

Diabetic eye disease: A UK Incidence and Prevalence Study

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Notes on version

There are a number of slight differences between this report and the British Medical Journal paper 'Population trends in the 10-year incidence and prevalence of diabetic retinopathy in the UK: a cohort study in the Clinical Practice Research Datalink 2004–2014' (<http://bmjopen.bmj.com/content/7/2/e014444>).

These differences are as follows:

1. The report includes information on the crude incidence and prevalence of diabetic retinopathy in key population subgroups. The paper presents age-standardized incidence and prevalences. These figures are standardized against the mid-2014 UK population estimates from the Office for National Statistics - and thus take account for the age structure of the UK population (Figure 1 and table 2 in the paper).
2. Severe diabetic retinopathy in the report includes codes for severe pre-proliferative retinopathy. In the paper, severe retinopathy is defined as proliferative retinopathy - and thus the severe DR population is slightly smaller in the paper compared to the report.
3. Risk of developing retinopathy is presented as crude hazard ratios in the report- stratified by gender, age, ethnic group, calendar year, geographical region, and deprivation. (Tables 13 and 14). In the paper, the risk of developing retinopathy is presented as an adjusted hazard ratio, which takes account of age, gender, ethnic group, deprivation, geographic region, and additionally, duration of diabetes) This is figure 2 in the paper.

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Background

Diabetic retinopathy (DR) is the most common form of eye disease amongst individuals with diabetes mellitus. (1) Though diabetic retinopathy is thought to be one of the leading causes of visual impairment and blindness in the UK. UK wide population-based measures of incidence and prevalence have not been determined, with previous research generally limited to estimates based on regional screening programmes or small general practices samples.(2–4) In the UK, within 20 years of diagnosis nearly all people with type 1 and almost two thirds of people with type 2 diabetes (60%) have some degree of retinopathy.(5)

Ethnic and gender differences in the risk of diabetes and subsequent visual impairment have been established both in the UK and worldwide.(6–11) In the UK, the risk of developing type two diabetes has been shown to be 2-6 times higher in South Asian communities compared to the White British population.(12,13)

If untreated, diabetic retinopathy leads to blindness, and is one of the most common causes of sight loss in people of working age.(1) Compared to the general population, the risk of developing cataracts or glaucoma is doubled amongst individuals with diabetic retinopathy.(14)

Since 2004 it has been a requirement of the UK Quality and Outcomes Framework (QOF) that patients with diabetes should be screened annually for diabetic retinopathy, and that screening should be recorded by general practitioners in patient records. QOF indicators are known to have been well recorded by GPs and so we anticipate results of screening will have been recorded with a high degree of accuracy.(15,16) Having a more complete understanding of the burden of disease due to diabetic retinopathy in the UK will help improve future service planning and provision.

Aim

To estimate the incidence and prevalence of diabetic retinopathy in the United Kingdom. We will use nationally representative data from the Clinical Practice Research Datalink (CPRD) to measure how common this condition occurs in the UK population. We will also look to see whether diabetic retinopathy is more or less common in specific groups of people; specifically we will look at whether incidence and prevalence varies with age, sex, geographical location, ethnicity and socio-economic

status. Furthermore we will estimate the time it takes to develop visual impairment following onset of diabetic retinopathy.

Study Type

This is a descriptive study. Measures of overall and annual prevalence and incidence of diabetic retinopathy will be calculated. Furthermore incidence of visual impairment will be calculated within patients with diagnosed diabetic retinopathy.

Methodology

Description of the data source

The Clinical Practice Research Datalink (CPRD, formerly GPRD) was initially set up in 1987 as a commercial data bank by the company VAMP (Value Added Medical Products). Now run by the Medicines and Health Care products Regulatory Agency (MHRA), the CPRD is the largest primary care database in the UK, representing over 8% of the UK population.

The CPRD currently contains longitudinal primary care records for approximately 13.5 million patients, of whom 5.5 million are currently active.⁽¹⁷⁾ Continuous observational data has been collected in most practices for over six years yielding over 30 million patient years of observation. Patients contributing to the CPRD are registered with one of 650 practices which all use the Vision clinical software system. General practitioners and practice staff record data onto their clinical systems and send anonymized patient data every 6 weeks to the CPRD. These data are then appended to the continually growing database which contains information on diagnoses, symptoms, referrals, test results, medications, consultations, demographics, and lifestyle factors. Around fifty percent of English practices contributing to the CPRD also allow linkage to other data sources such as the Hospital Episode Statistics for England, and the Office for National Statistics (ONS) Mortality Data.

For research purposes, individual patient data is anonymised, with identifying information such as NHS number, name, date of birth, address, and postcode removed. In addition to these demographic data, researchers can access coded data pertaining to diagnoses, symptoms and processes of care. Coded data are entered according to the Read clinical coding system- a hierarchical system of medical coding used across UK primary care.

The Clinical Practice Research Datalink is well suited to investigate the national prevalence and incidence of diabetic retinopathy due to its representativeness of the UK population with respect to gender, age and ethnic group, and large number of contributing practices and patients- which will enable a more granular and detailed description of trends over time and between demographic subgroups.^(17,18)

Identification of diabetic retinopathy

Clinical terms to identify diagnoses of diabetic retinopathy were agreed upon via consultation between the research team and clinicians at Moorfields eye hospital. All diagnoses of diabetic retinopathy was identified by searching for the following Read clinical terms in the CPRD. Diabetic retinopathy was classified as severe if the codes pertained to laser therapy, advanced retinopathy, preproliferative or proliferative retinopathy.

A summary of the clinical terms used to identify diabetic retinopathy is shown in Table 1. The full list of Read codes can be found in the appendix. Onset of diabetic retinopathy was defined as the first ever diagnostic code entered onto the patient record. Patients with a diagnosis for severe retinopathy at any time were included in a sub-analysis of patients with advanced disease, with onset defined as the earliest ever code of severe DR on the patient record.

Table 1. Search terms for Diabetic Retinopathy

Keywords for identifying diabetic retinopathy in the CPRD
RETINAL and or *SCR* or *ARTERIES* or *EXUDATE* or *MICROANEURYSMS* or *PHOTOGRAPHY* or *ABNORMALITY*
O/E and *RETINA* or *FUNDUS* or *PHOTOCOAGULATION* or *MACULAR* or *VITREOUS*
*LASER” and *RETINA*
RETINOPATHY or *FUNDOSCOPY* or *MACULOPATHY* or *RED REFLEX* or *SEEN BY OP* or *RETINAL SCR* or *RETINOSCOPY* or *SLIT LAMP* or *DIABETIC EYE* or *EYE FUNDUS* or *EXAMINATION OF RETINA* or *RETINA AND OTHER PARTS OF EYE OPERATIONS* or *VITRECTOMY*
Keywords excluded (to remove obstetric terms related to “fundus”)
TERM SIZE or *WEEK SIZE* or *OBSTETRIC*

Identification of diabetes mellitus

For the purposes of this study, diabetic status was determined via the use of classification algorithms developed by the UK Biobank study for use in electronic health records.(19) The UK Biobank is a prospective cohort study investigating genetic, lifestyle and environmental risk factors for major chronic diseases such as cancer, diabetes, heart disease, and stroke. A key objective of the Biobank program is to improve the identification and classification of diabetes in routine medical records. The algorithms developed for the Biobank study are the

most current iteration of a diagnostic toolkit designed to counteract the most common diagnostic errors .

The algorithms for classification of diabetes follow the general principles for outcomes adjudication as defined by the Biobank study; namely to:

- a) Use a staged approach to ascertain, confirm, and sub-classify disease
- b) Avoid false positive cases, but tolerate some false negative cases
- c) Be geographically generalizable, scalable, cost-effective, and future proof

Flowchart 1: Assigning initial diabetes classification

The first of the three Biobank algorithms provided an initial diabetes classification for each patients based on diagnostic Read codes alone. Patients with type 1 or type 2 diabetes were classified using a hierarchical method starting with definite codes and stepping down to probable codes and then possible codes. Patients whose only diabetes codes were for subtype specific were classified separately. A summary of the read codes used to typify diabetes mellitus is shown in table 2. A full list of Read codes can be found in the appendix. he codes listed include codes which confirm diagnoses of diabetes and also refute diagnoses (such as diabetes resolved/ceased) depending on their temporal ordering in the patient record.

Table 2. Categorization of Read codes for Diabetes Mellitus

	Type 1 Diabetes	Type 2 Diabetes	Other
Definite	Type 1 DM: C10E Not contradicted/ceased/superseceded	Type 2 DM: C10F Not contradicted/ceased/superseceded	Gestational L180 Genetic C10c-C10D Other/Secondary
Probable	IDDM: C108 Adult onset: C1073 Gestational: L1805 Not contradicted/ceased/superseceded	NIDDM: C109 Gestational: L1806 Gestational: L180X Not contradicted/ceased/superseceded	C10G-J, L-N, C11y0 Insulin resistance: C10K, C1098, C10F8
Possible	Diabetes mellitus, adult onset: C10z1 C10y0 C110 Not contradicted/ceased/superseceded	Diabetes mellitus, adult onset: C10%, C112 (z), L180x Not contradicted/ceased/superseceded	Ceased: 21263, 212H

Flowchart 2: Improving classification of type 1 diabetes

The second algorithm further refined the classification of patients initially identified as having type 1 diabetes by utilizing supporting information which allowed patients to retain their classification as having type 1 diabetes, or to be reclassified as having either type 2 diabetes or gestational diabetes. Supporting information including prescriptions of diabetic medications (insulin, metformin, and other antidiabetic drugs), pregnancy, hospitalizations, body mass index, age, gender, and ethnicity are used to detect potential errors in the classification of type 1 diabetes.

Flowchart 3: Improving classification of type 2 diabetes

The third algorithm further refined the classification of patients initially identified as having type 2 diabetes by utilizing supporting information which allowed patients to retain their classification as having type 2 diabetes, or to be reclassified as having type 1 diabetes, polycystic ovary syndrome, gestational diabetes, or not diabetes.

Calculating prevalence and incidence of T1DM, T2DM, and diabetic retinopathy

A prospective cohort study was conducted to examine the prevalence and incidence of diabetes mellitus and diabetic retinopathy in all patients aged 12 and over in the whole of the CPRD. The prevalence and incidence of diabetic retinopathy were also examined separately for individuals with type 1 diabetes and type 2 diabetes.

Prevalence analysis

For the study of diabetes and retinopathy prevalence, the outcome was all individuals with a diagnostic code at the midpoint of each calendar year from January 2004 to January 2015. Point prevalence was calculated by dividing the number of individuals with any one of a) Type 1 diabetes b) Type 2 diabetes c) Diabetic Retinopathy d) Severe diabetic retinopathy by the number of patients in the CPRD aged 12 years and over on July 1st of each year.

Incidence analysis

For the study of disease incidence, the outcome was first diagnosis of diabetes or diabetic retinopathy between January 2004 and January 2015. Individuals with a first diagnosis prior to 1994 were excluded from the analysis. Incidence was calculated by dividing the number of newly diagnosed patients aged 12 and over by the number of person-years of

follow-up of all eligible patients aged 12 and over contributing to the CPRD.

Crude incidence rates of diabetes and diabetic retinopathy per 10,000 person years of follow-up time were calculated for all patients in the CPRD. For the analysis, the start of follow-up was defined as the latest of practice up to standard date or 12 months after the patients current registration date.

Follow-up time ended at the date of first diagnosis of diabetes or diabetic retinopathy. For patients not diagnosed with the outcome of interest, follow-up time was censored at the earliest of date of transferring out of the practice, date of latest data collection, death, or December 31st 2014. To examine trends over time, Cox proportional hazards regression using time since first registration as the timescale was used to evaluate the risk of diabetic retinopathy in all patients between January 2004 and December 2014 stratified by age band, gender, calendar year, region, deprivation, and ethnic group.

Age was grouped into bands spanning ages 25-24, 25-34, 45-54, 55-64, and 75 and older. Ethnicity was grouped into the five categories of the 2011 census, namely, White, South Asian, Black African/Caribbean, Mixed, and Other. Patients with missing ethnicity, or with codes which were unusable were collapsed into a category of unknown ethnicity. The full list of codes and their categorization can be found in the appendix.

Deprivation was classified using the Index of Multiple Deprivation (IMD).(20) IMD scores are assigned to small geographic locations known as “Lower Layer Super Output Areas” (LSOA), which cover populations of approximately 1,500 people, allowing for exploration of small scale geographic differences in deprivation. Each LSOA has an IMD score which is made of up several domains including income, employment, health and disability, education, barriers to housing and services, crime, and living environment. Each patient in the CPRD was assigned a deprivation score relating to the deprivation value of their general practice.

Calculating time to of visual impairment amongst individuals with diabetic retinopathy

Within our population with diabetic retinopathy, the time between onset of retinopathy and visual impairment was examined for the whole population and by gender, ethnic group, age group, and deprivation. The

analysis was conducted separately for patients with diabetic retinopathy only and for patients with both diabetic retinopathy and a diagnosis for major eye disease defined as glaucoma, cataract, or macular degeneration. The Read codes for eye disease are listed in detail in the appendix

Cox proportional hazards regression was used to estimate the median number of years to developing subsequent visual impairment. Visual impairment codes were selected from a pre-defined list created and checked by the CALIBER study group, who create shareable codeslists for use in studies using routine electronic healthcare databases (www.caliberresearch.org). The codes are summarized below in Table 3, and listed in detail in the appendix.

Table 3. Categorization of Read codes for visual impairment

Visual Impairment Category											
Severely sight impaired (VA worse than 3/60)	2B79	2B6A	2B6Q	2B7A	2B7T	2B6R	2B7R	2B6B	2B6S	2B7P	2B7B
	2B7C	2B7V	2B6P	2B6V	2B69	2B6C	2B7S	2B7Q	2B6T		
Reduced visual acuity (VA 6/12 to 6/36)	2B6G	2B7J	2B76	2B64	2B6J	2B6H	2B7K	2B6K	2B7H	2B77	2B75
Sight impaired (VA 3/60 to 6/60)	2B7W	2B6E	2B6X	2B6L	2B7L	2B68	2B78	2B7E	2B7X	2B6W	

For patients with diabetic retinopathy alone, time to visual impairment was calculated from their first retinopathy diagnosis. For patients with co-morbid eye disease, time to visual impairment was calculated from the most recent diagnosis for retinopathy, glaucoma, cataracts, or macular degeneration.

Findings

Number of patients with diabetes and diabetic retinopathy

From a total of 10,207,366 patients in the CPRD with research quality data, 7,707,475 were eligible for inclusion in the study. Amongst all patients aged 12 and over on December 31st 2014, the prevalence of type 1 diabetes was 0.4% (CI95% 0.39%-0.40%). The prevalence of type 2 diabetes was 4.39% (CI95% 4.38%-4.40%). The prevalence of diabetic retinopathy was 1.87% (CI95% 1.86%-1.88%) while the prevalence of severe diabetic retinopathy was 0.18% (CI85% 0.17%-0.18%).

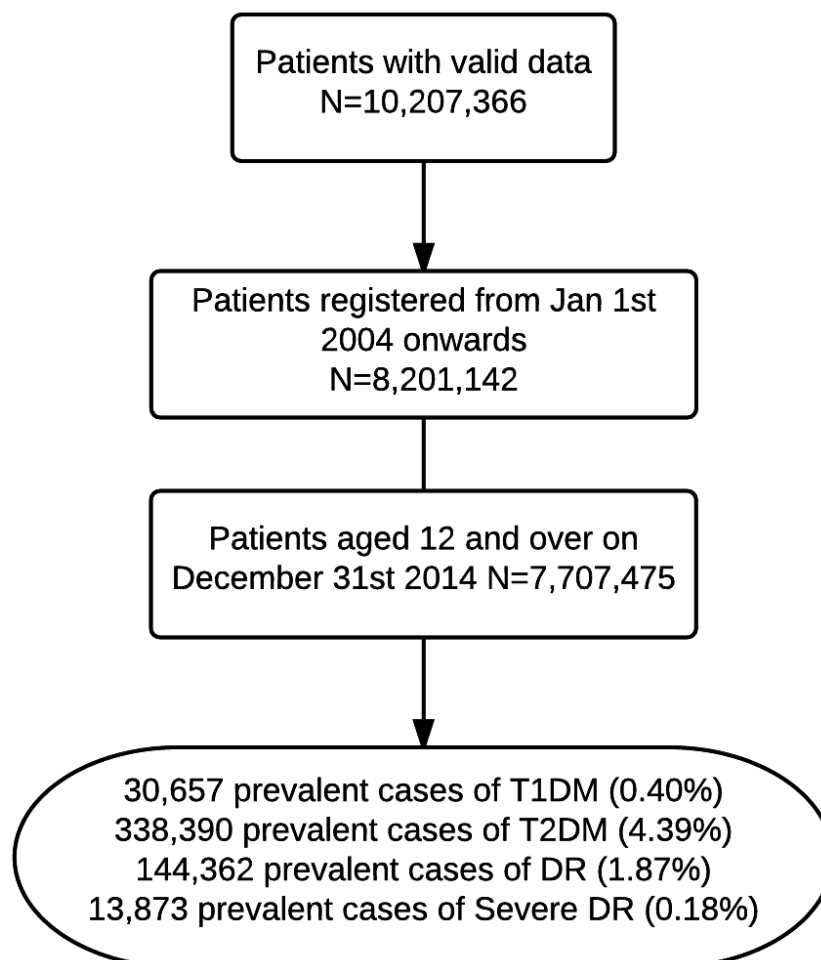


Figure 1. Derivation of study population from the CPRD

The earliest ever diagnostic Read code for each patient identified as having diabetic retinopathy is shown in table 4.

Table 4. Diagnostic Read codes for all retinopathy identified in the CPRD

First diagnosis of any diabetic retinopathy	No.	%
Diabetic retinopathy	32,175	22.30

Background diabetic retinopathy	29,732	20.60
O/E - right eye background diabetic retinopathy	13,993	9.70
O/E - left eye background diabetic retinopathy	13,363	9.30
Fundoscopy abnormal	5,721	4.00
Anterior vitrectomy	5,629	3.90
Diabetic maculopathy	4,552	3.20
O/E - retinal haemorrhages	4,102	2.80
Unspecified background retinopathy	3,500	2.40
Non proliferative diabetic retinopathy	3,069	2.10
Hypertensive retinopathy	3,015	2.10
O/E - vitreous haemorrhages	2,835	2.00
Central serous retinopathy	2,696	1.90
O/E - retinal pigmentation	2,039	1.40
Pars plana vitrectomy	1,666	1.20
Proliferative diabetic retinopathy	1,131	0.80
O/E - left eye diabetic maculopathy	1,059	0.70
O/E - right eye diabetic maculopathy	1,031	0.70
Type 2 diabetes mellitus with retinopathy	830	0.60
Retinal microaneurysms NOS	783	0.50
Retinal laser therapy	722	0.50
Diabetic retinopathy NOS	677	0.50
Preproliferative diabetic retinopathy	604	0.40
Retinopathy of prematurity	594	0.40
O/E - diabetic maculopathy present both eyes	592	0.40
O/E - No retinal laser photocoagulation scars	538	0.40
Other background retinopathy	491	0.30
Retina and other parts of eye operations	443	0.30
Retinal abnormality - diabetes related	433	0.30
Maculopathy	398	0.30
O/E - retinal microaneurysms	382	0.30
Laser photocoagulation of retina for detachment	339	0.20
O/E - right eye preproliferative diabetic retinopathy	337	0.20
Laser therapy - retinal lesion	332	0.20
O/E - left eye preproliferative diabetic retinopathy	305	0.20
Panretinal laser photocoagulation to lesion of retina	300	0.20
O/E - referable retinopathy	292	0.20
O/E - right eye clinically significant macular oedema	259	0.20
O/E - retinal exudates	254	0.20
Retinal exudate or deposit	250	0.20
O/E - right eye proliferative diabetic retinopathy	210	0.10
Type 1 diabetes mellitus with retinopathy	201	0.10
O/E - left eye proliferative diabetic retinopathy	179	0.10
Vitrectomy using pars plana approach	171	0.10
O/E - retinal A-V nipping	170	0.10
Vitrectomy using anterior approach	168	0.10
O/E - left eye clinically significant macular oedema	164	0.10

Advanced diabetic maculopathy	162	0.10
Focal laser photocoagulation of retina	130	0.10
Other proliferative retinopathy	128	0.10
Retinal abnormality - non-diabetes	128	0.10
Other background retinopathy NOS	118	0.10
Laser destruction of lesion of retina	101	0.10
Exudative retinopathy	95	0.10
O/E - retinal vessel narrowing	92	0.10
Insulin dependent diabetes mellitus with retinopathy	77	0.10
O/E- non-referable retinopathy	63	<0.10
O/E - Laser photocoagulation scars	47	<0.10
Panretinal laser photocoagulation to lesion of retina NEC	46	<0.10
Type 2 diabetes mellitus with exudative maculopathy	46	<0.10
Proliferative retinopathy NOS	45	<0.10
O/E - right eye stable treated prolif diabetic retinopathy	41	<0.10
Solar retinopathy	40	<0.10
Proliferative retinopathy due to sickle cell disease	38	<0.10
Non-insulin-dependent diabetes mellitus with retinopathy	30	<0.10
Type II diabetes mellitus with retinopathy	29	<0.10
Atherosclerotic retinopathy	21	<0.10
O/E - retinal vascular prolif.	20	<0.10
O/E - sight threatening diabetic retinopathy	20	<0.10
High risk non proliferative diabetic retinopathy	14	<0.10
Type 1 diabetes mellitus with exudative maculopathy	14	<0.10
Atherosclerotic retinopathy	12	<0.10
Type I diabetes mellitus with retinopathy	11	<0.10
Venostasis retinopathy	11	<0.10
Arteriosclerotic retinopathy	9	<0.10
Renal retinopathy	9	<0.10
High risk proliferative diabetic retinopathy	8	<0.10
Retinal arteries silverwire	7	<0.10
O/E - left eye stable treated prolif diabetic retinopathy	6	<0.10
Other intraretinal microvascular abnormality	5	<0.10
Other specified other proliferative retinopathy	5	<0.10
Pseudoretinitis pigmentosa	**	<0.10
Impaired vision due to diabetic retinopathy	**	<0.10
[X]Other proliferative retinopathy	**	<0.10
Total	144,362	100.00

**cells with fewer than 5 individuals cannot be included due to concerns over patient anonymity

The earliest ever diagnostic Read code for the subset of patients identified as having severe diabetic retinopathy is shown in table 5.

