Electronic Supplementary Material (ESM)

This document provides supplementary material for the manuscript: A systematic review of trends in all-cause mortality among people with diabetes. The information in the document is intended to provide additional details for data extraction and analyses.

ESM Methods

Inclusion and exclusion criteria for selecting studies

To be included in this review, studies needed to report all-cause mortality in populations with diabetes in two or more separate time periods such that a trend could be calculated. Included studies comprised diabetes registries, administrative and health insurance databases, or health survey data linked to a mortality database, and reported on secular trends in all-cause mortality among people with diabetes or type 2 diabetes. All articles identified were English language. We excluded studies which were restricted to people with type 1 diabetes or with newly diagnosed diabetes or with selected comorbid conditions (e.g. with coronary heart disease, obesity or renal disease). We excluded studies with a sample size <500 at each time period, closed cohort studies, and randomised controlled trials. Studies only reporting death attributable specifically to diabetes were also excluded.

Quality score

This scale below includes items that assess representativeness of the study population, size of sample in each time period, the methods of assessing diabetes status and outcome, whether the mortality rate was adjusted/standardised, and number of data points reported. The maximum score was 11 and final scores were defined as low (score 0–6), medium (score 7–8), or high (score 9–11).

Modified Newcastle–Ottawa Quality Assessment scale for trends in all-cause mortality among people with diabetes

A study can be awarded a maximum of one, two, three or four points for each numbered item within each category.

Selection

1. Selection of people with diabetes
    a) National representative (2 points) e.g. national diabetes registry; national primary care database; national health insurance database; national population-based cohort/survey
    b) Regional representative (1 point) e.g. regional diabetes register; regional primary care database; regional administrative health database; regional medication database; regional cohort/survey
    c) Selected group (0 points) e.g. patient group, insured population, in a country without universal insurances or no description
2. Assessment of diabetes status
    a) Screening of total adult population for undiagnosed diabetes (FPG, OGTT, $HbA1_c$) (4 points)
    b) By blood glucose measurement (FPG, OGTT, $HbA1_c$) or multiple approaches (2 or more criteria used) (3 points)
    c) Clinical diagnosis (e.g. ICD code or doctor-diagnosed) (2 points)
    d) Self-report of physician-diagnosed diabetes and/or anti-diabetic medication (1 point)
    e) No description (0 points)
3. Sample size in each time period
    a) >10,000 (1 point)
    b) ≤10,000 (0 points)

Outcome

1. Assessment of outcome

a) By record linkage (1 point) e.g. national death registry

b) Other – regular follow-up (0 points)

Comparability

1. Is the mortality rate adjusted/standardised for age?

a) Yes (1 point)

b) No (0 points)

Completeness of trend data

1. How many time periods are reported?

a) ≥10 (2 points)

b) 5-9 (1 point)

c) <5 (0 points)

Joinpoint trend analyses

Joinpoint Trend Analysis Software (version 4.7.0.0) uses permutation tests to identify the years or time periods where linear trends change significantly either in direction or in magnitude, and calculates an annual per cent change (APC) for each segment identified and the average annual per cent change (AAPC) over the study's whole observation period with the weights equal to the length of each segment [1, 2]. If there were no join points (i.e., no significant change in direction or magnitude over the whole period), APC is constant and it equals the AAPC.

We used three different approaches to determine the point estimate of APC in mortality rates (%) and its 95% confidence interval (95% CI, ESM Table 3). Specifically, 1) for studies with counts of deaths (including reported raw counts or rates converted to counts using the number

of people with diabetes) and denominators (people with diabetes) in more than three time periods, we applied counts and denominators in the joinpoint regression model and assumed Poisson variance for calculating the APC in mortality rates; 2) for studies that did not provide counts but did report mortality rates and their 95% CI in more than three time periods, we used the reported mortality rates and their standard errors (calculated as the width of the 95% CI divided by 3.92) in the joinpoint regression model; 3) for studies reporting mortality rates in only two time periods, we undertook a log-linear regression analysis either using counts or using mortality rates and their standard errors to determine the difference in mortality rates between the two time periods and to calculate the APC in mortality rates.

ESM Table 1 Details of the search strategy

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Daily and Versions (R) 1946 to Present
Search Strategy:1980–2019
1 diabetes.mp.
2 diabetes mellitus/ or exp diabetes mellitus, type 2/
3 1 or 2
4 mortality/ or "cause of death"/ or child mortality/
5 (death or trends).mp.
6 4 or 5
7 3 and 6
8 Pragmatic Clinical Trial/ or Clinical Trial, Phase III/ or Randomised Controlled Trial/ or Trial.mp. or Clinical Trial, Phase II/ or "Trial of Labor"/ or Clinical Trial, Phase I/ or Clinical Trial, Phase IV/ or Clinical Trial/ or Controlled Clinical Trial.mp. or case reports/ or clinical conference/ or clinical study/ [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
9 7 not 8
10 animal*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
11 9 not 10
12 letter*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
13 11 not 12
14 opinion*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
15 13 not 14
16 editorial*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
17 15 not 16
18 limit 17 to (english language and yr="1980–2019")

ESM Table 2 Format of mortality data and types of subgroups reported, listed by location

