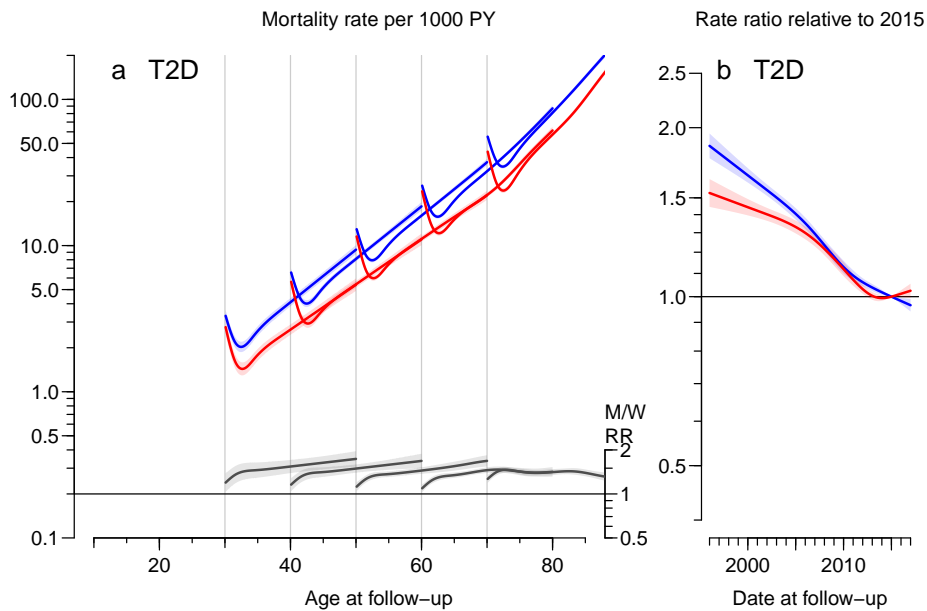


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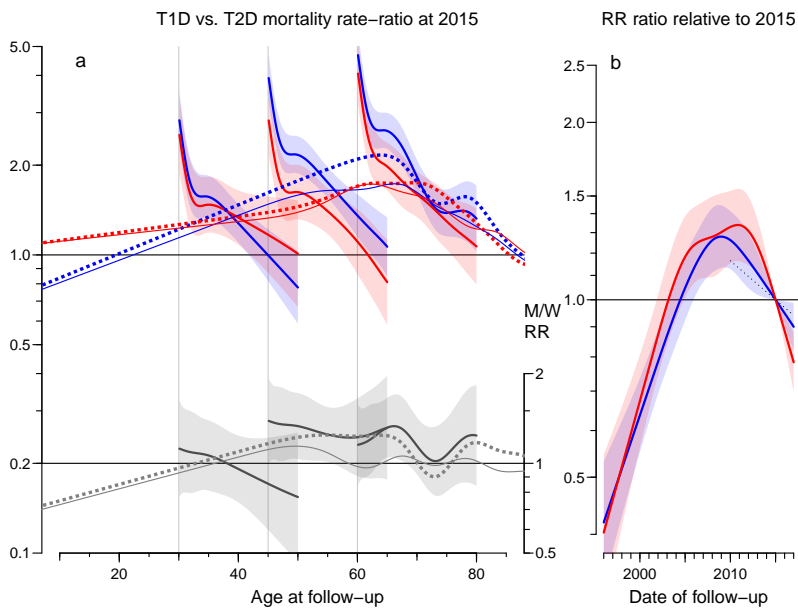
Mortality among T1D patients



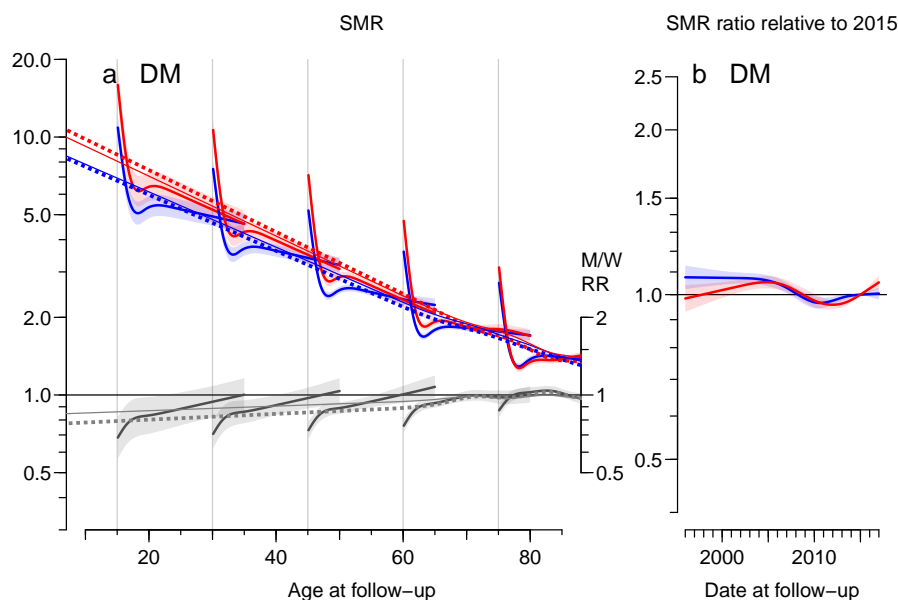
Mortality among T2D patients



Mortality RR between T1D/T2D



SMR relative to persons without DM



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Mortality summary

- ▶ Mortality in DM patients increases exponentially by age.
- ▶ Decreasing by time: 4.0/3.8%/year (non-DM: 2.8/2.4)
- ▶ Duration effects differs between T1D and T2D:
 - ▶ T1D: smaller mortality for longer duration
 - ▶ T2D: larger mortality for longer duration
- ▶ SMR is (almost) the same for men and women.
- ▶ SMR is 3 at age 45, 1.5 at 80

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Register is for surveillance

- ▶ How many persons have diabetes (age/sex/time...)
- ▶ How is the prognosis of diabetes patients
- ▶ How large is the population burden
- ▶ How do these develop over time

Thanks for your attention

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