Table 5. Diagnostic Read codes for severe retinopathy identified in the CPRD

First diagnosis of severe diabetic retinopathy	No.	%
Proliferative diabetic retinopathy	3,455	24.90
Preproliferative diabetic retinopathy	2,046	14.70
O/E - right eye preproliferative diabetic retinopathy	1,411	10.20
O/E - left eye preproliferative diabetic retinopathy	1,321	9.50
Retinal laser therapy	1,062	7.70
O/E - right eye proliferative diabetic retinopathy	688	5.00
Panretinal laser photocoagulation to lesion of retina	615	4.40
O/E - left eye proliferative diabetic retinopathy	614	4.40
Laser therapy - retinal lesion	610	4.40
Laser photocoagulation of retina for detachment	479	3.50
Advanced diabetic maculopathy	374	2.70
Focal laser photocoagulation of retina	315	2.30
Other proliferative retinopathy	264	1.90
Laser destruction of lesion of retina	242	1.70
Proliferative retinopathy NOS	106	0.80
Panretinal laser photocoagulation to lesion of retina NEC	94	0.70
O/E - Laser photocoagulation scars	86	0.60
Proliferative retinopathy due to sickle cell disease	42	0.30
High risk non proliferative diabetic retinopathy	23	0.20
High risk proliferative diabetic retinopathy	16	0.10
Other specified other proliferative retinopathy	8	0.10
[X]Other proliferative retinopathy	**	<0.10
Total	13,873	100.00

**cells with fewer than 5 individuals cannot be included due to concerns over patient anonymity

Results of prevalence analysis

Study Populations

The breakdown of each of the study populations by gender, ethnic group and deprivation quintile is presented in table 6. Compared to the general CPRD population, both diabetic populations have a higher proportion of males. Additionally, the population with type 2 diabetes has a higher proportion of individuals of South Asian and Black African/Caribbean ethnicity and individuals in the least affluent quintiles compared to the general CPRD population. The population with type 1 diabetes has a greater proportion of individuals of White ethnicity, and a similar distribution of deprivation as the general CPRD population.

Table 6. Demographic characteristics of the CPRD population 2004-2014

Population	CPRD		T2DM		T1DM	
	N	%	N	%	N	%
Denominator (12+)	7,707,475	100%	338,390	100%	30,657	100%
Gender						
Male	3,790,664	49.18%	187,141	55.30%	17,761	57.93%
Female	3,916,811	50.82%	151,249	44.70%	12,896	42.07%
Ethnic Group						
White	4,006,927	51.99%	205,168	60.63%	19,810	64.62%
South Asian	223,090	2.89%	15,840	4.68%	453	1.48%
Black	142,070	1.84%	7,186	2.12%	373	1.22%
Other	109,402	1.42%	3,891	1.15%	254	0.83%
Mixed	50,363	0.65%	1,095	0.32%	152	0.50%
Unknown	3,175,623	41.20%	105,210	31.09%	9,615	31.36%
IMD Quintile						
1 (most affluent)	1,338,388	17.36%	52,280	15.45%	5,280	17.22%
2	1,496,051	19.41%	61,008	18.03%	5,934	19.36%
3	1,621,330	21.04%	71,982	21.27%	6,517	21.26%
4	1,723,122	22.36%	79,130	23.38%	6,910	22.54%
5 (least affluent)	1,470,726	19.08%	72,094	21.31%	5,833	19.03%

The gender breakdown of the whole CPRD population in 2014 is similar to that over the whole study period. The proportion of males and those of South Asian ethnicity with type 1 or type 2 diabetes is increased in 2014 compared to the whole study period.

Table 7. Demographic characteristics of the CPRD population 2014

Population	CPRD		T2DM		T1DM	
	N	%	N	%	N	%
Denominator (12+)	3,207,886	100%	160,415	100%	13,788	100%
Gender						
Male	1,528,040	49.32%	90,141	56.19%	8,002	58.04%
Female	1,625,846	50.68%	70,274	43.81%	5,786	41.96%
Ethnic Group						
White	1,749,939	54.55%	95,157	59.32%	9,001	65.28%
South Asian	94,210	2.94%	8,234	5.13%	212	1.54%
Black	60,576	1.89%	3,747	2.34%	155	1.12%
Other	42,292	1.32%	1,903	1.19%	115	0.83%
Mixed	18,184	0.57%	524	0.33%	65	0.47%
Unknown	1,242,685	38.74%	50,855	31.70%	4,240	30.75%
1 (most affluent)						
2	627,041	19.73%	26,408	16.58%	2,710	19.80%
3	672,597	21.17%	31,378	19.70%	2,824	20.63%
4	607,787	19.13%	31,801	19.96%	2,708	19.79%
5 (least affluent)	696,504	21.92%	36,785	23.09%	3,015	22.03%
5 (least affluent)	573,630	18.05%	32,918	20.67%	2,430	17.75%

Overall Prevalence of diabetic retinopathy

During the study period there were a total of 144,362 prevalent cases of diabetic retinopathy giving an overall prevalence of 1.87% in the entire CPRD population, 28.31% in the population with type 2 diabetes and 48.43% in the population with type 1 diabetes. In both the CPRD and T2DM populations, the prevalence of diabetic retinopathy is higher amongst males and those of South Asian ethnicity. Amongst those with Type 1 diabetes, prevalence is highest in the White ethnic group compared to all other ethnic groups and slightly higher for females compared to males. In all study populations, the prevalence of diabetic retinopathy increases with deprivation.

Table 8. Overall prevalence of Diabetic Retinopathy in the CPRD 2004-2014

Diabetic Retinopathy	CPRD		T2DM		T1DM	
	N with DR	% with DR	N with DR	% with DR	N with DR	% with DR
Denominator (12+)	7,707,475	100.00%	338,390	100%	30,657	100%
Prevalent DR	144,362	1.87%	95,807	28.31%	14,846	48.43%
Gender						
Male	80,148	2.11%	54,309	29.02%	8,579	48.30%
Female	64,214	1.64%	41,498	27.44%	6,267	48.60%
Ethnic Group						
White	91,447	2.28%	60,781	29.62%	9,953	50.24%
South Asian	5,727	2.57%	4,743	29.94%	184	40.62%
Black	2,684	1.89%	2,074	28.86%	124	33.24%
Other	1,461	1.34%	1,085	27.88%	93	36.61%
Mixed	491	0.97%	322	29.41%	51	33.55%
Unknown	42,552	1.34%	26,802	25.47%	4,441	46.19%
IMD Quintile						
1 (most affluent)	23,915	1.79%	14,669	15.45%	2,714	18.4%
2	27,123	1.81%	17,601	18.53%	2,869	19.45%
3	29,494	1.82%	19,170	20.18%	3,104	21.05%
4	33,143	1.92%	22,850	24.06%	3,281	22.25%
5 (least affluent)	29,410	2.0%	20,685	21.78%	2,779	18.84%

In 2014, there were a total of 76,637 prevalent cases of diabetic retinopathy, giving an overall prevalence of 2.39% in the entire CPRD population, 30.65 in the population with type 2 diabetes and 55% in the population with type 1 diabetes. Differences by gender ethnic group, and deprivation quintile remain apparent.

Table 9. Overall prevalence of Diabetic Retinopathy in the CPRD 2014

Diabetic Retinopathy	CPRD		T2DM		T1DM	
Denominator (12+)	3,207,886	100%	160,415	100%	13,788	100%
Prevalent DR	73,637	2.39%	49,166	30.65%	7,583	55.0%
Gender						
Male	41,492	2.62%	28,299	31.39%	4,393	54.90%
Female	32,145	1.98%	20,867	29.69%	3,190	55.13
Ethnic Group						
White	45,726	2.61%	30,253	31.79%	5,028	55.86%
South Asian	3,088	3.28%	2,545	30.91%	94	44.34%
Black	1,526	2.52%	1,190	31.76%	59	38.06%
Other	808	1.91%	605	31.79%	47	40.87%
Mixed	236	1.30%	156	29.77%	22	33.85%
Unknown	22,253	1.79%	14,417	28.35%	2,333	55.02%
IMD Quintile						
1 (most affluent)	12,435	1.98%	7,354	27.85%	1,504	55.50%
2	14,662	2.18%	9,780	31.17%	1,558	55.17%
3	14,969	2.46%	9,910	31.16%	1,541	56.91%
4	17,344	2.49%	12,144	33.01%	1,688	55.99%
5 (least affluent)	13,420	2.34%	9,456	28.73%	1,233	50.74%

Overall Prevalence of severe diabetic retinopathy

During the study period there were a total of 13,873 prevalent cases of severe diabetic retinopathy giving an overall prevalence of 0.18% in the entire CPRD population, 2.41% in the population with type 2 diabetes and 10.25% in the population with type 1 diabetes. In all study populations the prevalence of severe diabetic retinopathy is raised in Males compared to Females. In the CPRD and T2DM populations, prevalence is highest in the South Asian population, while in the T1DM population, prevalence is highest in the White population. In all study populations, the prevalence of diabetic retinopathy increases with deprivation until quintile 4.

Table 10. Overall prevalence of severe Diabetic Retinopathy in the CPRD 2004-2014

Severe Retinopathy	CPRD		T2DM		T1DM	
	N with DR	% with	N with	% with	N with	% with DR
Denominator (12+)	7,707,475	100.00%	338,390	100%	30,657	100%
Prevalent Severe DR	13,873	0.18%	8,158	2.41%	3,142	10.25%
Gender						
Male	8,207	0.22%	4,981	2.66%	1,890	10.64%
Female	5,666	0.14%	3,177	2.10%	1,252	9.71%
Ethnic Group						
White	8,688	0.22%	4,932	2.40%	2,185	11.03%
South Asian	679	0.30%	559	3.53%	34	7.51%
Black	336	0.24%	244	3.40%	24	6.43%
Other	137	0.13%	97	2.49%	16	6.30%
Mixed	57	0.11%	40	3.65%	9	5.92%
Unknown	3,976	0.13%	2,286	2.17%	874	9.09%
IMD Quintile						
1 (most affluent)	2,078	0.16%	1,007	12.51%	524	16.8%
2	2,520	0.17%	1,459	18.12%	591	18.95%
3	2,778	0.17%	1,599	19.86%	659	21.13%
4	3,435	0.20%	2,071	25.72%	751	24.08%
5 (least affluent)	2,910	0.20%	1,916	23.80%	594	19.04%

In 2014 there were a total of 6,929 prevalent cases of severe diabetic retinopathy, giving an overall prevalence of 0.22% in the entire CPRD population, 2.41% in the population with type 2 diabetes and 12.45% in the population with type 1 diabetes. Differences in prevalence by gender, ethnic group, and deprivation quintile mirror those found in the entire study population from 2004-2014.

Table 11. Overall prevalence of severe Diabetic Retinopathy in the CPRD 2014

Severe Retinopathy	CPRD		T2DM		T1DM	
	N with DR	% with	N with	% with	N with	% with DR
Denominator (12+)	3,207,886	100%	160,415	100%	13,788	100%
Prevalent Severe DR	6,929	0.22%	3,868	2.41%	1,717	12.45%
Gender						
Male	4,185	0.26%	2,439	2.71%	1,025	12.81%
Female	2,744	0.17%	1,429	2.03%	692	11.96%
Ethnic Group						
White	4,183	0.24%	2,197	2.31%	1,175	13.05%
South Asian	365	0.39%	293	3.56%	12	5.66%
Black	184	0.30%	134	3.58%	12	7.74%
Other	66	0.16%	45	2.36%	7	6.09%
Mixed	32	0.18%	24	4.58%	5	7.69%
Unknown	2,099	0.17%	1,175	2.31%	506	11.93%
IMD Quintile						
1 (most affluent)	1,093	0.17%	472	1.79%	313	11.55%
2	1,344	0.20%	752	2.40%	351	12.43%
3	1,323	0.22%	727	2.29%	349	12.89%
4	1,729	0.25%	1,009	2.74%	404	13.40%
5 (least affluent)	1,333	0.23%	831	2.52%	287	11.81%

Prevalence of diabetes and retinopathy in the total CPRD population

Overall

The prevalence of diabetic retinopathy alongside that of type 1 and type 2 diabetes in the whole CPRD population over the period 2004 to 2014 is displayed below. The prevalence of type 1 diabetes in the entire CPRD population aged 12 and over is 0.4% while the prevalence of type 2 diabetes is 4.39%. The prevalence of diabetic retinopathy is 1.87% while the prevalence of severe diabetic retinopathy is 0.18%

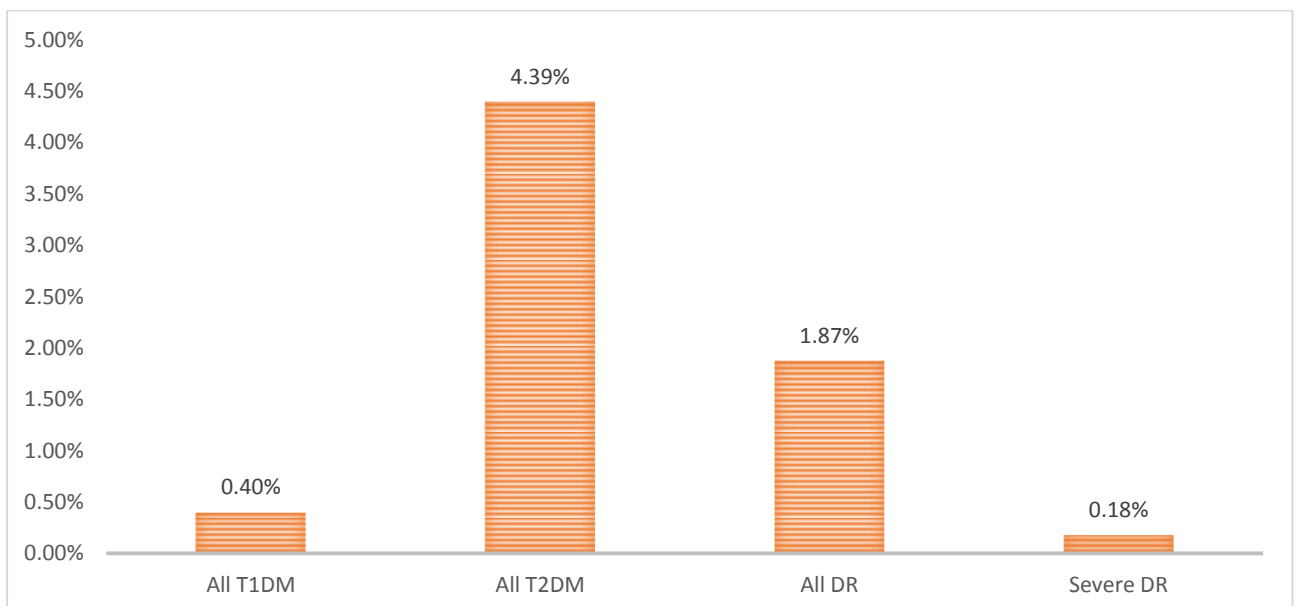
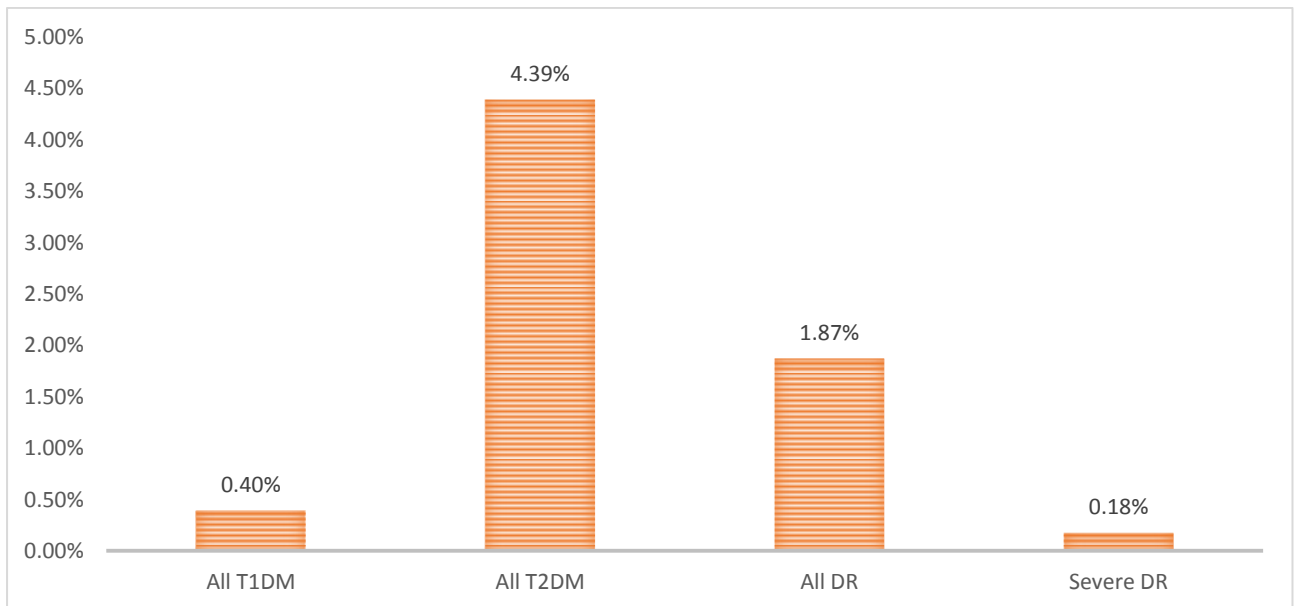


Figure 2. Prevalence of diabetes and retinopathy in the CPRD

The prevalence of diabetic retinopathy appears to rise in tandem with the rising prevalence of type 2 diabetes. The prevalence of severe diabetic retinopathy and type 1 diabetes remain largely static over the study period.