Author, publication year	Data presented		Subgroups reported				Reported mortality in non-diabetes
	Crude	Adjusted/ Standardised for	Type 2 diabetes classified	Age group	Total population	Sex-specified	
Harding et al, 2016 [3]	No	Age	Yes	Yes	Yes	No	No
Booth et al, 2006 [4]	No	Age, sex	No	No	Yes	No	Yes
Lind et al, 2013 (Canada) [5]	No	Age, sex	No	Yes	Yes	No	Yes
Lipscombe et al, 2007, 2010 [6, 7]	Yes	Age, sex	No	Yes	Yes	Yes	Yes
Oster et al, 2011 [8]	No	Age	No	No	Yes	Yes	Yes
Pohar et al, 2007 [9]	No	Age	No	No	Yes	No	No
Carstensen et al, 2008 [10]	Yes	No	No	No	Yes	Yes	Yes
Færch et al, 2014 [11]	Yes	No	Yes	No	No	Yes	Yes[a]
Green et al, 2015 [12]	Yes	Age	No	No	Yes	Yes	No
Støvring et al, 2007 [13]	Yes	No	No	Yes	Yes	Yes	Yes
Michaelis and Jutzi, 1990 [14]	Yes	No	Yes	Yes	Yes	No	Yes[a]
Forssas et al, 2003 [15]	Yes	Age	No	No	Yes	Yes	Yes
Forssas et al, 2010 [16]	No	Age	No	No	No	Yes	No
Karpati et al, 2014 [17]	No	Age	No	Yes	Yes	No	Yes[a]
Monesi et al, 2012 [18]	Yes	Age	No	Yes	Yes	No	Yes
Kim et al, 2018 [19]	Yes	Age, sex	No	No	Yes	No	Yes
Pildava et al, 2014 [20]	Yes	No	No	No	Yes	Yes	Yes[a]
Heintjes et al, 2019 [21]	No	Age	Yes	No	Yes	Yes	Yes
Dale et al, 2008 [22]	Yes	No	No	No	Yes	Yes	Yes
Dedov et al, 2017 [23]	Yes	No	Yes	No	Yes	No	No
Evans et al, 2007 [24]	Yes	No	Yes	No	Yes	No	No
Read et al, 2016 [25]	No	Age	Yes	Yes	Yes	Yes	Yes
Rawshani et al, 2017 [26]	Yes	Age, sex	Yes	No	Yes	No	Yes
Ringborg et al, 2008 [27]	Yes	Age, sex	Yes	No	Yes	No	No
Li et al, 2019 [28]	Yes	Age	No	Yes	Yes	Yes	No
Lind et al, 2013 (UK) [5]	No	Age, sex	No	Yes	Yes	No	Yes
Zghebi et al, 2017 [29]	Yes	No	Yes	No	Yes	Yes	Yes
Gregg et al, 2007 [30]	No	Age, sex	No	No	Yes	Yes	Yes
Gregg et al, 2018 [31]	No	Age, sex, ethnicity	No	Yes	Yes	Yes	Yes
Hyland et al, 2016 [32]	Yes	No	Yes	No	Yes	No	No
McBean et al, 2004 [33]	Yes	Age	No	Yes	Yes	No	Yes
Narayanan et al, 2010 [34]	No	Age	No	No	Yes	No	No
Stokes and Mehta, 2013 [35]	No	Age	No	No	Yes	No	Yes
Thomas et al, 2003 [36]	No	Age, sex	No	Yes	Yes	No	Yes
Tierney et al, 2004 [37]	Yes	Age	No	No	Yes	No	No
Yashkin et al, 2015 [38]	Yes	Mixed population	No	No	Yes	No	No

[a]Mortality data in the general population

ESM Table 3 Determination of statistical significance of mortality trends in people with diabetes, listed by location

Author, publication year	Years reported	Sex	Significance of mortality trends reported in the original publications	APC in mortality rates reported in the original publication	Type of data for calculating the APC	Universal trend over the whole study period	Joinpoint detected
Harding et al, 2016 [3]	2000–2011	T	Yes	No	Rates & SE	Yes	No
Booth et al, 2006 [4]	1992–1999	T	Yes	No	Counts	Yes	No
Lind, 2013 (Canada) [5]	1996–2009	T	No	No	Counts	No	Yes, 2005
Lipscombe et al, 2010 [7]	1994–2005	M	No	No	Counts	Yes	No
		F	No	No	Counts	Yes	No
Oster et al, 2011 (Europid) [8]	1995–2007	M	Yes	Yes	Counts	Yes	No
		F	Yes	Yes	Counts	Yes	No
Oster et al, 2011 (indigenous) [8]	1995–2007	M	Yes	Yes	Counts	Yes	No
		F	Yes	Yes	Counts	No	Yes, 1998
Pohar et al, 2007 [9][a]	1993, 2001	T	Yes	No	NA	Yes	No
Carstensen et al, 2008 [10]	1995–2006	M	Yes	Yes	Reported APC	Yes	No
		F	Yes	Yes	Reported APC	Yes	No
Færch et al, 2014 [11]	2002–2010	M	Yes	Yes	Reported APC	Yes	No
		F	Yes	Yes	Reported APC	Yes	No
Green et al, 2015 [12]	2000–2011	M	No	No	Counts	Yes	No
		F	No	No	Counts	Yes	No
Støvring et al, 2007 [13]	1994–2003	M	Yes	Yes	Reported APC	Yes	No
		F	Yes	Yes	Reported APC	Yes	No
Michaelis and Jutzi, 1990 [14]	1961–1987	T	No	No	Counts	No	Yes, 1981
Forssas et al, 2003 [15][a]	1981–1985, 1991–1996	M	Yes	No	Counts[b]	Yes	No
		F	Yes	No	Counts[b]	Yes	No
Forssas et al, 2010 [16][a]	1991–1994, 2000–2003	M	Yes	No	Counts	Yes	No
		F	Yes	No	Counts	Yes	No
Karpati et al, 2014 [17]	2004–2012	T	Yes	No	Counts	Yes	No
Monesi et al, 2012 [18]	2001–2007	T	Yes	No	Counts	Yes	No
Kim et al, 2018 [19]	2003–2013	T	Yes	No	Rates & SE	Yes	No
Pildava et al, 2014 [20]	2000–2012	M	Yes	No	Counts	Yes	No
		F	Yes	No	Counts	No	Yes, 2004
Heintjes et al, 2019 [21]	2008–2016	M	No	No	Rates & SE	Yes	No
		F	No	No	Rates & SE	Yes	No
Dale et al, 2008 [22][a]	1984–1993, 1995–2004	M	No	No	Counts	Yes	No
		F	No	No	Counts	Yes	No