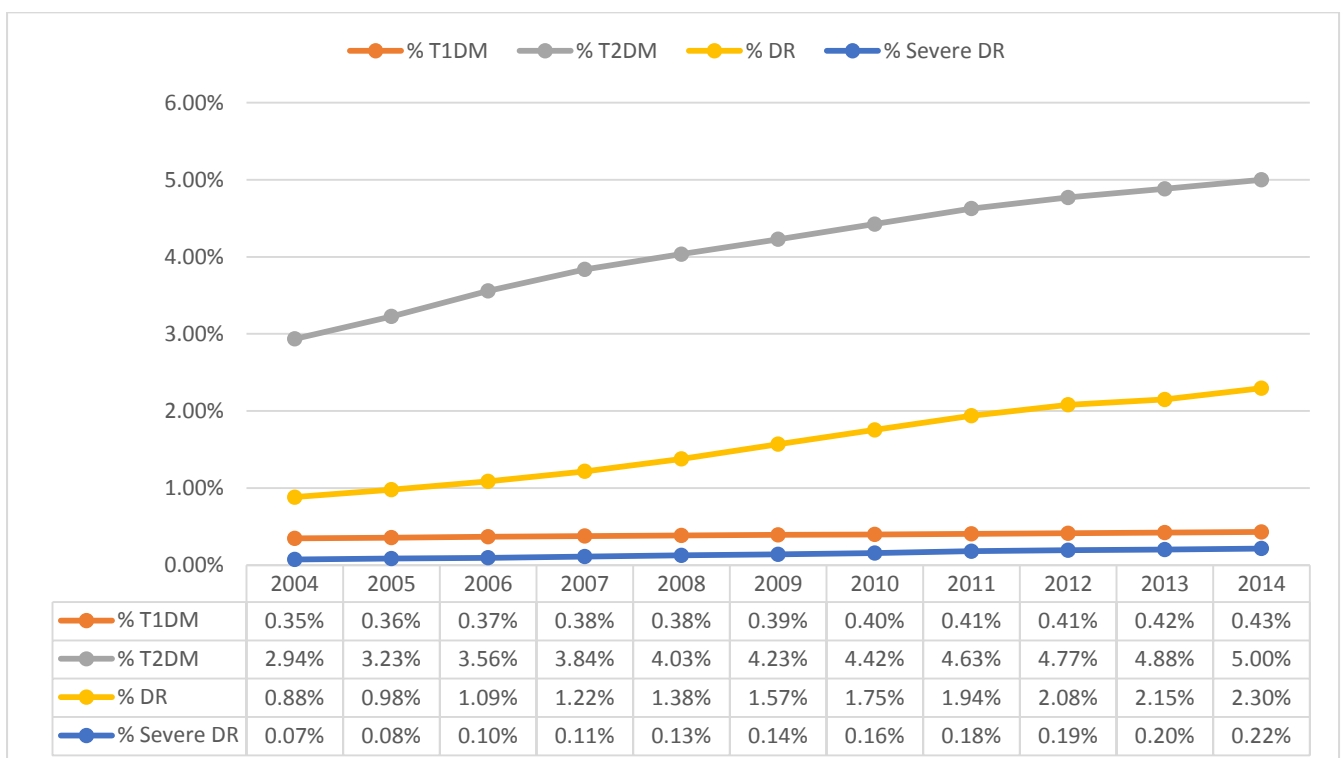
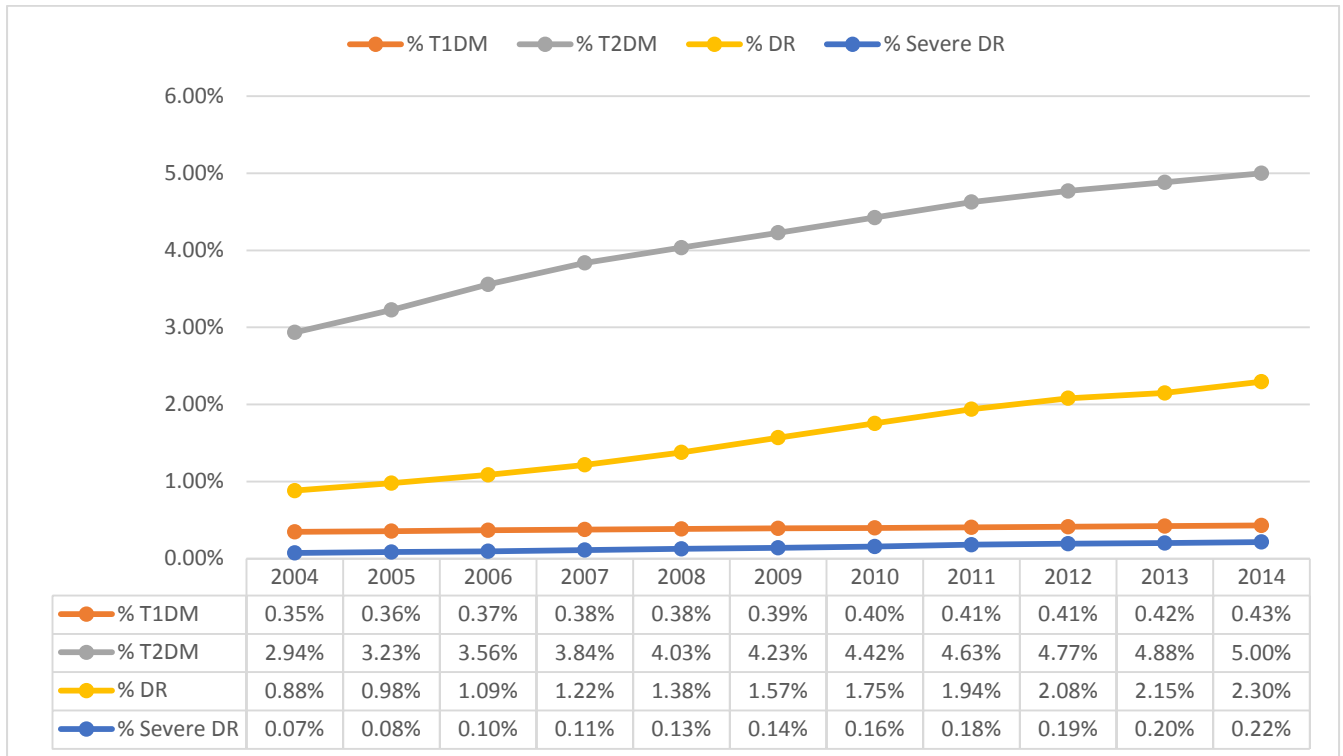


Figure 3. Prevalence of diabetes and retinopathy in the CPRD 2004-2014

By Gender

The overall prevalence of both diabetes and diabetic retinopathy is consistently higher in males compared to females.

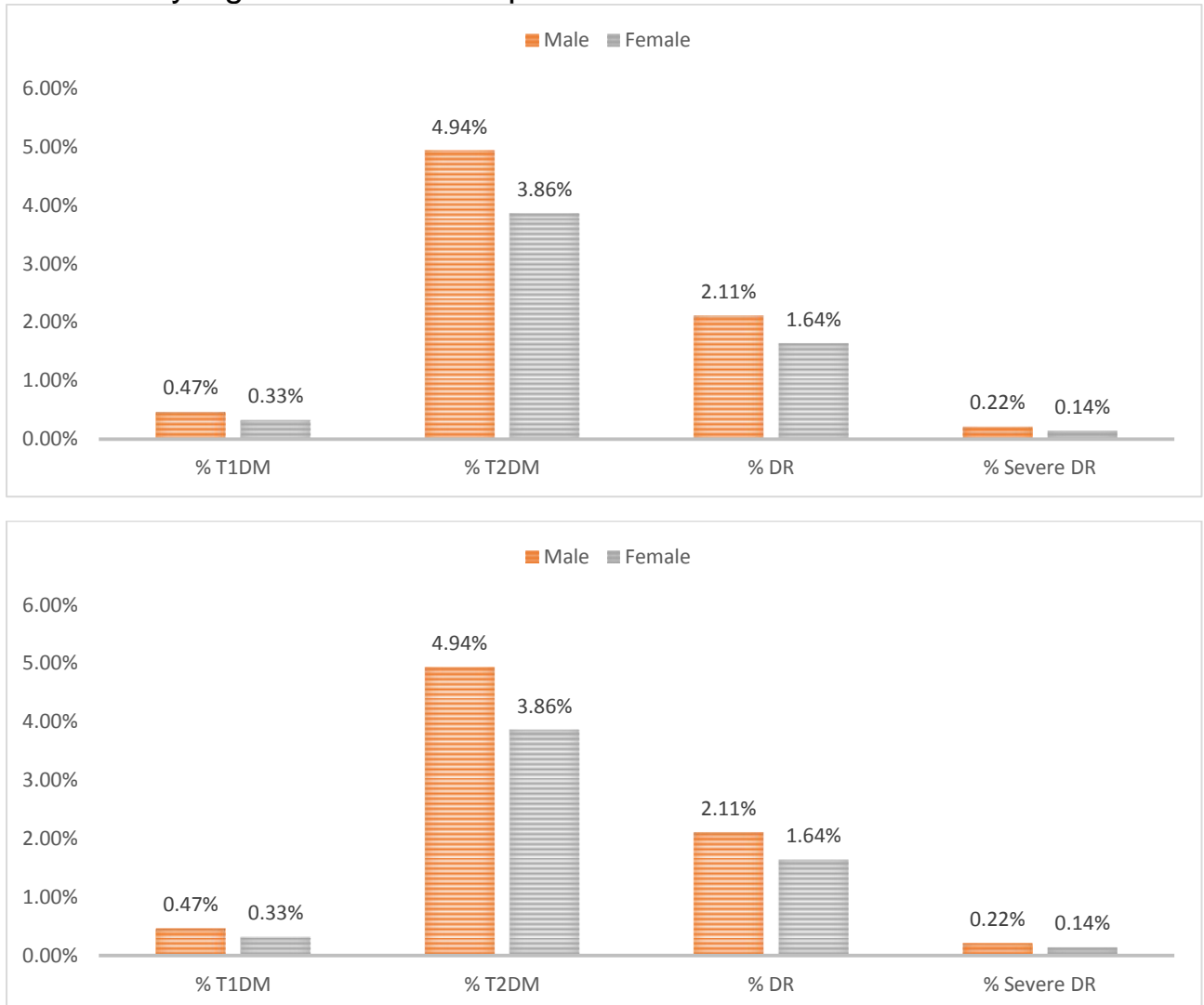


Figure 4. Prevalence of diabetes and retinopathy in the CPRD by gender

When examined separately by gender, the prevalence of both type 1 and type 2 diabetes and diabetic retinopathy is lower for women in all years compared to men, with the gap widening from 2009 onwards. The same trend holds true for both overall retinopathy and severe retinopathy.

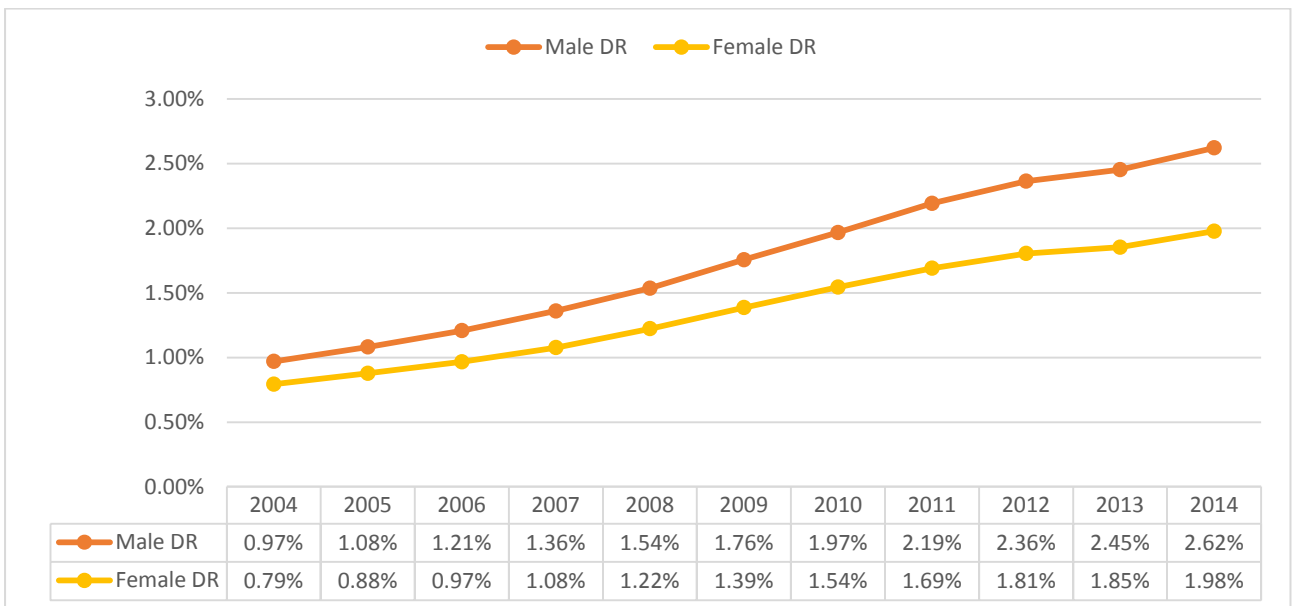
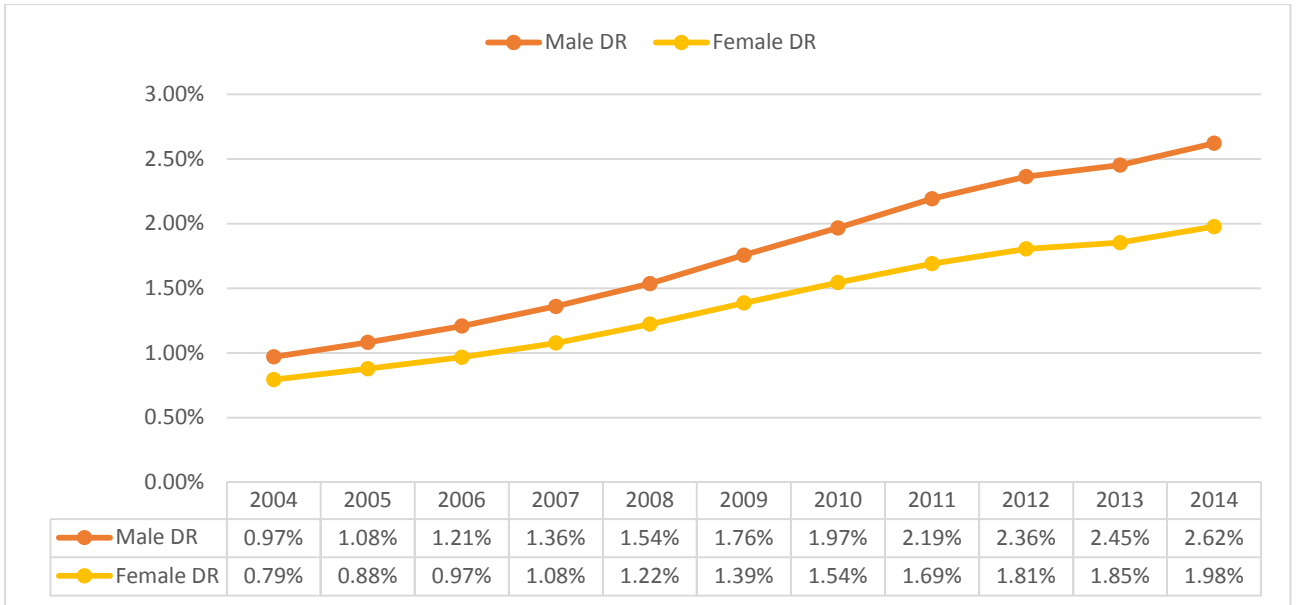


Figure 5. Prevalence of all retinopathy in the CPRD 2004-2014 by gender

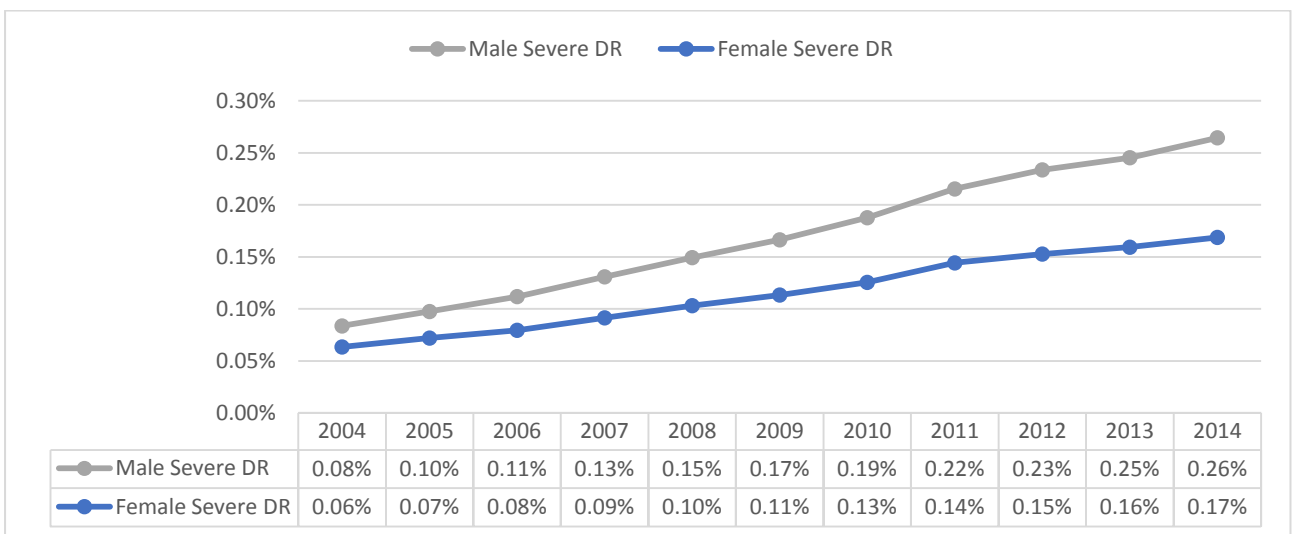
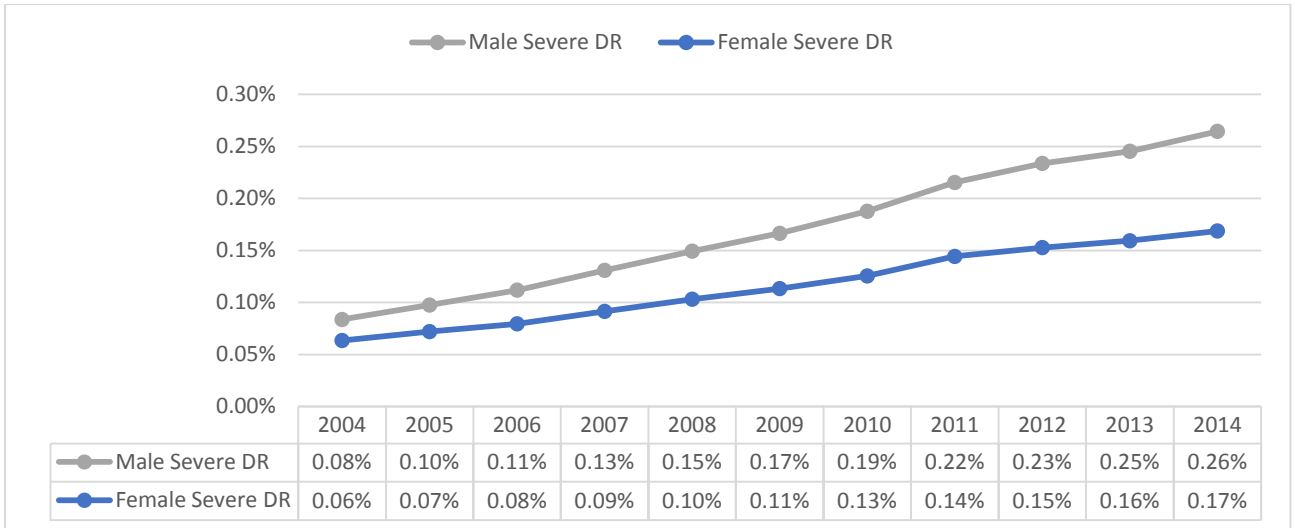
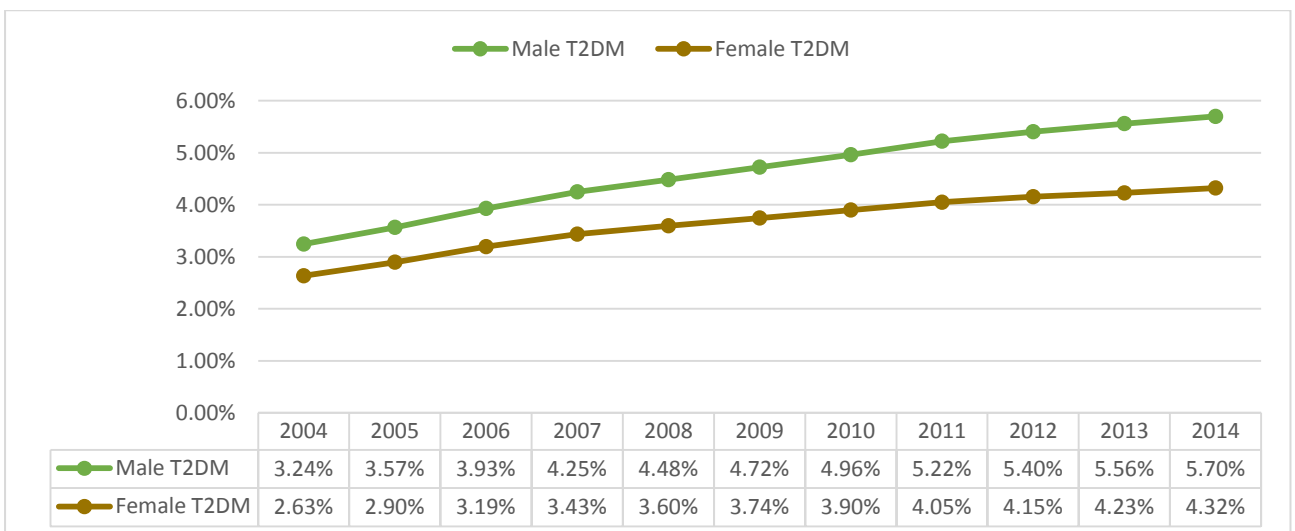


Figure 6. Prevalence of severe retinopathy in the CPRD 2004-2014 by gender



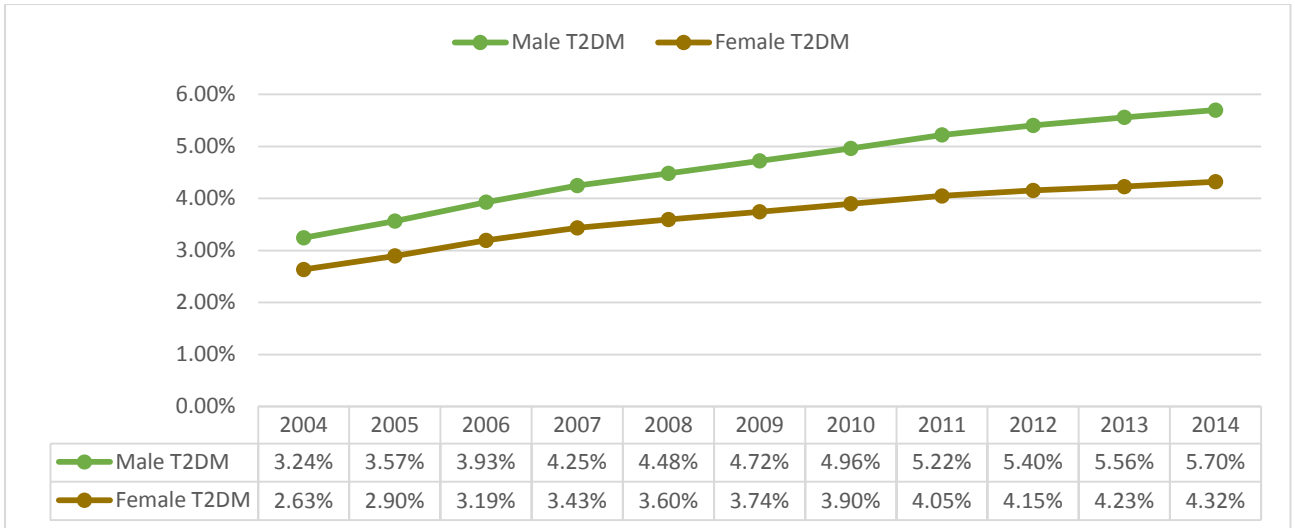


Figure 7. Prevalence of type 2 diabetes in the CPRD 2004-2014 by gender

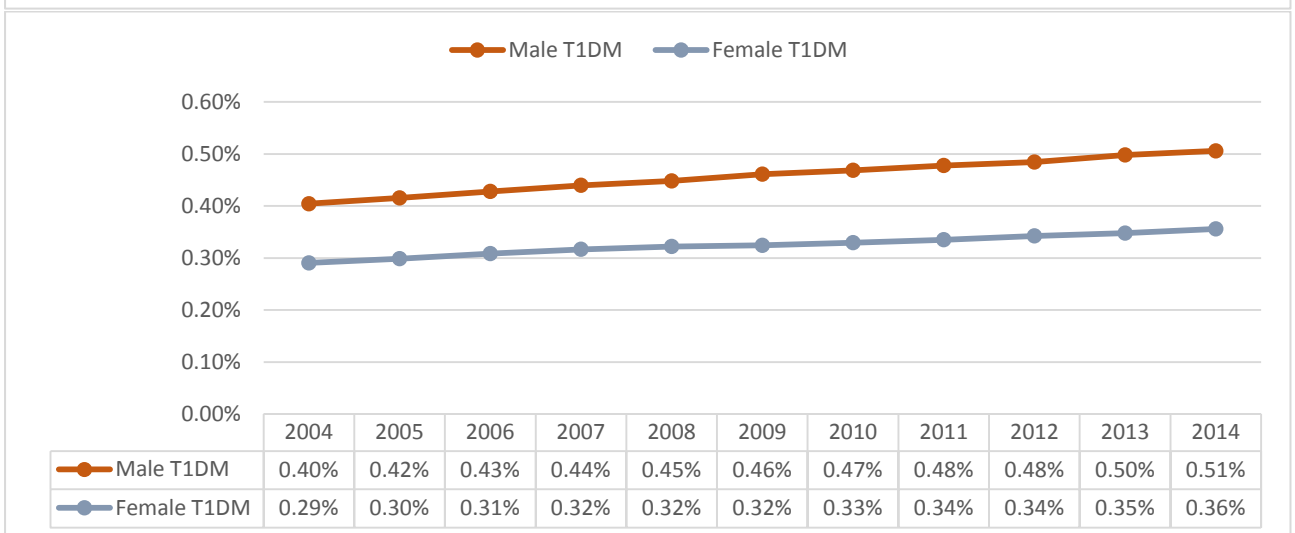
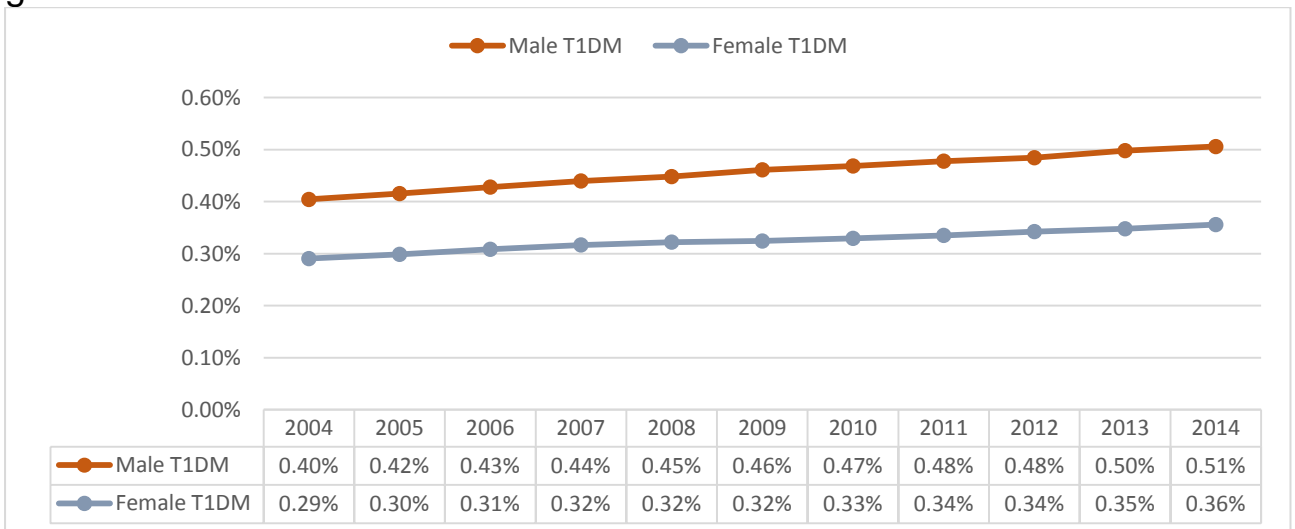


Figure 8. Prevalence of type 1 diabetes in the CPRD 2004-2014 by gender

By Age group

After splitting the population into ten year age bands, there is a clear trend towards increasing prevalence both over time and with increasing age. The increase in prevalence of retinopathy over time is most pronounced for individuals aged 55 and over. The same trend is apparent for severe diabetic retinopathy. Examining trends in the prevalence of type 2 diabetes by age group and time period, there is a slight increase in prevalence over time, which is most pronounced in the oldest age groups.



Figure 9. Prevalence of diabetes mellitus and retinopathy in the CPRD 2004-2014 by age group

By Ethnic Group

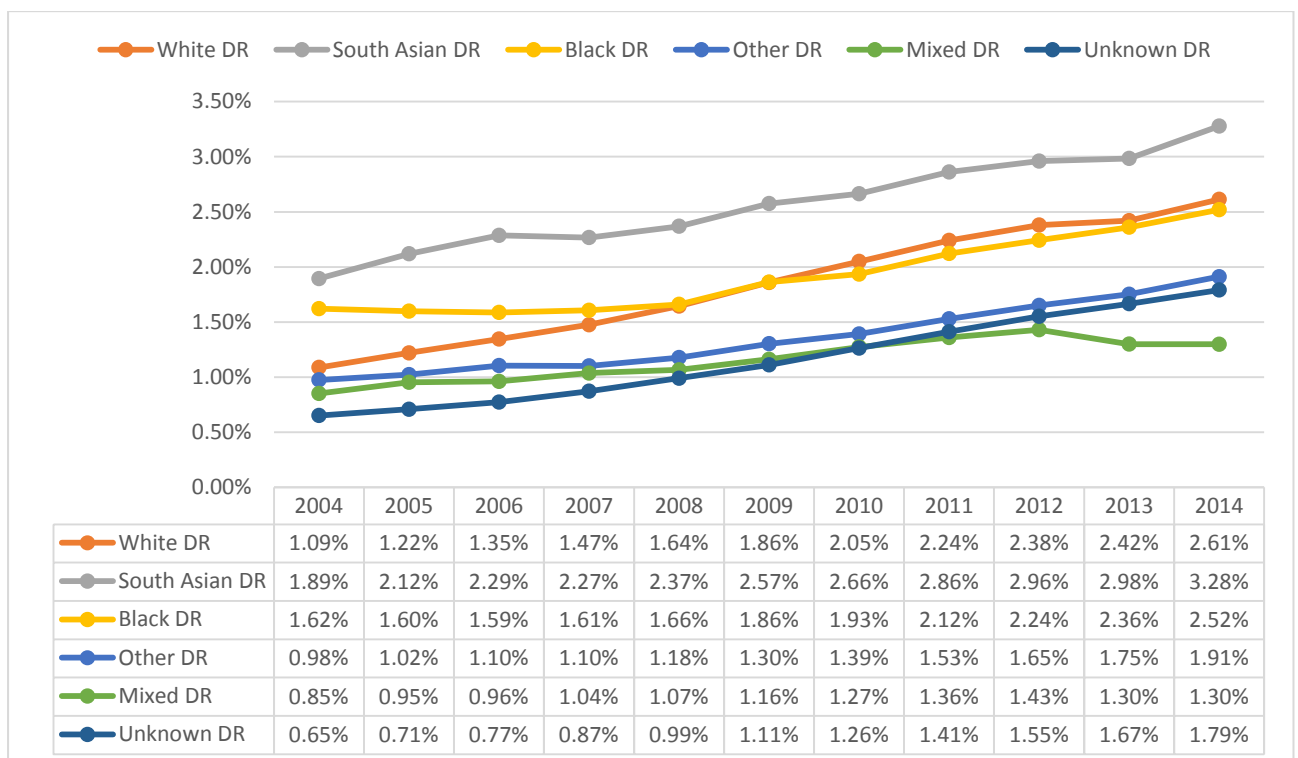
By ethnic group, the prevalence of type 2 diabetes and retinopathy is highest in the South Asian group while prevalence of type 1 diabetes is highest in the White group.



Figure 10. Prevalence of diabetes mellitus and retinopathy in the CPRD by ethnic group

Over time, the prevalence of retinopathy and severe retinopathy increased. Prevalence of both forms of retinopathy was consistently highest for the South Asian population, followed by the Black African/Caribbean and White populations, for whom prevalence overlapped from 2008 onwards. Prevalence was lowest for those of Mixed or unknown ethnicity.

As with retinopathy, the prevalence of type 2 diabetes is highest for the South Asian group followed by the Black African/Caribbean group and the White group. Prevalence increases over time in all groups, most notably for the White and unknown ethnic groups. Prevalence of type 1 diabetes remains stable over time for most ethnic groups, rising slightly in recent years for the White, Other, and Mixed ethnic groups.



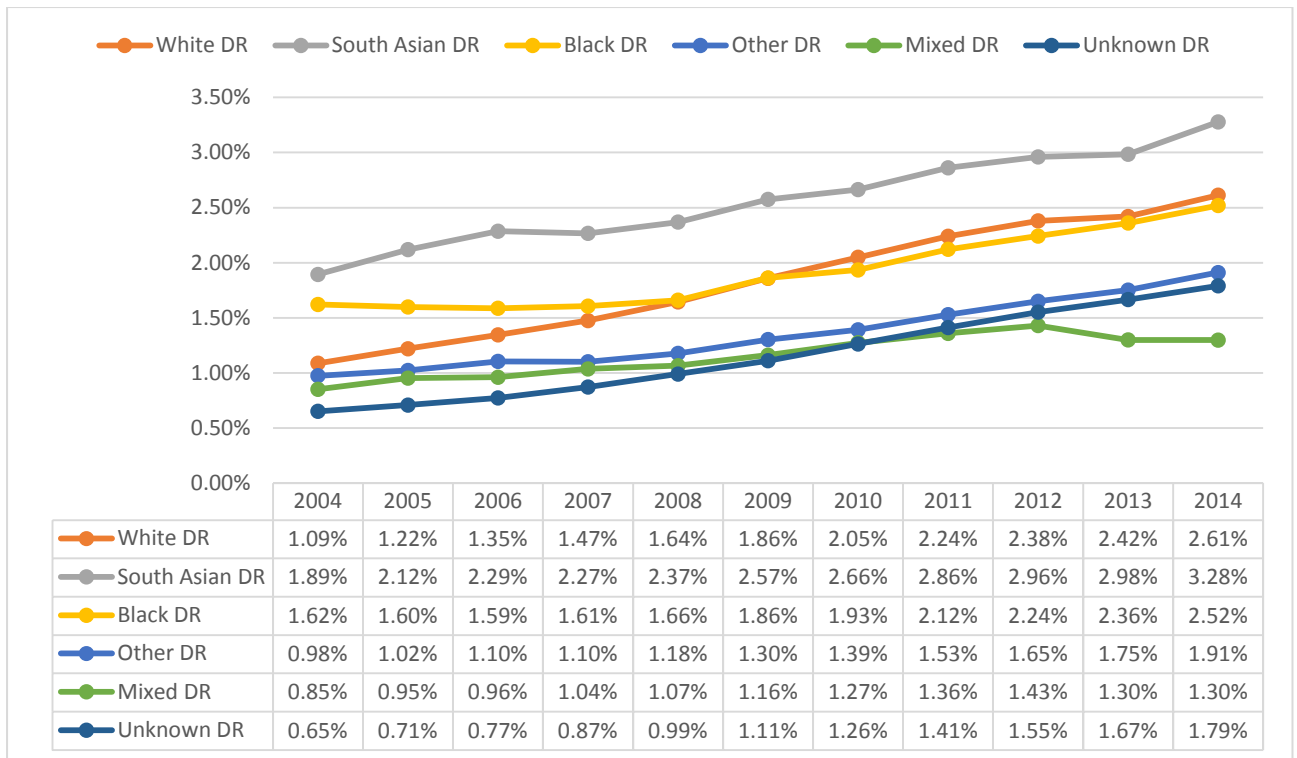
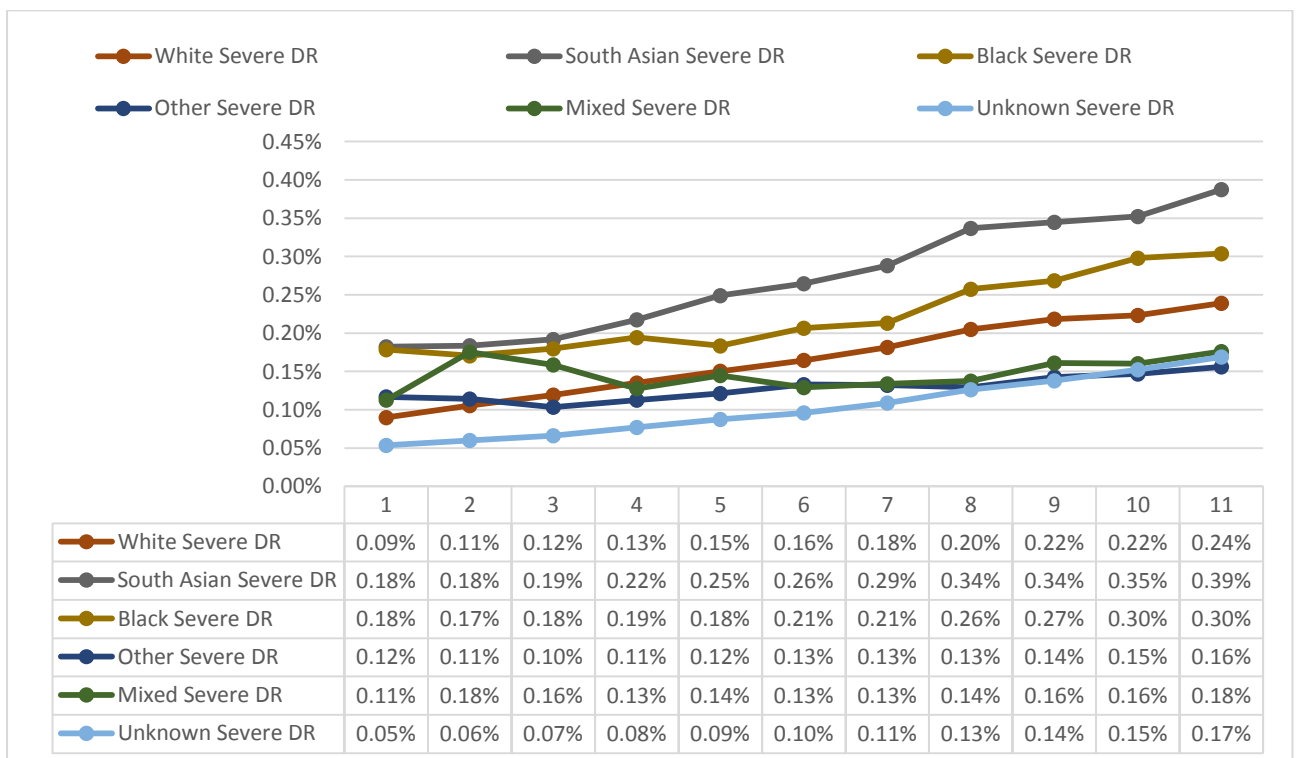


Figure 11. Prevalence of all retinopathy in the CPRD 2004-2014 by ethnic group



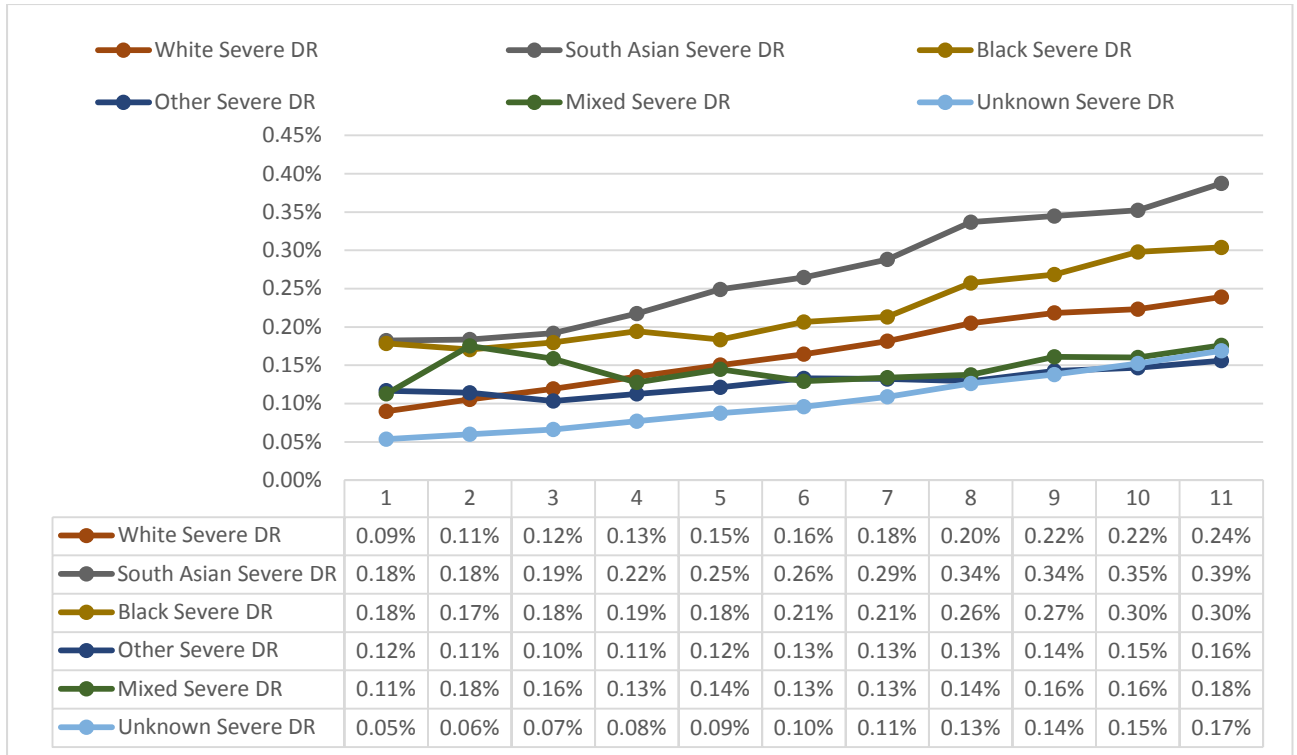
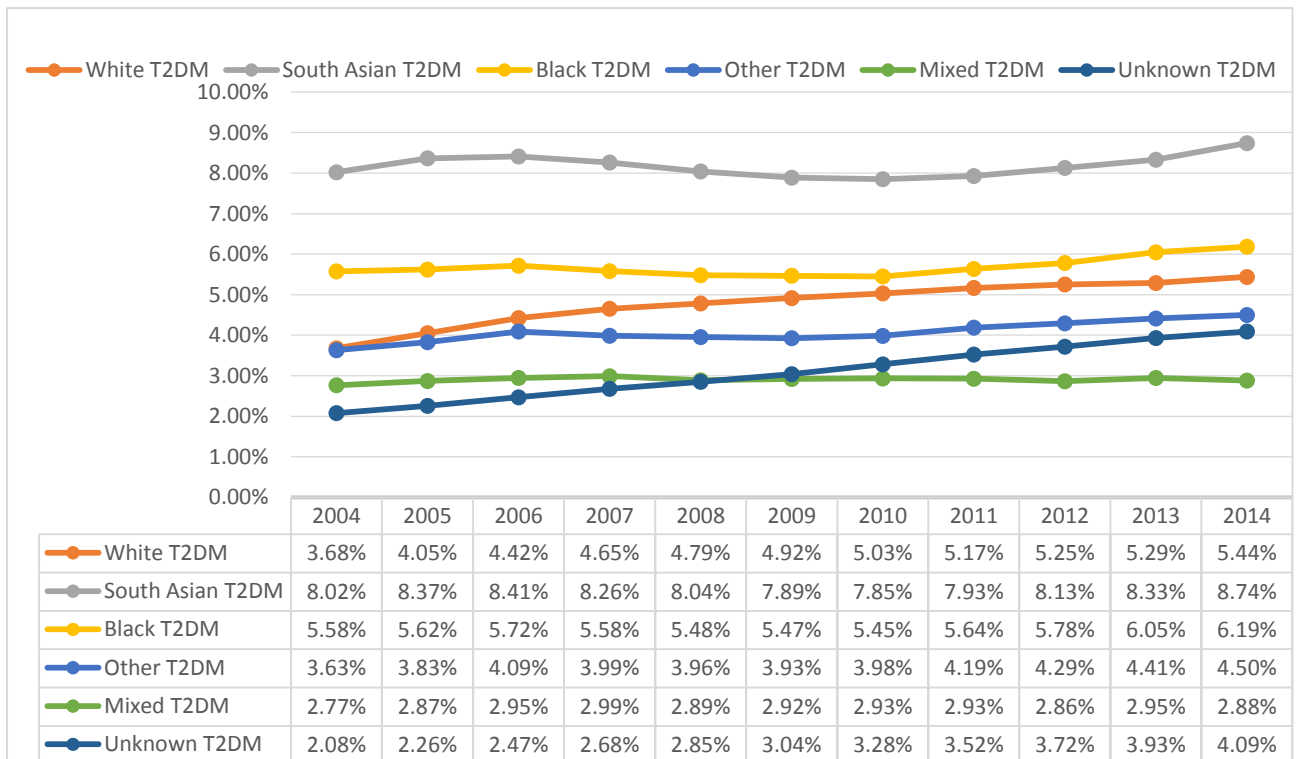