Author, publication year	Years reported	Sex	Significance of mortality trends reported in the original publications	APC in mortality rates reported in the original publication	Type of data for calculating the APC	Universal trend over the whole study period	Joinpoint detected
Dedov et al, 2017 [23]	2013–2016	T	No	No	Counts	Yes	No
Evans et al, 2007 [24]	1993–2003	T	Yes	No	Counts	Yes	No
Read et al, 2016 [25]	2004–2013	M	No	No	Counts	Yes	No
		F	No	No	Counts	Yes	No
Rawshani et al, 2017 [26][a]	1998/1999–2014	T	Yes	No	Rates & SE	No	Yes, 2008/2009
Ringborg et al, 2008 [27]	1996–2003	T	Yes	No	Counts	Yes	No
Li et al, 2019 [28]	2005–2014	M	Yes	No	Counts	Yes	No
		F	Yes	No	Counts	Yes	No
Lind et al, 2013 (UK) [5]	1996–2009	T	No	No	Counts	Yes	No
Zghebi et al, 2017 [29]	2004–2014	M	No	No	Counts	No	Yes, 2012
		F	No	No	Counts	No	Yes, 2011
Gregg et al, 2007 [30][a]	1971–1986, 1988–2000	M	Yes	No	Rates & SE	Yes	No
		F	Yes	No	Rates & SE	Yes	No
Gregg et al, 2018 (Europid) [31][a]	1988–1994, 2000–2015	T	Yes	No	Rates & SE	Yes	No
Gregg et al, 2018 (black) [31][a]	1988–1994, 2000–2015	T	Yes	No	Rates & SE	Yes	No
Gregg et al, 2018 (other) [31][a]	1988–1994, 2000–2015	T	Yes	No	Rates & SE	Yes	No
Hyland et al, 2016 [32]	2002–2011	T	Yes	No	Counts	Yes	No
McBean et al, 2004 (Europid) [33][a]	1994–2001	T	Yes	No	Counts	Yes	No
McBean et al, 2004 (black) [33][a]	1994–2001	T	Yes	No	Counts	Yes	No
McBean et al, 2004 (Hispanic) [33][a]	1994–2001	T	Yes	No	Counts	Yes	No
McBean et al, 2004 (Asian) [33][a]	1994–2001	T	Yes	No	Counts	Yes	No
Narayanan et al, 2010 (Eskimo) [34][a]	1986–1990, 2002–2006	T	Yes	No	Counts	Yes	No
Narayanan et al, 2010 (Indian) [34][a]	1986–1990, 2002–2006	T	Yes	No	Counts	Yes	No
Narayanan et al, 2010 (Aleut) [34][a]	1986–1990, 2002–2006	T	Yes	No	Counts	Yes	No
Stokes and Mehta, 2013 [35][a]	1988–2001, 1999–2006	T	Yes	No	Rates & SE	Yes	No
Thomas et al, 2003 [36][a]	1970–1974, 1990–1994	T	No	No	Rates & SE	Yes	No
Tierney et al, 2004 [37]	1997–2002	T	Yes	No	Counts	Yes	No
Yashkin et al, 2015 [38]	1992–2012	T	Yes	No	Counts	No	Yes, 1999, 2004

[a]Studies did not measure mortality rates in continuous years

[b]Counts were only available for the total people with diabetes

F, female; M, male; NA, not available; SE, standard error; T, total

ESM Table 4 Change in all-cause mortality rates over time among people with and without diabetes, listed by location

Author, publication year	Years reported	Mid-point	Sex	Mortality in diabetes			Mortality in non-diabetes			Comparison of mortality trends between diabetes and non-diabetes[c]
				Baseline rate[a]	End rate[b]	APC in mortality rates, % (95% CI)	Baseline rate[a]	End rate[b]	APC in mortality rates, % (95% CI)	
Harding et al, 2016 [3]	2000–2011	2006	T	9.7	7.9	-1.7 (-2.0, -1.4)				Greater reduction in diabetes[d]
Booth et al, 2006 [4]	1992–1999	1996	T	14.5	13.4	-1.8 (-2.7, -0.8)	9.3	8.0	-2.4 (-3.0, -1.8)	Similar reduction
Lind et al, 2013 (Canada) [5]	1996–2009	2003	T	19.4	12.2	-3.4 (-3.9, -3.0)[e]	10.2	8.1	-1.7 (-2.0, -1.5)[e]	Greater reduction in diabetes[f]
Lipscombe et al, 2010 [7]	1994–2005	2000	M	41.8	28.5	-3.4 (-3.7, -3.1)	10.6	8.5	-2.1 (-2.4, -1.8)	Greater reduction in diabetes
Lipscombe et al, 2010 [7]	1994–2005	2000	F	39.0	27.2	-3.2 (-3.6, -2.9)	9.4	8.6	-1.0 (-1.3, -0.8)	Greater reduction in diabetes
Oster et al, 2011 (Europid) [8]	1995–2007	2001	M	17.0	11.0	-3.2 (-4.1, -2.3)[f]	8.6	6.7	-2.3 (-2.5, -2.0)[f]	Similar reduction
Oster et al, 2011 (Europid) [8]	1995–2007	2001	F	14.1	10.6	-2.5 (-2.9, -2.1)[f]	7.3	6.2	-1.6 (-1.8, -1.3)[f]	Greater reduction in diabetes
Oster et al, 2011 (indigenous) [8]	1995–2007	2001	M	33.0	16.3	-2.5 (-6.5, 1.7)[f]	16.2	16.5	0.4 (-1.0, 1.9)[f]	Similar change
Oster et al, 2011 (indigenous) [8]	1995–2007	2001	F	35.0	17.7	-2.0 (-5.1, 1.2)[f]	12.8	11.9	-0.2 (-1.0, 0.7)[f]	Similar change
Pohar et al, 2007 [9][g]	1993, 2001	1997	T	12.0	18.0	6.3[h]				NA
Carstensen et al, 2008 [10]	1995–2006	2001	M			-4.6 (-5.0, -4.2)[f]			-2.5[f]	Greater reduction in diabetes[f]
Carstensen et al, 2008 [10]	1995–2006	2001	F			-3.7 (-4.1, -3.3)[f]			-1.8[f]	Greater reduction in diabetes[f]
Færch et al, 2014 [11]	2002–2010	2006	M			-5.5 (-8.0, -2.9)[f]				Greater reduction in diabetes[f]
Færch et al, 2014 [11]	2002–2010	2006	F			-3.3 (-6.4, 0)[f]				Similar reduction[f]
Green et al, 2015 [12]	2000–2011	2006	M	56.1	40.7	-2.8 (-3.2, -2.4)				NA
Green et al, 2015 [12]	2000–2011	2006	F	53.7	36.8	-3.1 (-3.5, -2.7)				NA
Støvring et al, 2007 [13]	1994–2003	1999	M	73.1	53.5	-2.6 (-3.9, -1.2)	11.8	10.1	-1.8 (-2.3, -1.3)	Similar reduction
Støvring et al, 2007 [13]	1994–2003	1999	F	62.1	53.2	-3.0 (-4.6, -1.3)	11.0	10.6	-0.4 (-1.0, 0.2)	Greater reduction in diabetes
Michaelis and Jutzi, 1987 [14]	1961–1987	1974	T	48.5	68.6	1.8 (1.3, 2.2)[e]				Greater increase in diabetes[f]