Figure 12. Prevalence of severe retinopathy in the CPRD 2004-2014 by ethnic group



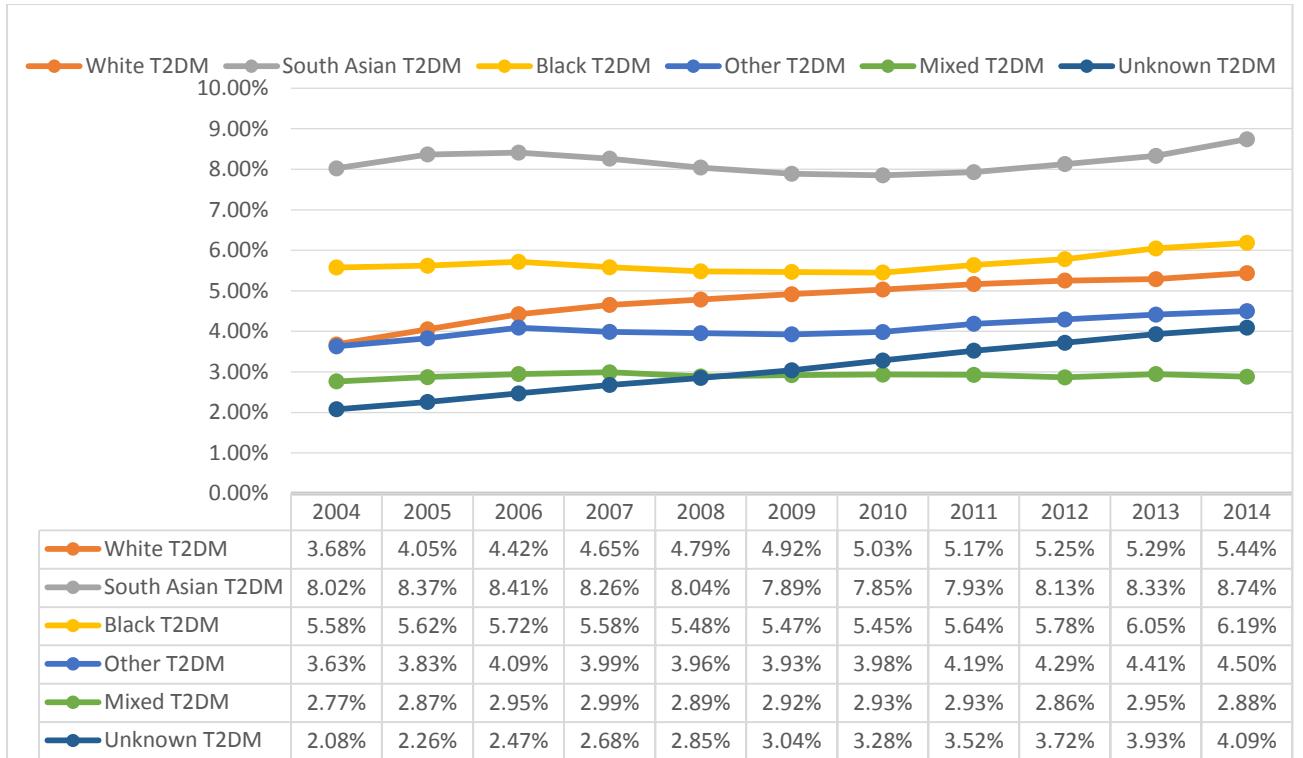
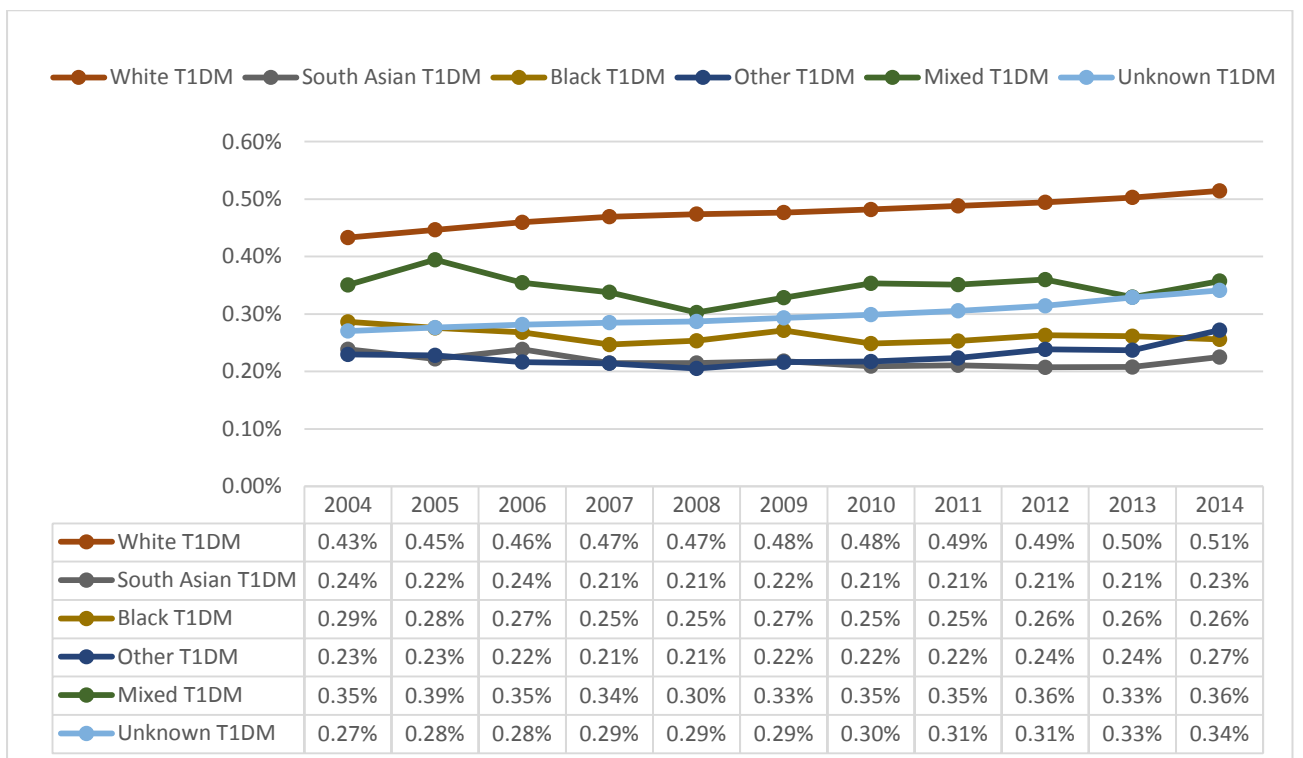


Figure 13. Prevalence of type 2 diabetes in the CPRD 2004-2014 by ethnic group



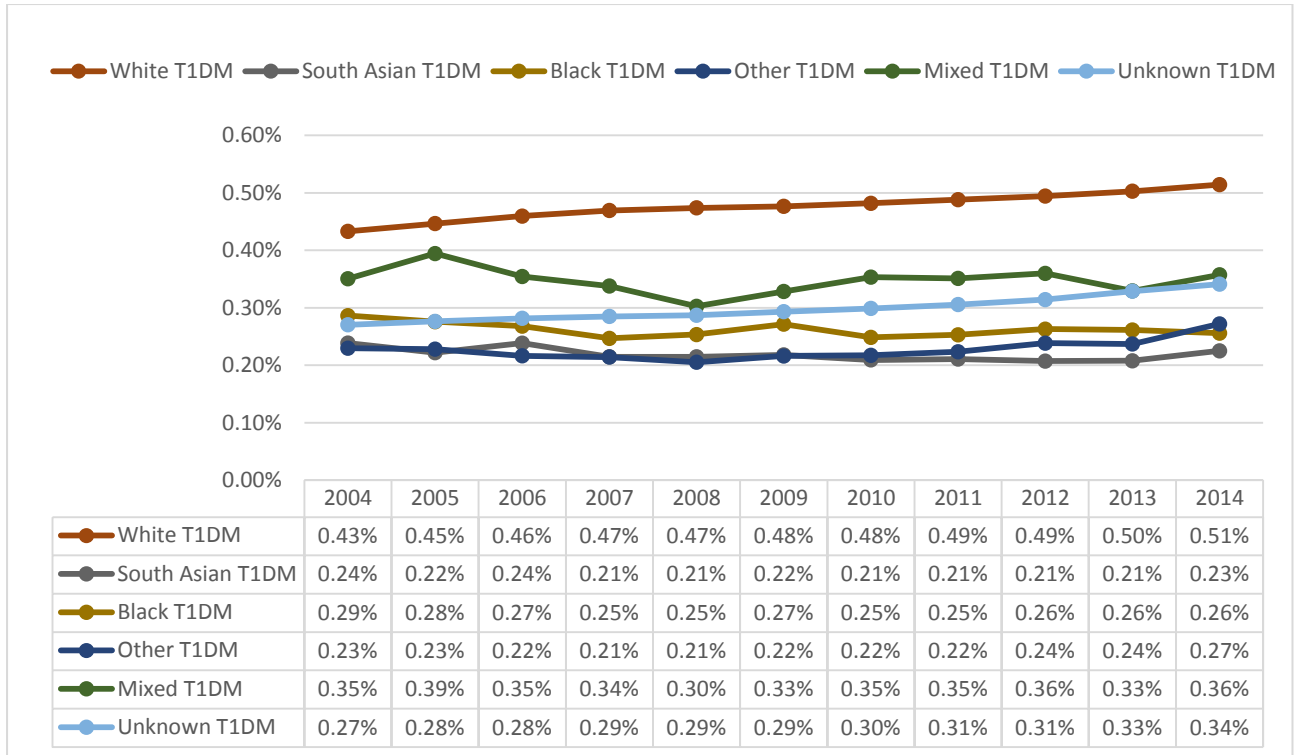


Figure 14. Prevalence of type 1 diabetes in the CPRD 2004-2014 by ethnic group

By Index of Multiple Deprivation Quintile

The prevalence of type two diabetes and retinopathy showed a clear trend with increasing deprivation. No relationship between deprivation and the prevalence of type 1 diabetes or severe retinopathy is evident.

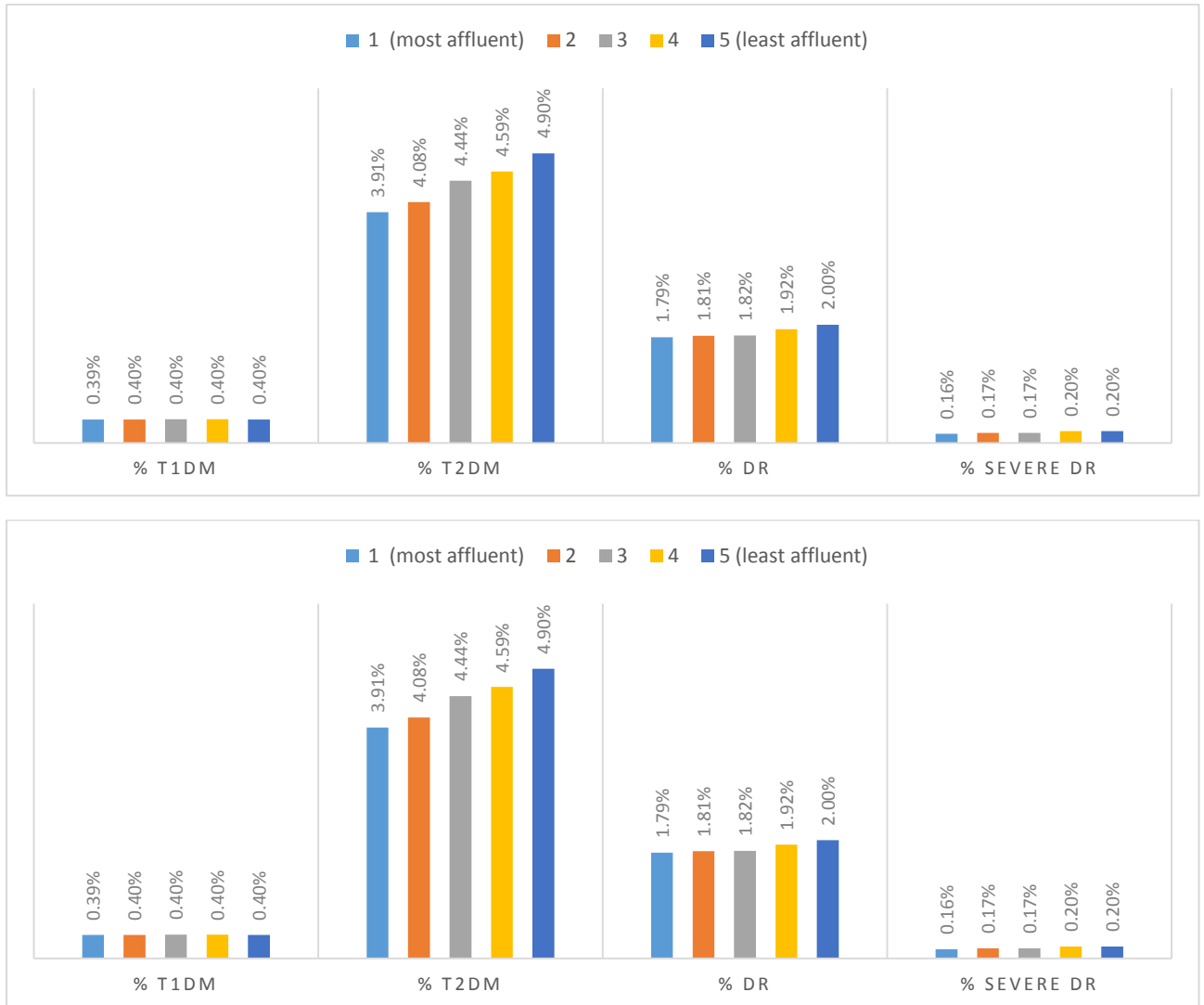


Figure 15. Prevalence of diabetes and retinopathy in the CPRD by deprivation quintile



Figure 16. Prevalence of all retinopathy in the CPRD 2004-2014 by deprivation quintile

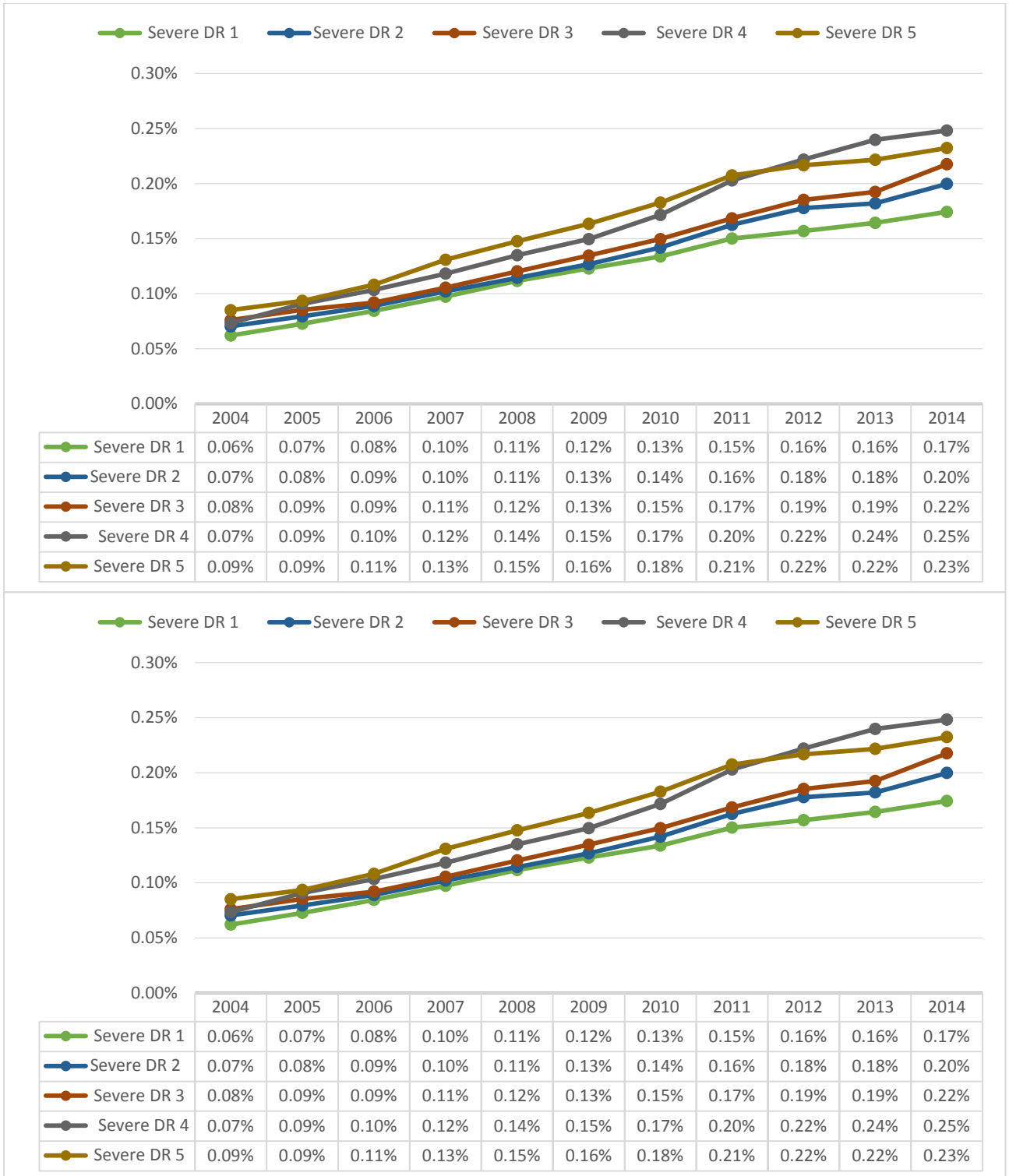


Figure 17. Prevalence of severe retinopathy in the CPRD 2004-2014 by deprivation quintile

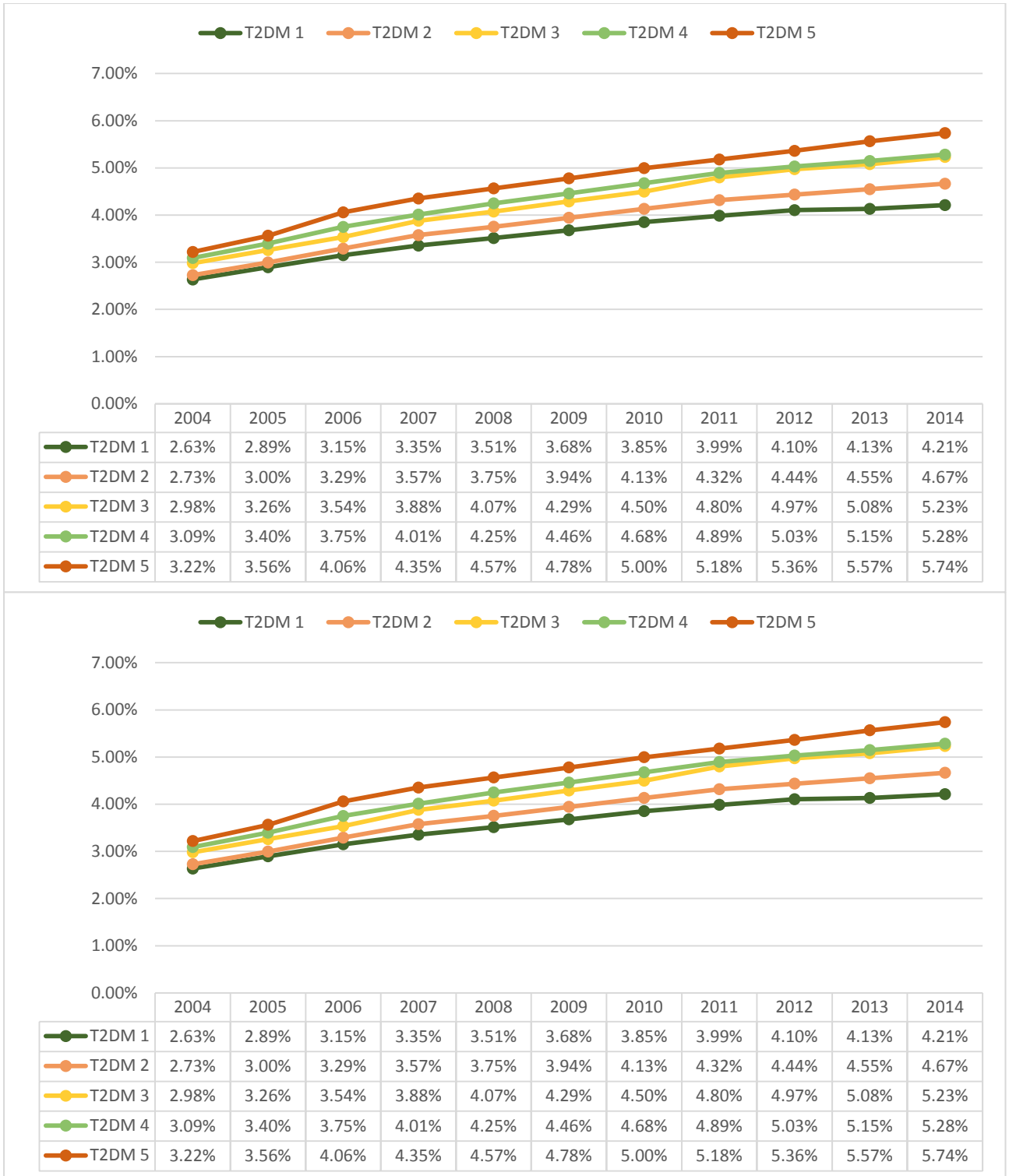


Figure 18. Prevalence of type 2 diabetes in the CPRD 2004-2014 by deprivation quintile