Author, publication year	Years reported	Mid-point	Sex	Mortality in diabetes			Mortality in non-diabetes			Comparison of mortality trends between diabetes and non-diabetes[c]
				Baseline rate[a]	End rate[b]	APC in mortality rates, % (95% CI)	Baseline rate[a]	End rate[b]	APC in mortality rates, % (95% CI)	
Forssas et al, 2003 [15][g]	1981–1985, 1991–1996	1988	M	35.5	30.5	-1.3[h]	12.7	10.0	-2.0[h]	Lesser reduction in diabetes[f]
Forssas et al, 2003 [15][g]	1981–1985, 1991–1996	1988	F	20.1	18.9	-0.6[h]	4.8	4.1	-1.4[h]	Lesser reduction in diabetes[f]
Forssas et al, 2010 [16][g]	1991–1994, 2000–2003	1997	M	62.6	43.4	-4.0 (-5.4, -2.5)				NA
Forssas et al, 2010 [16][g]	1991–1994, 2000–2003	1997	F	41.7	27.2	-4.7 (-7.8, -1.5)				NA
Karpati et al, 2014 [17]	2004–2012	2008	T	13.8	10.7	-3.1 (-4.0, -2.1)				Similar reduction[f]
Monesi et al, 2012 [18]	2001–2007	2004	T	37.5	34.5	-1.6 (-3.0, -0.1)				Greater reduction in diabetes[f]
Kim et al, 2019 [19]	2003–2013	2008	T	14.5	9.4	-4.1 (-5.0, -3.2)	7.9	4.4	-5.3 (-5.8, -4.9)	Lesser reduction in diabetes
Pildava et al, 2014 [20]	2000–2012	2006	M	64.4	54.7	-2.6 (-3.3, -2.0)	14.8	14.5	-0.2 (-0.6, 0.3)[e]	Greater reduction in diabetes
Pildava et al, 2014 [20]	2000–2012	2006	F	54.6	43.8	-1.9 (-2.3, -1.4)[e]	12.4	13.7	0.5 (0.0, 1.0)	Greater reduction in diabetes
Heintjes et al, 2019 [21]	2008–2016	2012	M	7.5	9.7	3.7 (0.4, 7.0)	6.2	6.7	4.4 (-0.4, 9.5)	Similar change
Heintjes et al, 2019 [21]	2008–2016	2012	F	4.2	8.8	8.1 (3.2, 13.2)	2.3	4.0	2.1 (-2.0, 6.4)	Similar change
Dale et al, 2008 [22][g]	1984–1993, 1995–2004	1995	M	82.1	45.0	-5.5 (-6.7, -4.2)	16.3	11.4	-3.2 (-3.7, -2.8)	Greater reduction in diabetes
Dale et al, 2008 [22][g]	1984–1993, 1995–2004	1995	F	79.7	47.6	-4.7 (-5.9, -3.5)	11.2	7.9	-3.1 (-3.6, -2.6)	Greater reduction in diabetes
Dedov et al, 2017 [23]	2013–2016	2015	T	19.1	23.2	7.4 (-5.9, 22.6)				NA
Evans et al, 2007 [24]	1993–2003	1998	T	69.0	53.9	-3.8 (-5.4, -2.2)				NA
Read et al, 2016 [25]	2004–2013	2009	M	20.8	18.4	-1.7 (-2.4, -1.1)				Similar reduction[f]
Read et al, 2016 [25]	2004–2013	2009	F	18.8	15.2	-1.4 (-2.7, -0.1)				Similar reduction[f]
Rawshani et al, 2017 [26][g]	1998/1999–2014	2006	T	40.6	33.8	-1.7 (-3.1, -0.3)[e]	34.6	21.1	-3.4 (-3.9, -2.9)	Lesser reduction in diabetes[f]
Ringborg et al, 2008 [27]	1996–2003	2000	T	54.0	41.0	-4.0 (-6.0, -2.0)				NA
Li et al, 2019 [28]	2005–2014	2010	M	16.1	12.3	-3.2 (-3.9, -2.5)				NA
Li et al, 2019 [28]	2005–2014	2010	F	9.6	7.6	-2.5 (-3.5, -1.4)				NA
Lind et al, 2013 (UK) [5]	1996–2009	2003	T	31.4	14.1	-5.7 (-6.2, -5.1)	14.6	8.6	-3.6 (-4.3, -3.0)	Greater reduction in diabetes[f]

Author, publication year	Years reported	Mid-point	Sex	Mortality in diabetes			Mortality in non-diabetes			Comparison of mortality trends between diabetes and non-diabetes[c]
				Baseline rate[a]	End rate[b]	APC in mortality rates, % (95% CI)	Baseline rate[a]	End rate[b]	APC in mortality rates, % (95% CI)	
Zghebi et al, 2017 [29]	2004–2014	2009	M	31.9	21.0	-4.1 (-7.2, -0.9)[e]	25.5	13.3	-5.8 (-6.9, -4.7)	Similar reduction
Zghebi et al, 2017 [29]	2004–2014	2009	F	31.8	22.4	-3.2 (-6.5, 0.3)[e]	24.6	14.2	-4.9 (-5.9, -3.9)	Similar change
Gregg et al, 2007 [30][g,i]	1971–1986, 1988–2000	1986	M	42.6	24.4	-3.5 (-11.9, 5.7)	19.0	11.6	-3.2 (-13.5, 8.2)	Similar reduction
Gregg et al, 2007 [30][g]	1971–1986, 1988–2000	1986	F	18.4	25.9	3.1 (-23.2, 38.4)	10.1	7.7	-1.9 (-16.7, 15.5)	Similar change
Gregg et al, 2018 (Europid) [31][g]	1988–1994, 2010–2015	2002	T	24.8	19.2	-1.8 (-3.0, -0.5)	11.1	19.6	-0.8 (-1.2, -0.4)	Similar reduction
Gregg et al, 2018 (black) [31][g,i]	1988–1994, 2010–2015	2002	T	26.8	17.8	-1.6 (-4.2, 1.2)	15.2	11.2	-1.3 (-2.4, -0.1)	Similar reduction
Gregg et al, 2018 (other) [31][g]	1988–1994, 2010–2015	2002	T	20.5	13.3	-2.8 (-5.6, 0.1)	9.8	9.2	-0.4 (-1.3, 0.4)	Similar change
Hyland et al, 2016 [32]	2002–2011	2007	T	85.5	71.3	-2.1 (-2.8, -1.4)				NA
McBean et al, 2004 (Europid) [33][g,i]	1994–2001	1997	T	92.9	87.7	-0.7 (-1.8, 0.3)	54.6	53.9	-0.1 (-0.6, 0.3)	Similar reduction
McBean et al, 2004 (black) [33][g]	1994–2001	1997	T	91.3	91.7	-0.04 (-1.7, 1.6)	61.0	61.1	-0.2 (-1.3, 0.9)	Similar change
McBean et al, 2004 (Hispanic) [33][g]	1994–2001	1997	T	69.1	72.5	0.1 (-3.3, 3.8)	39.2	43.3	0.3 (-2.8, 3.5)	Similar change
McBean et al, 2004 (Asian) [33][g,i]	1994–2001	1997	T	71.2	56.3	-4.8 (-7.8, -1.6)	47.5	37.1	-3.4 (-6.8, 0.1)	Similar change
Narayanan et al, 2010 (Eskimo) [34][g]	1986–1990, 2002–2006	1996	T	43.2	33.8	-1.5 (-3.5, 0.5)				NA
Narayanan et al, 2010 (Indian) [34][g]	1986–1990, 2002–2006	1996	T	41.9	32.4	-1.6 (-3.3, 0.1)				NA
Narayanan et al, 2010 (Aleut) [34][g]	1986–1990, 2002–2006	1996	T	40.0	34.0	-1.0 (-3.4, 1.4)				NA
Thomas et al, 2003 [36][g]	1970–1974, 1990–1994	1982	T	59.6	51.3	-0.7 (-1.8, 0.3)	22.7	17.8	-1.2 (-1.6, -0.9)	Similar change
Stokes and Mehta, 2013 [35][g]	1988–2001, 1999–2006	1999	T	20.3	20.8	0.3 (-5.1, 5.6)	7.8	6.0	-3.2 (-6.4, 0)	Similar change
Tierney et al, 2004 [37]	1997–2002	2000	T	40.9	26.7	-6.3 (-12.8, 0.6)				NA
Yashkin et al, 2015 [38]	1992–2012	2002	T	76.0	64.0	-1.1 (-1.5, -0.7)[e]				NA

Where a cell is empty, this indicates that relevant data were not available in the study.
[a]"Baseline rate" refers to the reported mortality rate in the first time period in the original publication, and it is presented as deaths per 1000 person-years or deaths per 1000 persons per year
[b]"End rate" refers to the reported mortality rate in the last time period in the original publication, and it is presented as deaths per 1000 person-years or deaths per 1000 persons per year
[c]The difference in the APCs in mortality rates between people with and without diabetes was determined by the *z* score. If the APCs in mortality rates were similar between people with and without diabetes, we classified as "similar change in mortality rates between diabetes and non-diabetes". Among the populations reporting declining mortality rates in people with diabetes over time, we classified the difference of mortality trends between diabetes and non-diabetes as "similar reduction between diabetes and non-diabetes" if the APCs were similar between those with and without diabetes; "greater mortality reduction in diabetes than non-diabetes" if the APC was more negative in diabetes than that in non-diabetes; and "lesser mortality reduction in diabetes than non-diabetes" if the APC was less negative in diabetes than that in non-diabetes
[d]Determined by the findings using same data source [39]
[e]Values are the average annual per cent changes in mortality rates in the population where there was at least one change point over study's whole observation period
[f]Reported in the original paper
[g]Studies did not measure mortality rates in continuous years
[h]Annual change of mortality rates is the relative change of mortality rates divided by the length of each study's observation period
[i]Classification of mortality trends in diabetes was determined according to statistical significance reported in the original paper, not according to the confidence intervals of the APC shown in the table
F, female; M, male; NA, not available; T, total

ESM Table 5 Comparison of the APC in mortality rates between people with and without diabetes in 33 populations

Mortality trends in diabetes	Difference in the APCs in mortality rates between diabetes and non-diabetes[a]	Study periods			
		1980–1989 (n=4)	1990–1999 (n=10)	2000–2016 (n=19)	1970–2016 (n=33)
Decreasing	APC more negative in diabetes than non-diabetes	0	3 (30%)	7 (37%)	10 (30%)
Decreasing	APC similar in diabetes and non-diabetes	1 (25%)	3 (30%)	4 (21%)	8 (24%)
Decreasing	APC less negative in diabetes than non-diabetes	1 (25%)	0	2 (11%)	3 (9%)
Unchanged	APC similar in diabetes and non-diabetes	2 (50%)	4 (40%)	4 (21%)	10 (30%)
Increasing	APC similar in diabetes and non-diabetes	0	0	2 (11%)	2 (6%)

Values are n (%). Only the 33 populations with mortality data available for computing the APC in mortality rates separately for those with and without diabetes are included for this analysis