Figure 19. Prevalence of type 1 diabetes in the CPRD 2004-2014 by deprivation quintile

By Geographic Region

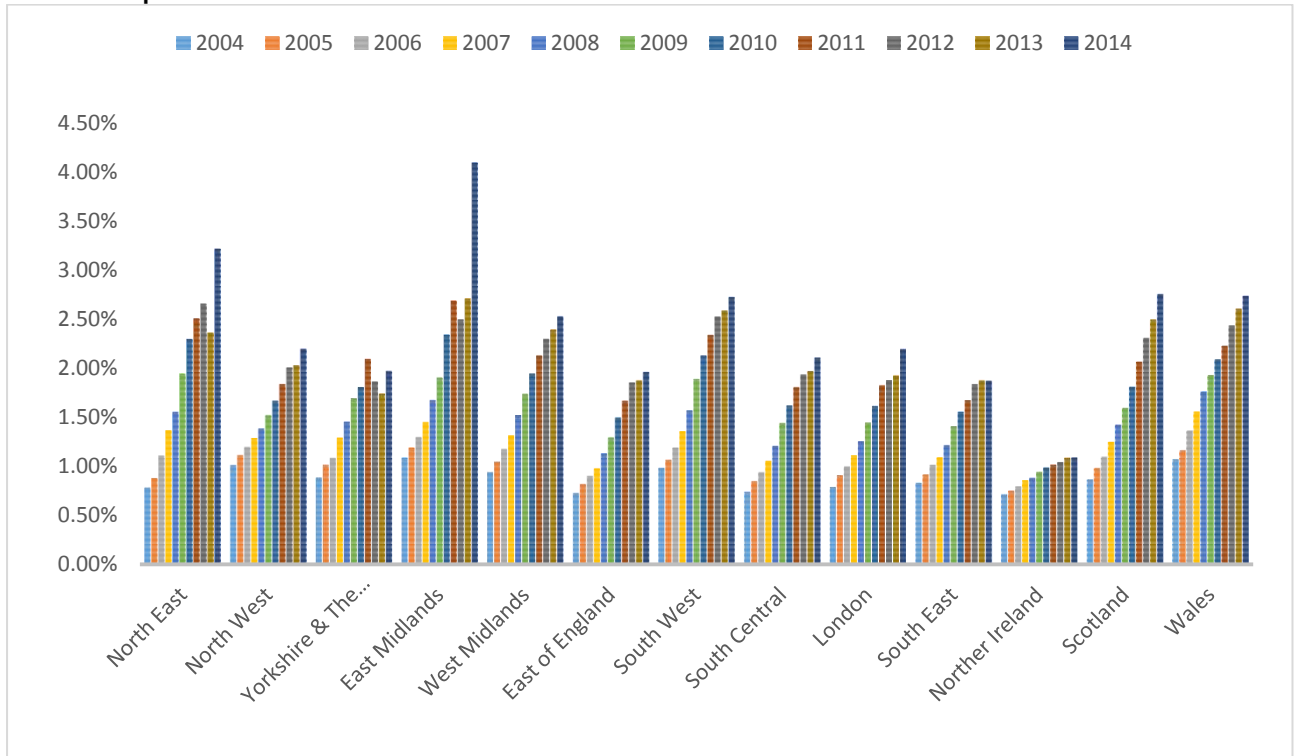
By geographic region the prevalence of type 2 diabetes and retinopathy were both highest in Wales, followed by the North West of England. The prevalence of severe diabetic retinopathy was highest in the North East of England while the prevalence of type 1 diabetes was highest in Scotland.



Figure 20. Prevalence of diabetes and retinopathy in the CPRD by region

Over time, the prevalence of retinopathy increases at variable rates depending on region. While the annual change is low in Northern Ireland, the annual change is higher in regions such as Scotland and the North East of England.

For severe diabetic retinopathy the annual increases are more modest overall, except for in areas such as the North East of England, the East Midlands, and the South West of England, where increases over time are steeper.



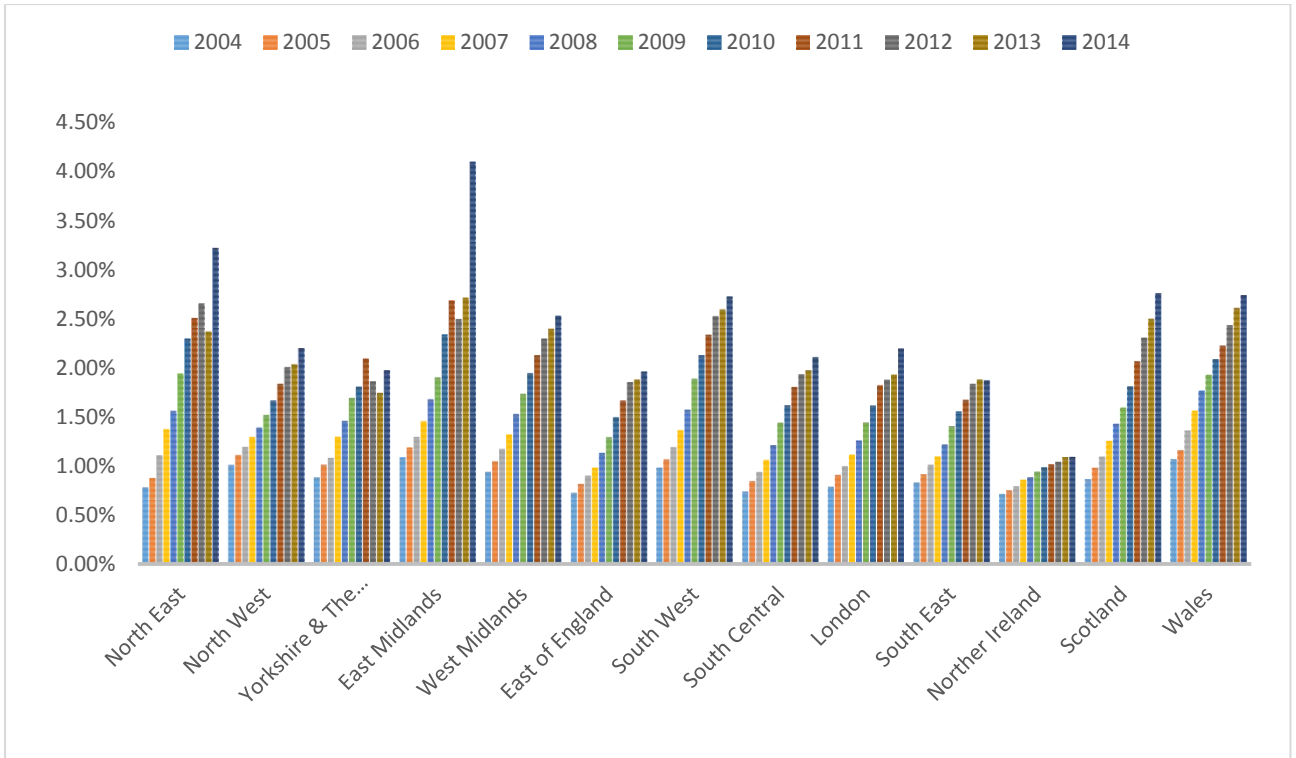
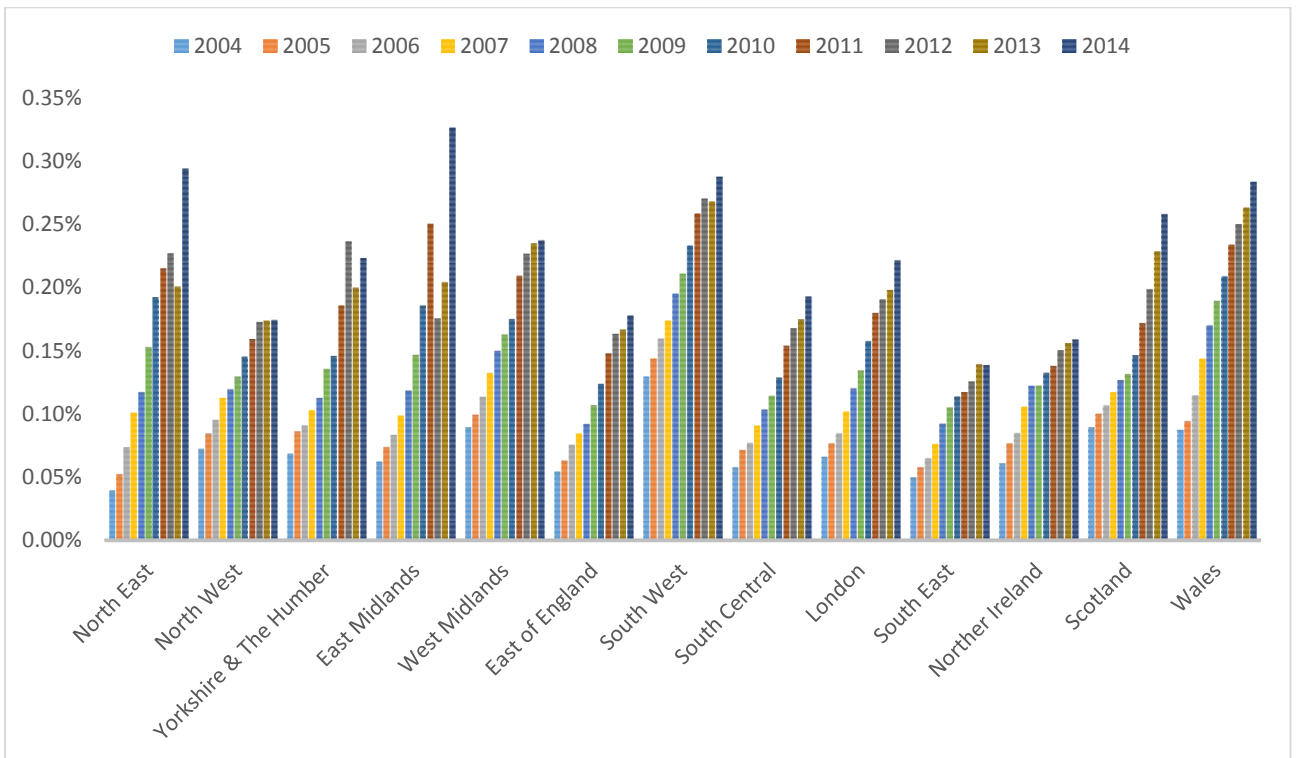


Figure 21. Prevalence of retinopathy in the CPRD 2004-2014 by region



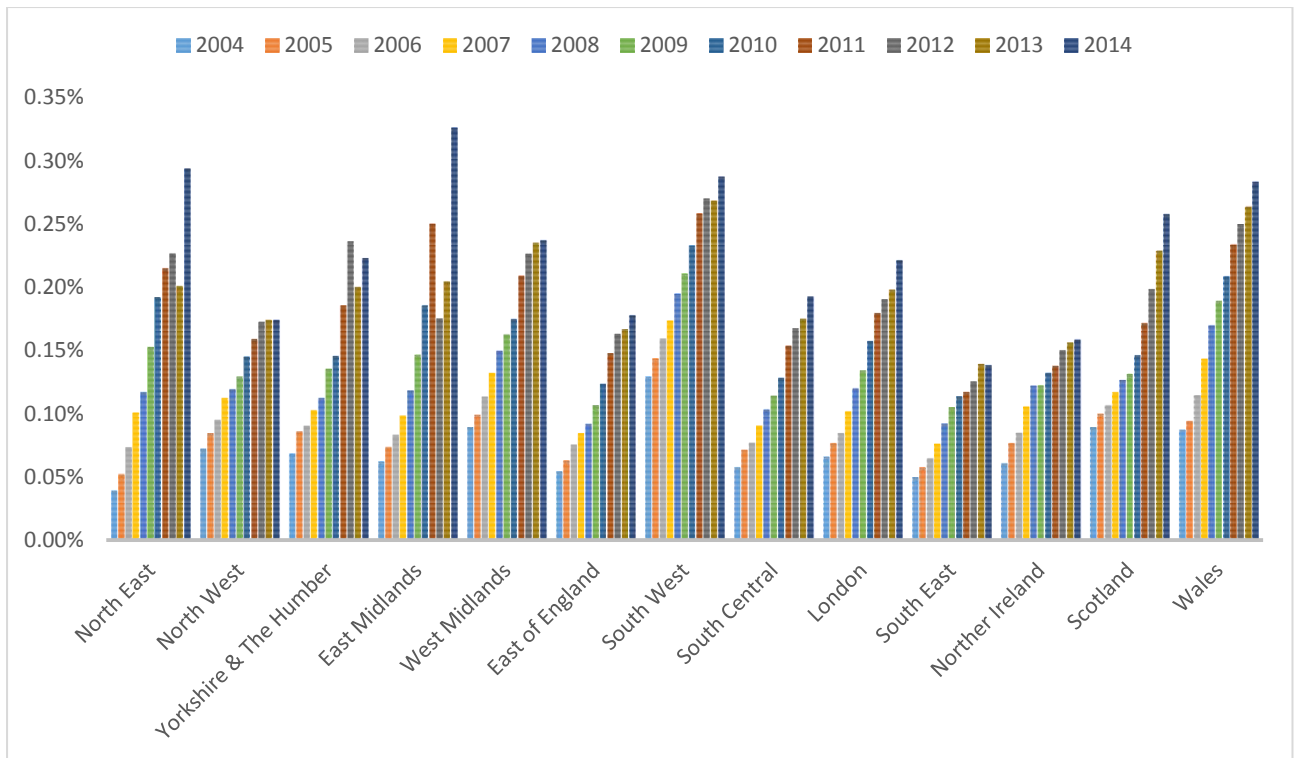


Figure 22. Prevalence of severe retinopathy in the CPRD 2004-2014 by region

Prevalence of retinopathy in patients with Type 2 diabetes By Gender

The overall prevalence of all retinopathy and severe retinopathy is higher in males compared to females with type 2 diabetes.

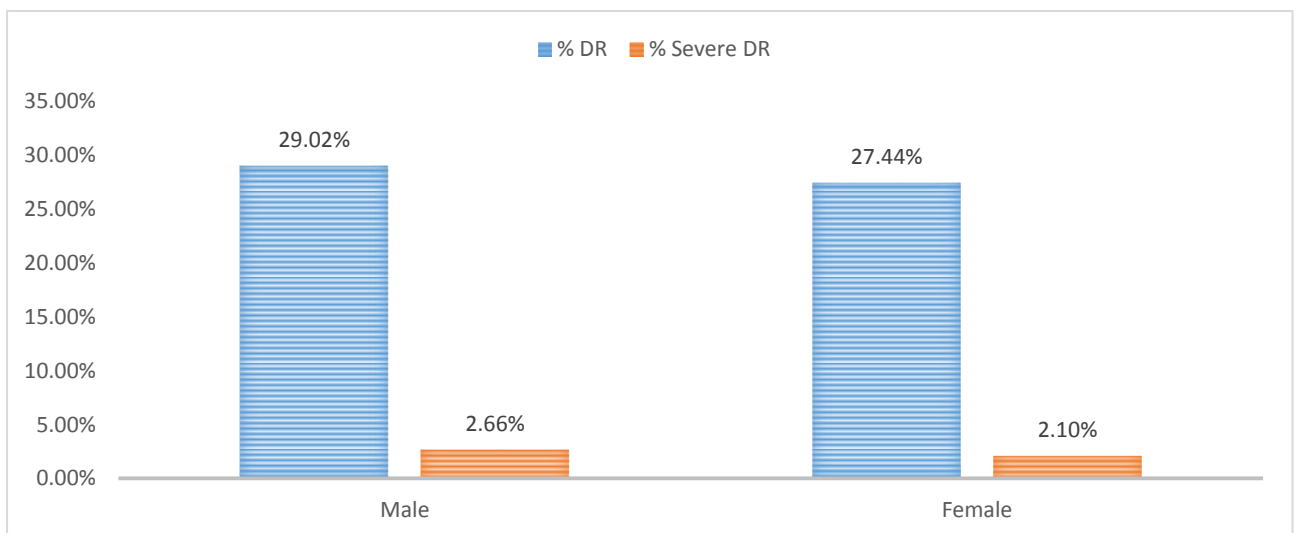
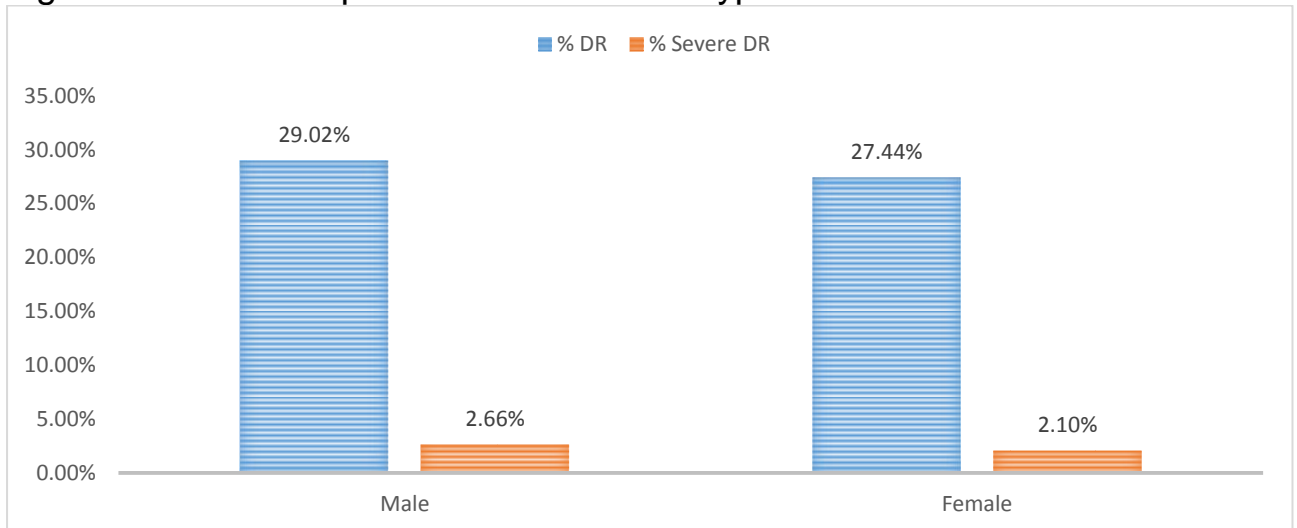


Figure 23. Prevalence of retinopathy in the T2DM population by gender

Over time, the prevalence of both retinopathy and severe retinopathy rise at a slightly higher rate for men compared to women, increasing the gap between genders over time.