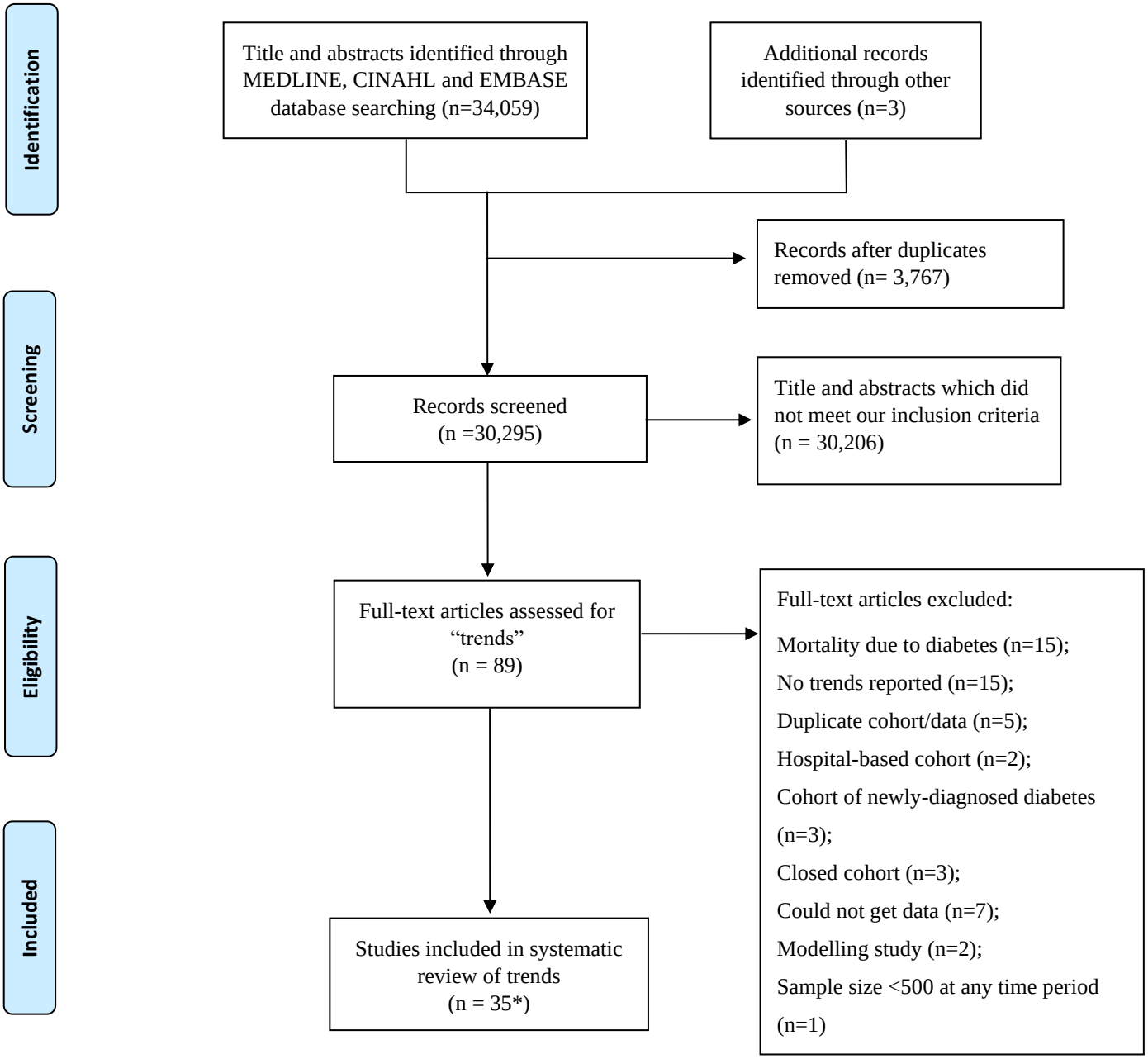
[a]Determined by the *z* score

ESM Table 6 Quality assessment of the included studies, listed by location

Author, year	Location	Selection of people with diabetes	Assessment of diabetes status	Sample size at time periods	Assessment of outcome	Comparability (adjusted/ standardised)	Completeness (no. of data points)	Total Score
Range		**0-2**	**0-4**	**0-1**	**0-1**	**0-1**	**0-2**	**11**
Harding et al, 2016 [3]	Australia	2	2	1	1	1	2	9
Booth et al, 2006 [4]	Canada	1	3	1	1	1	1	8
Lind et al, 2013 (Canada) [5]	Canada	1	3	1	1	1	2	9
Lipscombe et al, 2007, 2010 [6, 7]	Canada	1	3	1	1	1	2	9
Oster et al, 2011 [8]	Canada	1	3	1	1	1	2	9
Pohar et al, 2007 [9]	Denmark	1	3	1	0	1	0	6
Carstensen et al, 2008 [10]	Denmark	2	3	1	1	0	2	9
Færch et al, 2014 [11]	Denmark	0	2	0	1	0	1	4
Green et al, 2015 [12]	Denmark	2	3	1	1	1	2	10
Støvring et al, 2007 [13]	Denmark	1	1	0	1	0	2	5
Michaelis and Jutzi, 1990 [14]	East Germany	2	2	1	1	0	2	8
Forssas et al, 2003 [15]	Finland	2	1	1	1	1	0	6
Forssas et al, 2010 [16]	Finland	2	2	1	1	1	0	7
Karpati et al, 2014 [17]	Israel	2	3	1	1	1	1	9
Monesi et al, 2012 [18]	Italy	1	2	1	1	1	1	7
Kim et al, 2018 [19]	Korea	2	2	1	1	1	2	9
Pildava et al, 2014 [20]	Latvia	2	2	1	1	0	2	8
Heintjes et al, 2019 [21]	the Netherlands	2	1	1	1	1	1	7
Dale et al, 2008 [22]	Norway	1	1	0	1	0	0	3
Dedov et al, 2017 [23]	Russia	2	0	1	0	0	0	3
Evans et al, 2007 [24]	Scotland	1	3	0	1	0	2	7
Read et al, 2016 [25]	Scotland	2	2	1	1	1	2	9
Rawshani et al, 2017 [26]	Sweden	2	2	1	1	1	1	8
Ringborg et al, 2008 [27]	Sweden	1	3	0	1	1	1	7
Li et al, 2019 [28]	Taiwan	2	3	1	1	1	2	10
Lind et al, 2013 (UK) [5]	UK	2	2	1	1	1	2	9
Zghebi et al, 2017 [29]	UK	2	2	1	0	0	2	7
Gregg et al, 2007 [30]	USA	2	1	0	1	1	0	5
Gregg et al, 2018 [31]	USA	2	1	1	1	1	1	7
Hyland et al, 2016 [32]	USA	2	3	1	1	0	2	9
McBean et al, 2004 [33]	USA	2	3	1	1	1	1	9
Narayanan et al, 2010 [34]	USA	2	2	0	1	1	0	6

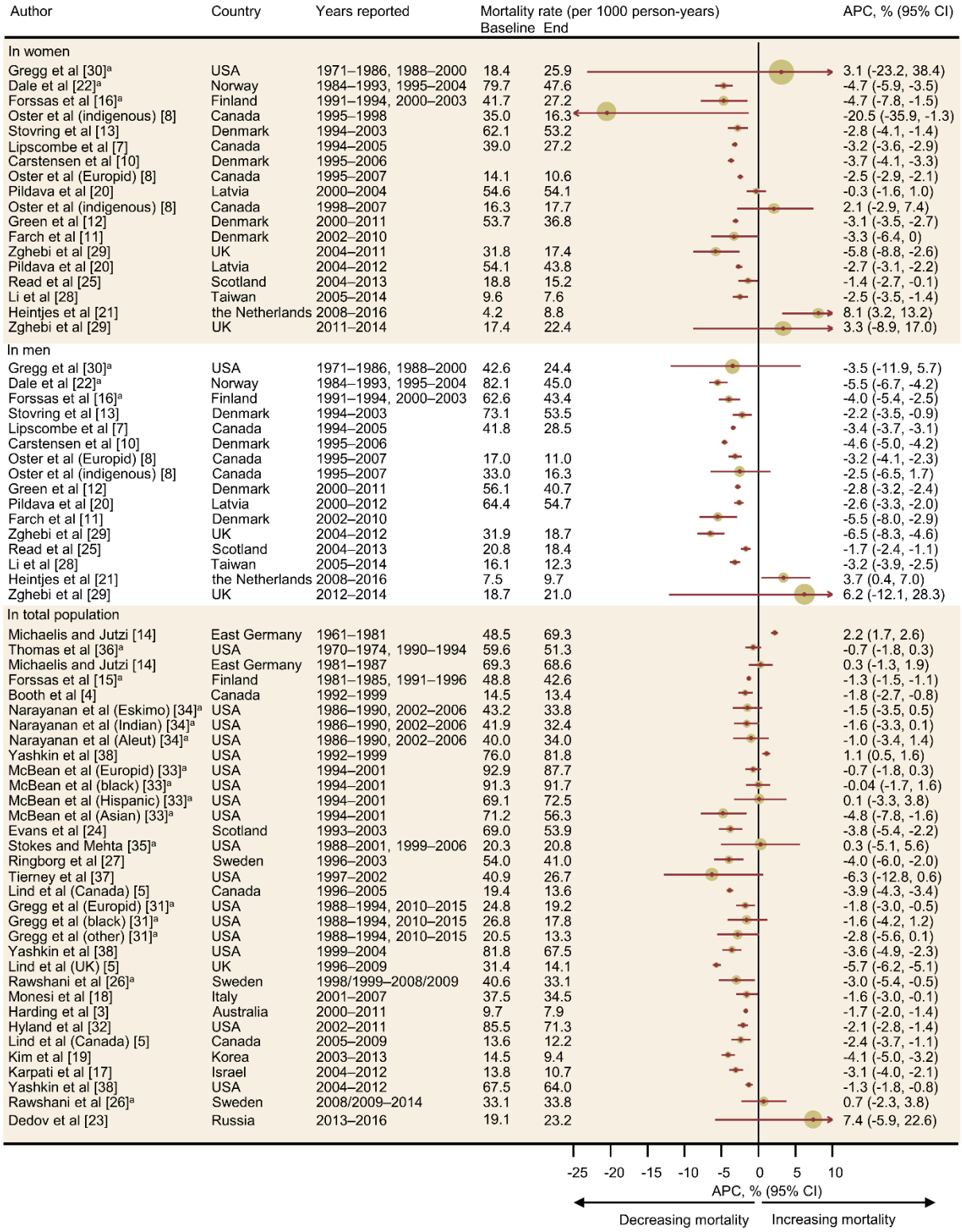
Author, year	Location	Selection of people with diabetes	Assessment of diabetes status	Sample size at time periods	Assessment of outcome	Comparability (adjusted/ standardised)	Completeness (no. of data points)	Total Score
Stokes and Mehta, 2013 [35]	USA	2	4	0	1	1	0	8
Thomas et al, 2003 [36]	USA	1	3	0	1	1	1	7
Tierney et al, 2004 [37]	USA	1	1	1	1	1	1	6
Yashkin et al, 2015 [38]	USA	2	3	1	1	1	2	10

ESM Fig. 1 Flow chart of search strategy



Notes: MEDLINE: International biomedical bibliographic database; CINAHL: Cumulative Index to Nursing and Allied Health Literature; EMBASE: International biomedical and pharmacological bibliographic database. *36 papers from 35 studies were included, two papers were based on the same data sources [6, 7] and thus were treated as one study.

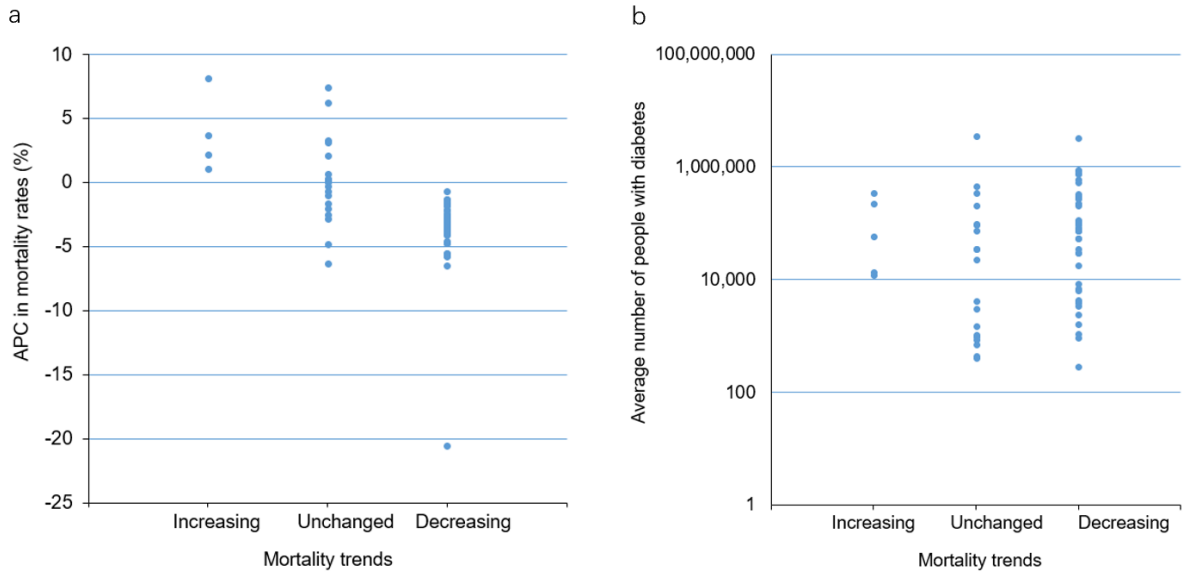
ESM Fig. 2 Forest plot of the APC in mortality rates among the 67 separate ethnic-specific or sex-specific populations with diabetes, listed by sex and the midpoint of the years reported