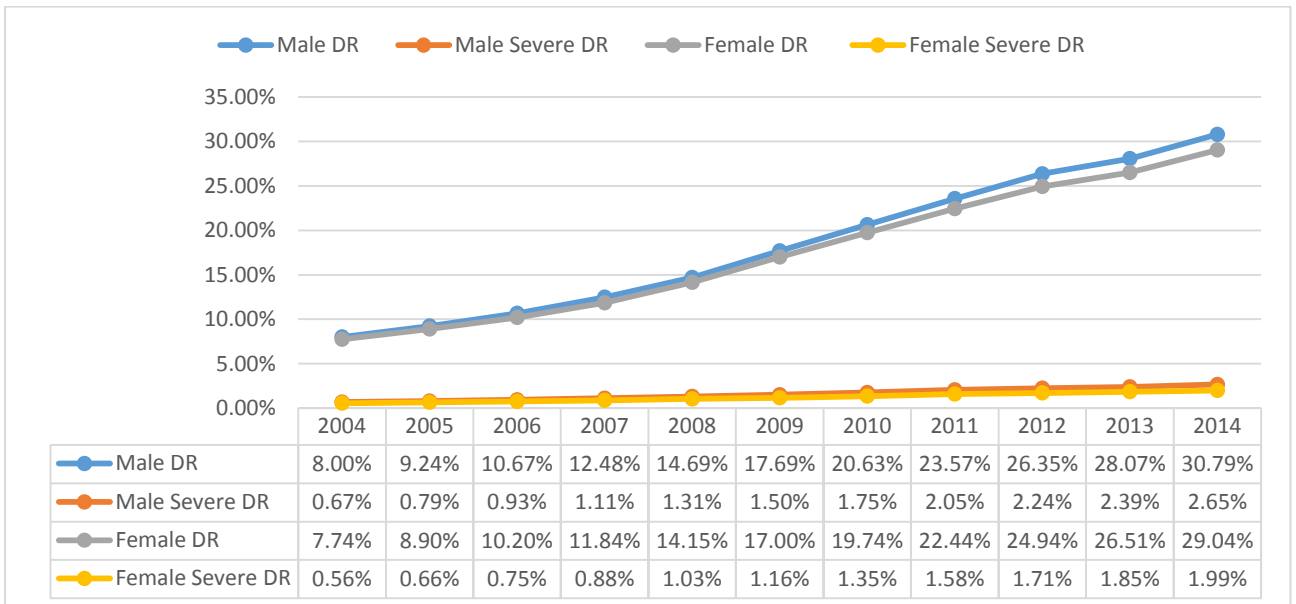
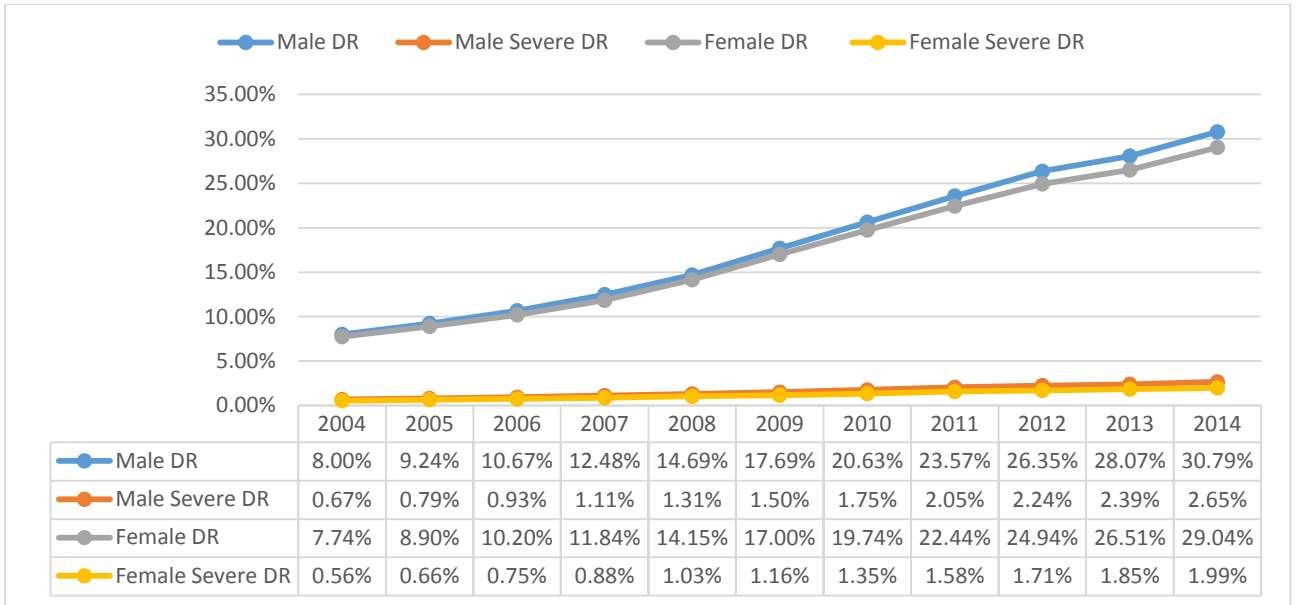


Figure 24. Prevalence of retinopathy in the T2DM population 2004-2014 by gender

By Age Group

In the population with type 2 diabetes, the prevalence of both retinopathy and severe retinopathy increases with age and over calendar period, particularly for individuals aged 25 and over. The rate of increase is highest in the oldest group of those aged 75 and over.

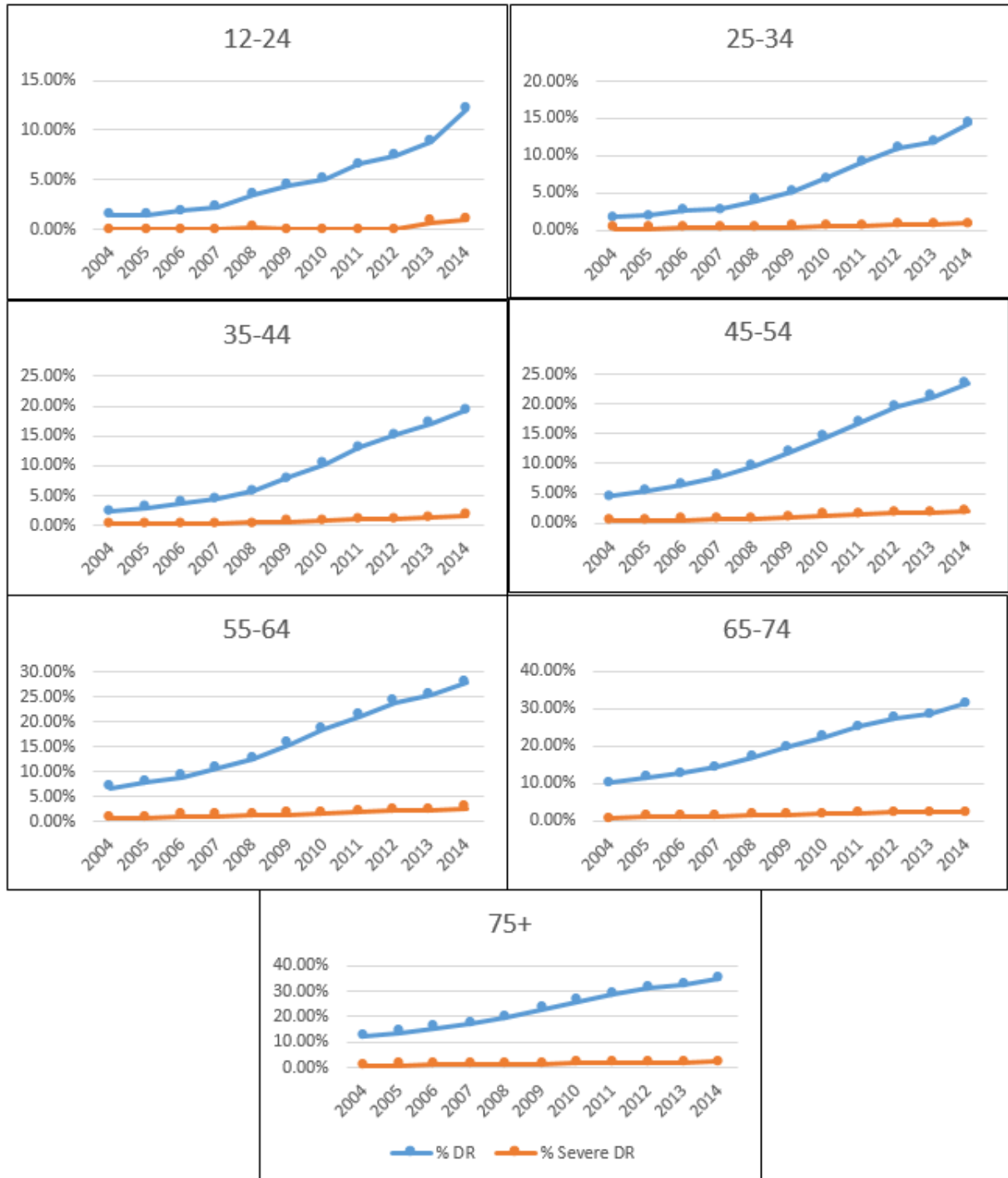


Figure 25. Prevalence of retinopathy in the T2DM population 2004-2014 by age group

By Ethnic Group

Amongst individuals with type 2 diabetes, though the overall prevalence of retinopathy is comparable between ethnic groups, differences in the progression over time are apparent.

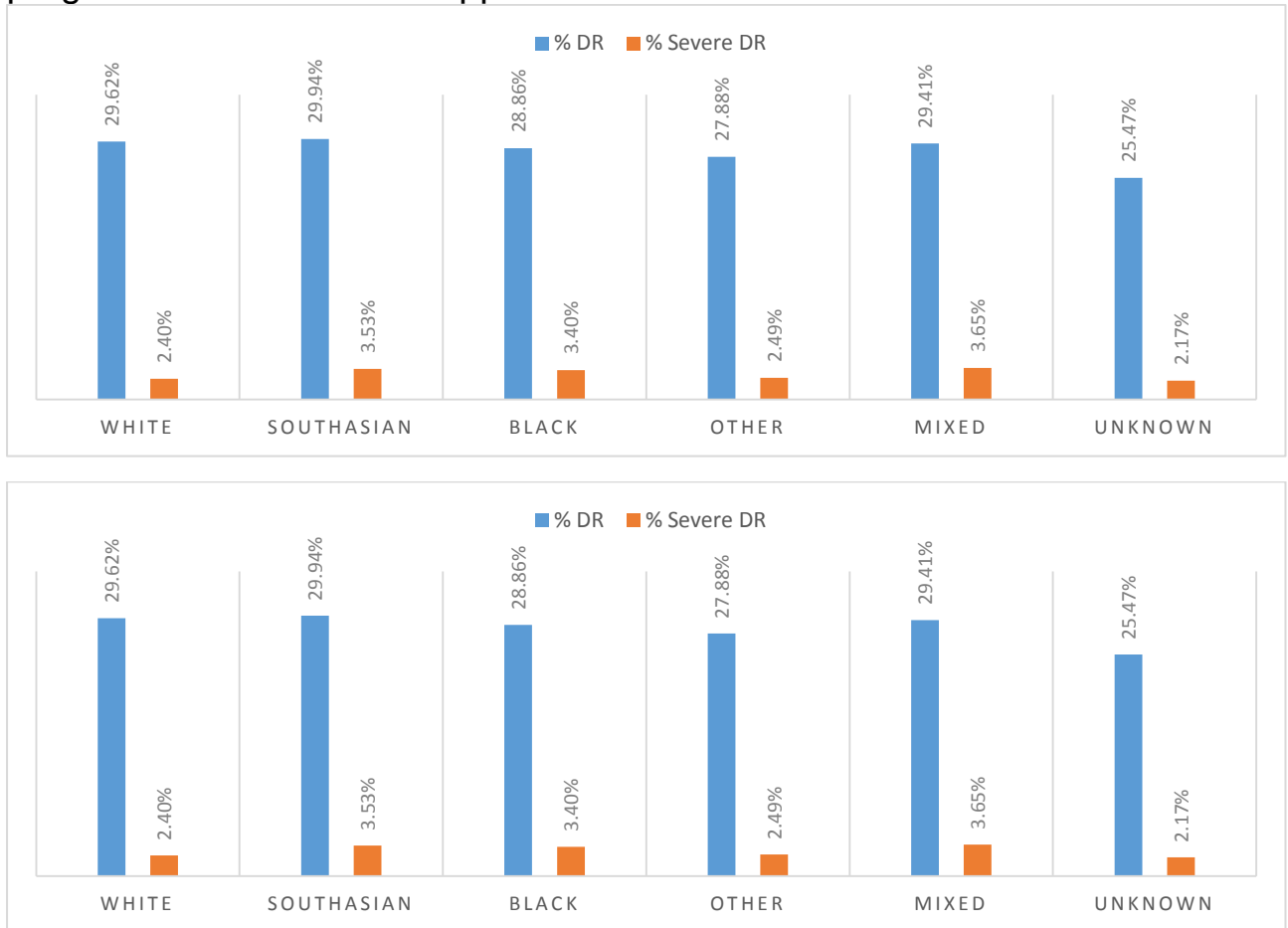


Figure 26. Prevalence of retinopathy in the T2DM population by ethnic group

Until 2010, the prevalence of retinopathy is highest in the South Asian population. After this time, the prevalence overlaps between the South Asian, White, Black African/Caribbean, and Mixed ethnic groups. The prevalence is lowest for those with unknown ethnicity in all years. The same trends are apparent for those with severe diabetic retinopathy, with the increase over time more modest.

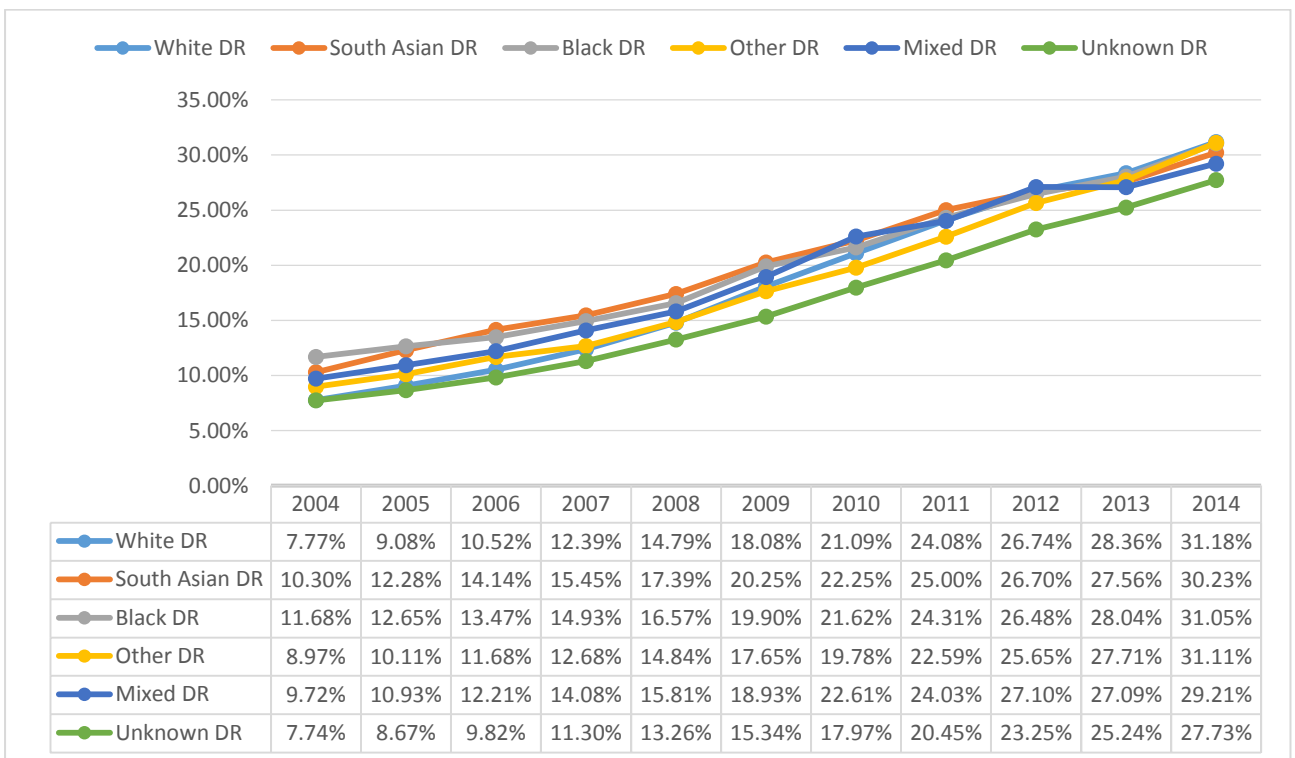
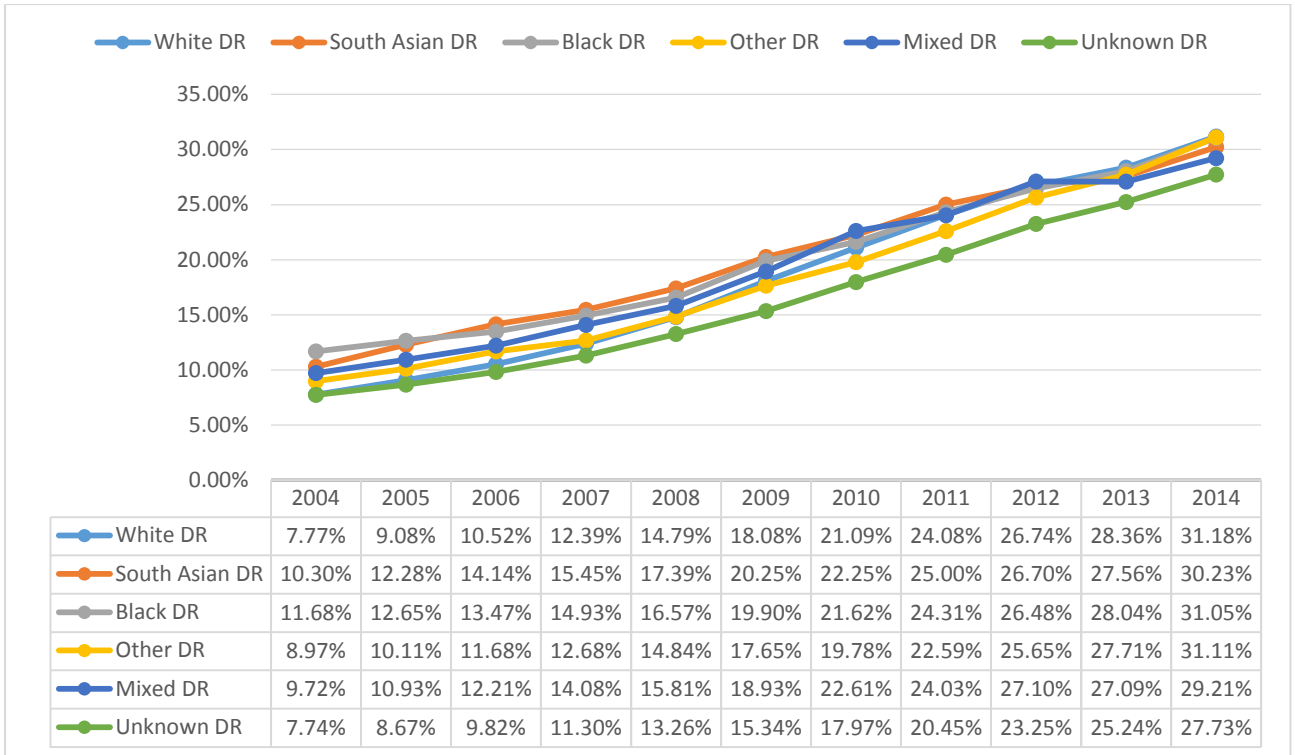


Figure 27. Prevalence of all retinopathy in the T2DM population 2004-2014 by ethnic group

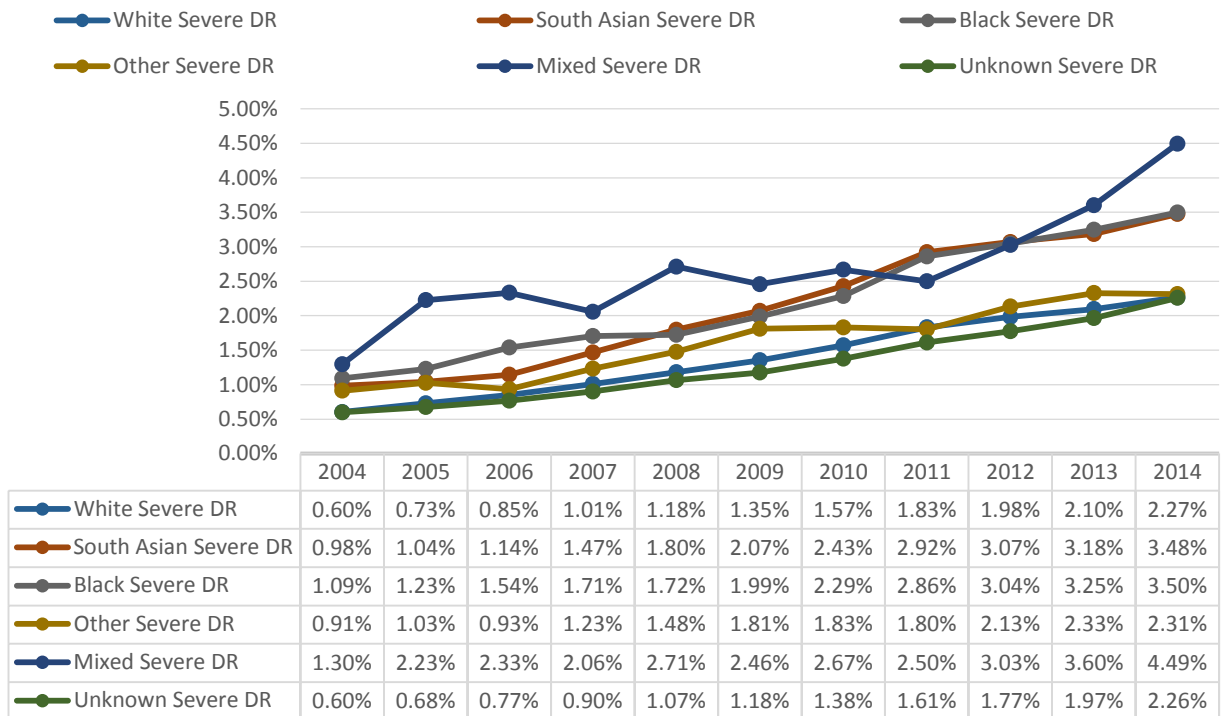
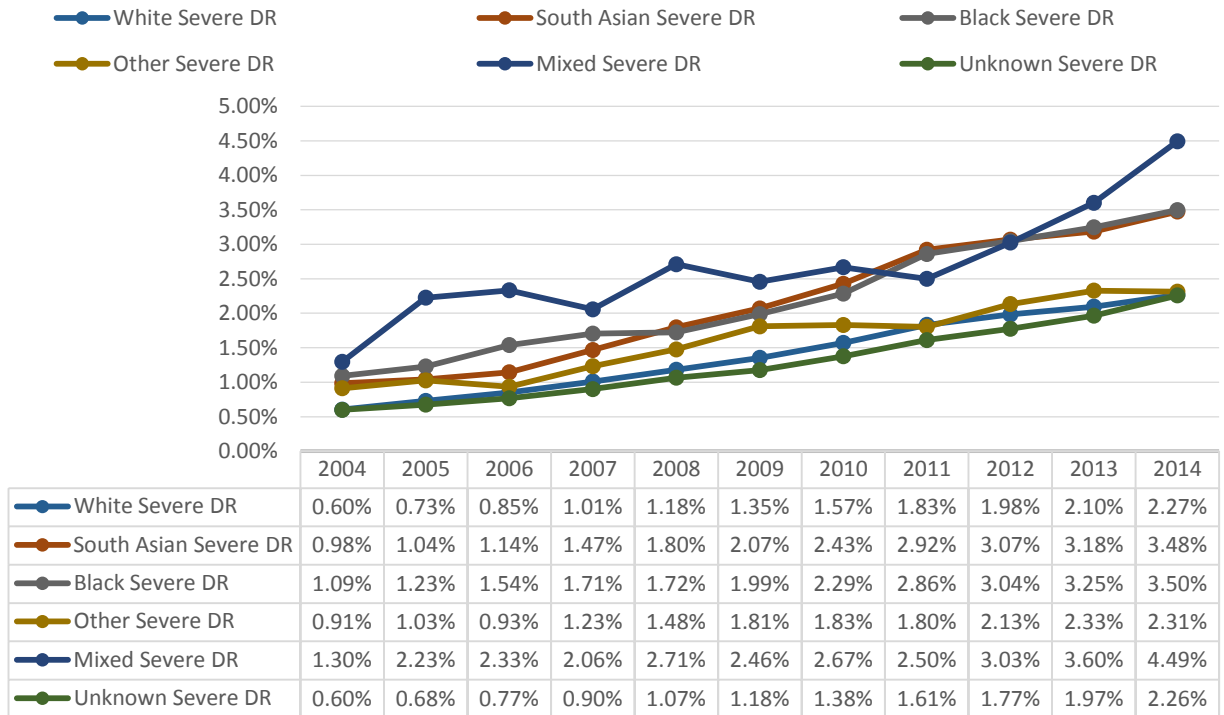


Figure 28. Prevalence of severe retinopathy in the T2DM population 2004-2014 by ethnic group

By Index of Multiple Deprivation Quintile

The overall prevalence of diabetic retinopathy is equivalent between deprivation quintiles. The prevalence of severe retinopathy increases slightly with increasing deprivation.