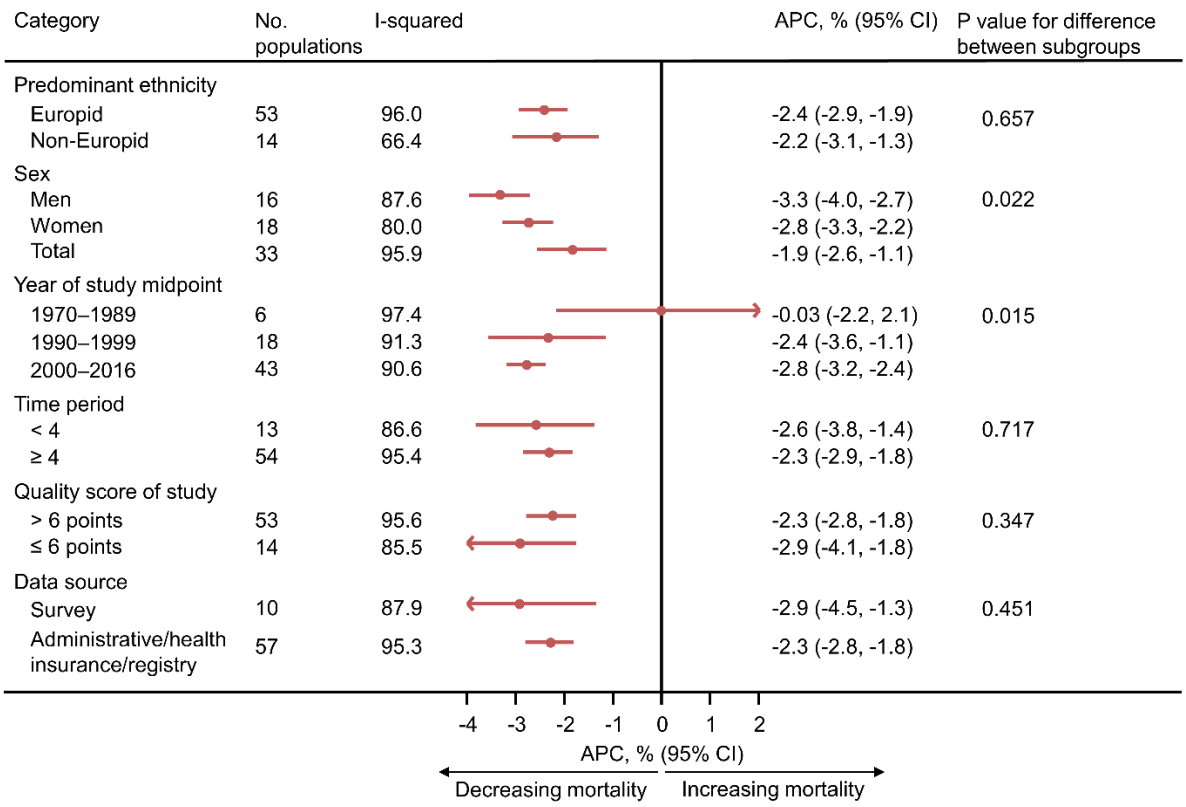
The diamonds represent individual point estimates of the APC in mortality rates from each population with a single mortality trend and the horizontal lines represent the 95% confidence intervals around the point estimates. The circles around the diamonds are in proportion to the size of standard error of each APC. Mortality data were available for computing the APC in the 67 separate ethnic-specific or sex-specific populations with diabetes

[a]Studies did not measure mortality rates in continuous years

ESM Fig. 3 Pattern of mortality trends with APC in mortality rates (a) and average population size in people with diabetes (b)

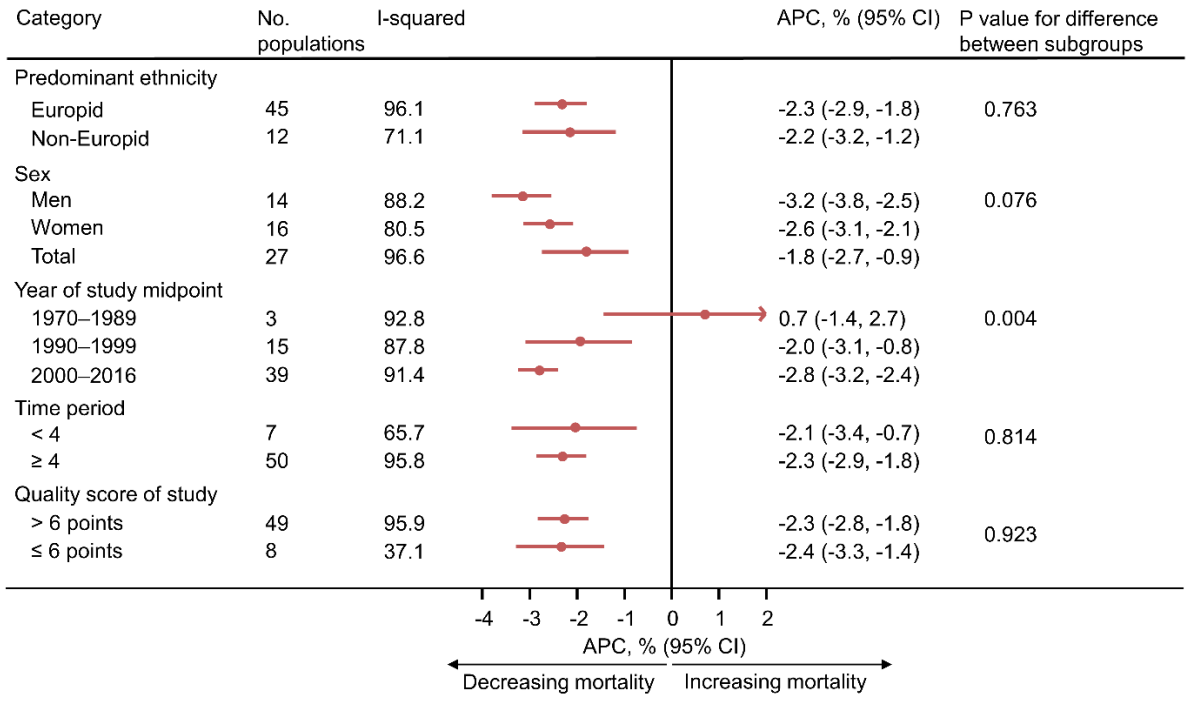


ESM Fig. 4 Forest plot showing the APC in mortality rates by subgroups among the 67 separate ethnic-specific or sex-specific populations with diabetes



Mortality data were available for computing the APC in mortality rates in the 67 separate ethnic-specific or sex-specific populations with diabetes. The estimates of the APC in mortality rates were pooled within each category of subgroup using random effect meta-analysis. Random effects meta-regression analyses were used to test differences across subgroups

ESM Fig. 5 Forest plot showing the APC in mortality rates by subgroups among the 57 separate ethnic-specific or sex-specific populations with diabetes from an administrative or health insurance or registry database



Mortality data were available for computing the APC in mortality rates in the 57 separate ethnic-specific or sex-specific populations with diabetes from an administrative or health insurance or registry database. The estimates of the APC in mortality rates were pooled within each category of subgroup using random effect meta-analysis. Random effects meta-regression analyses were used to test differences across subgroups

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