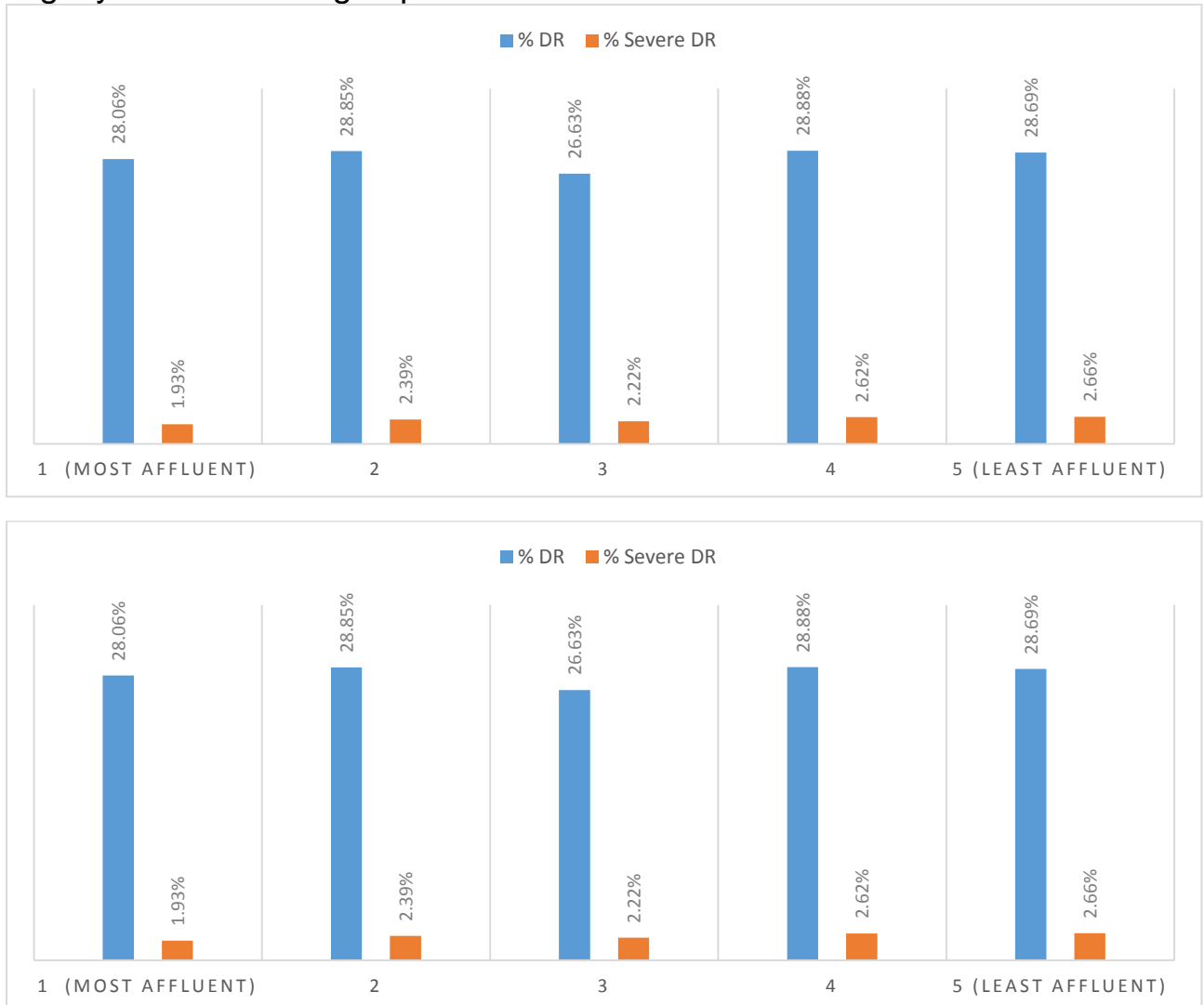


Figure 29. Prevalence of retinopathy in the T2DM population by deprivation quintile

Amongst individuals with type two diabetes, there is an overlap between deprivation groups with respect to the prevalence of both retinopathy and severe retinopathy, with no clear trend apparent.

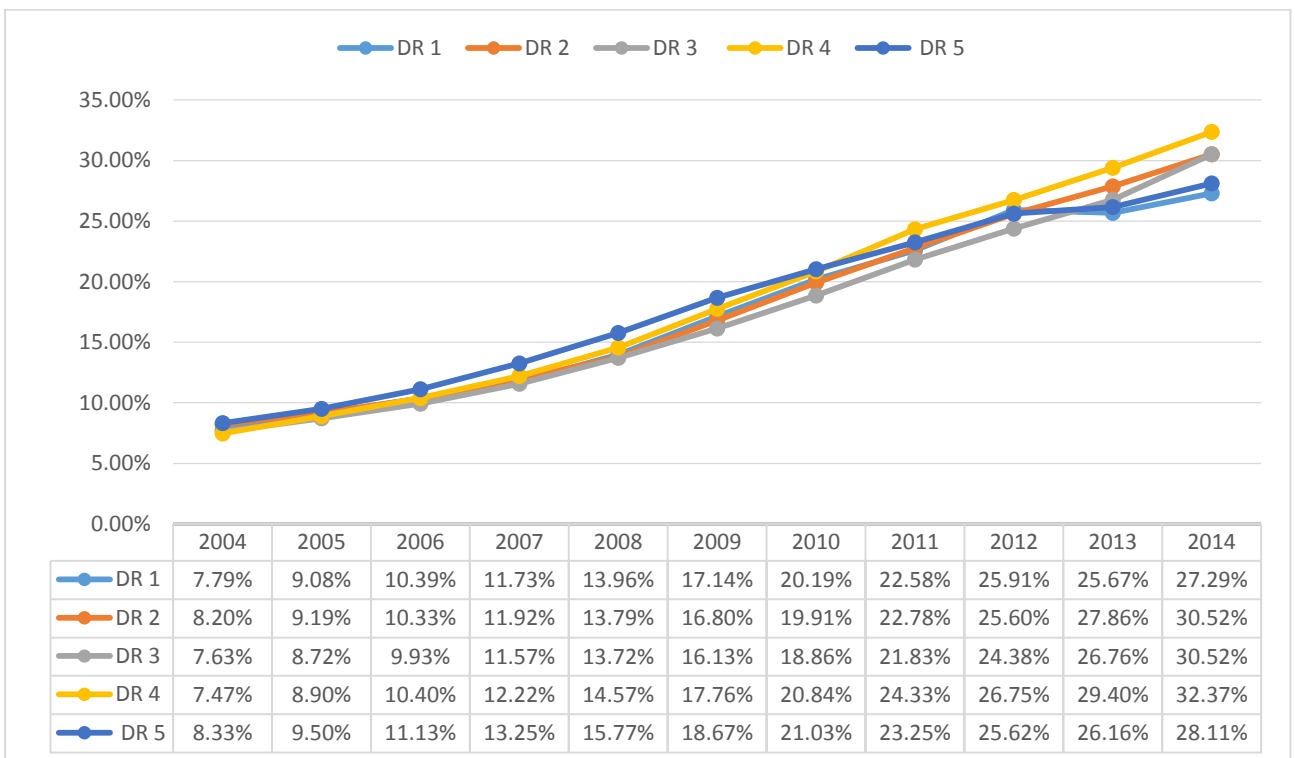
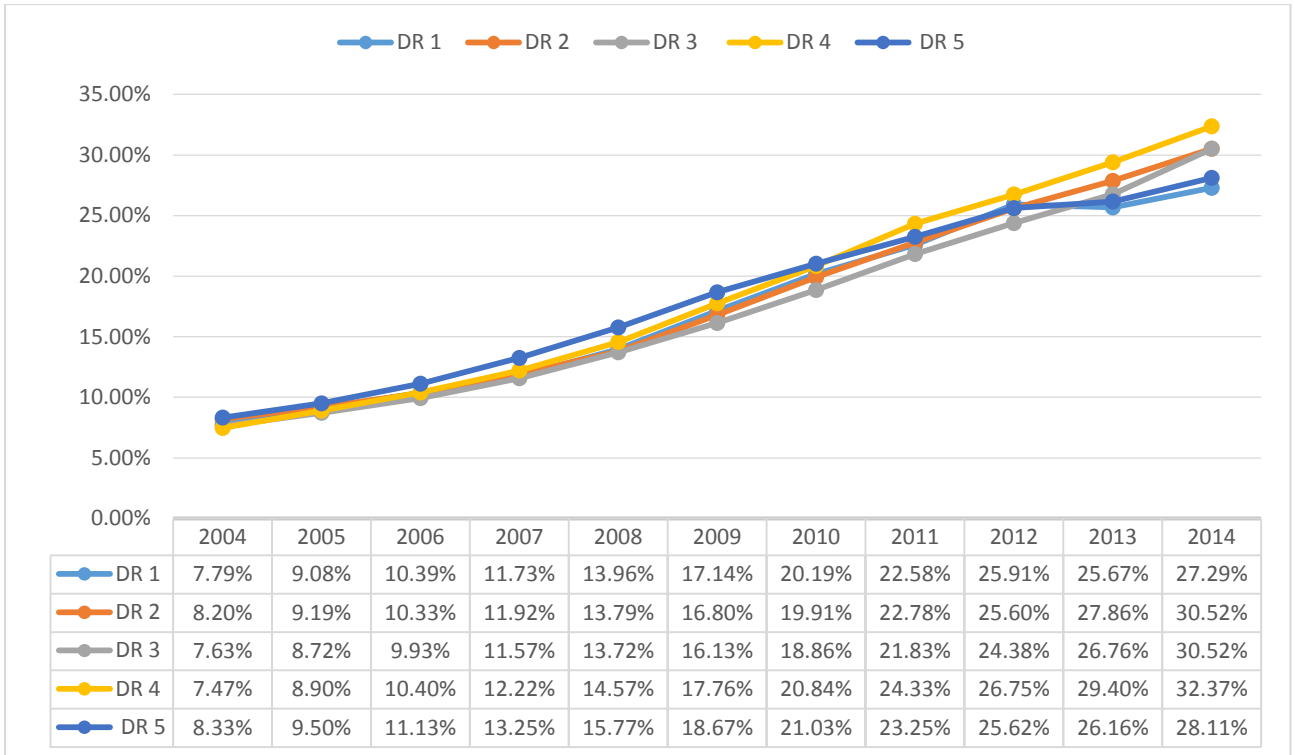
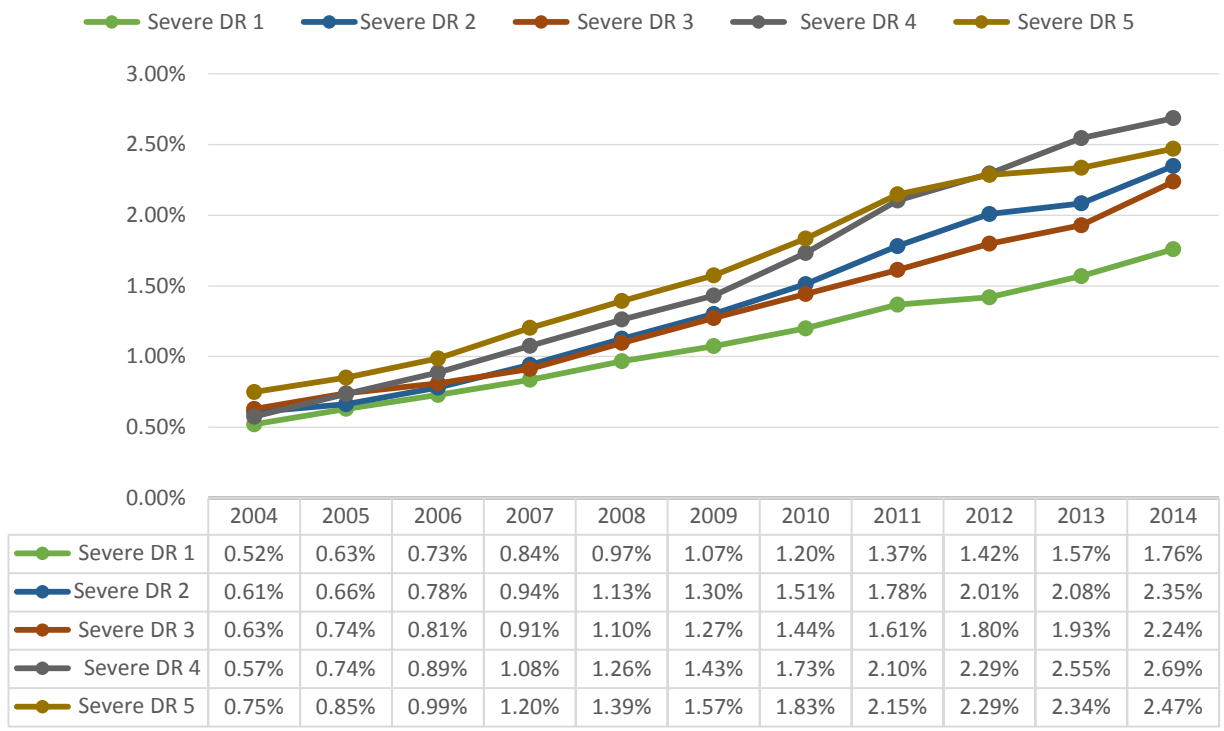
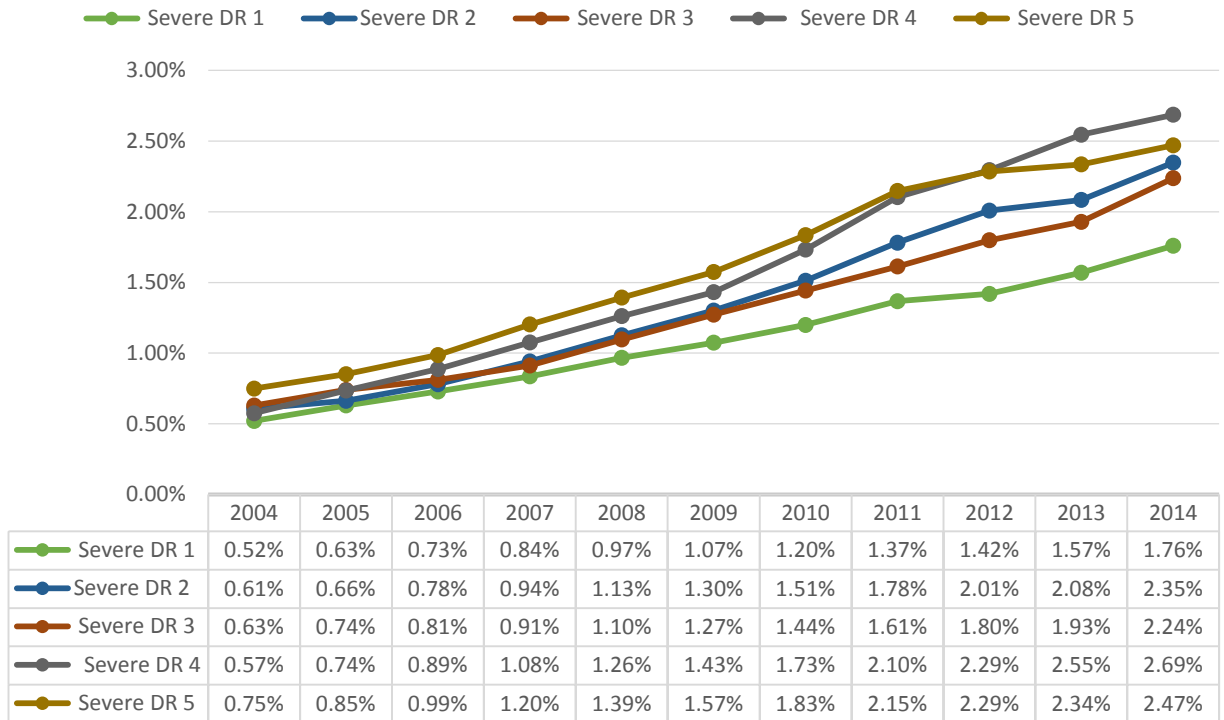


Figure 30. Prevalence of all retinopathy in the T2DM population 2004-2014 by deprivation quintile



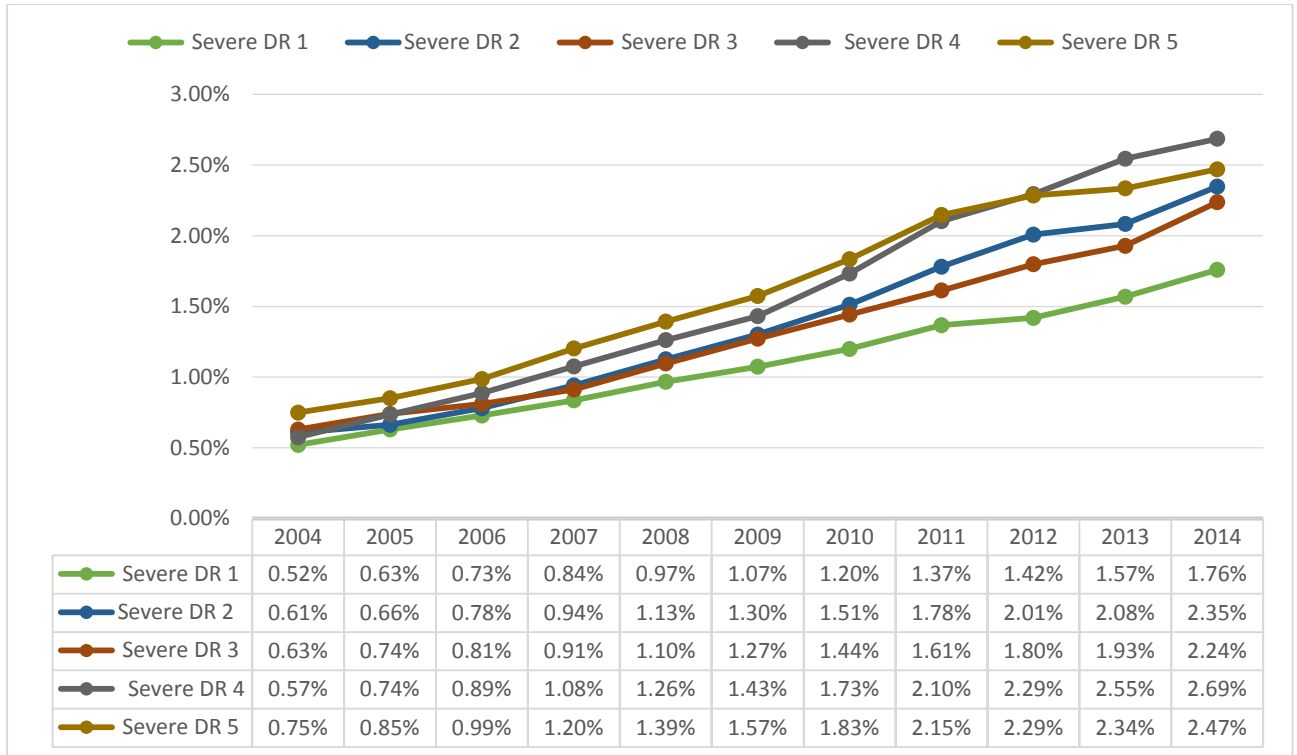


Figure 31. Prevalence of severe retinopathy in the T2DM population 2004-2014 by deprivation quintile

By Geographic Region

By geographic region, variability in the prevalence of retinopathy and severe retinopathy is evident. Overall prevalence of retinopathy is highest in Scotland and lowest in Northern Ireland. The prevalence of severe retinopathy is highest in the North East of England and lowest in the South East of England.

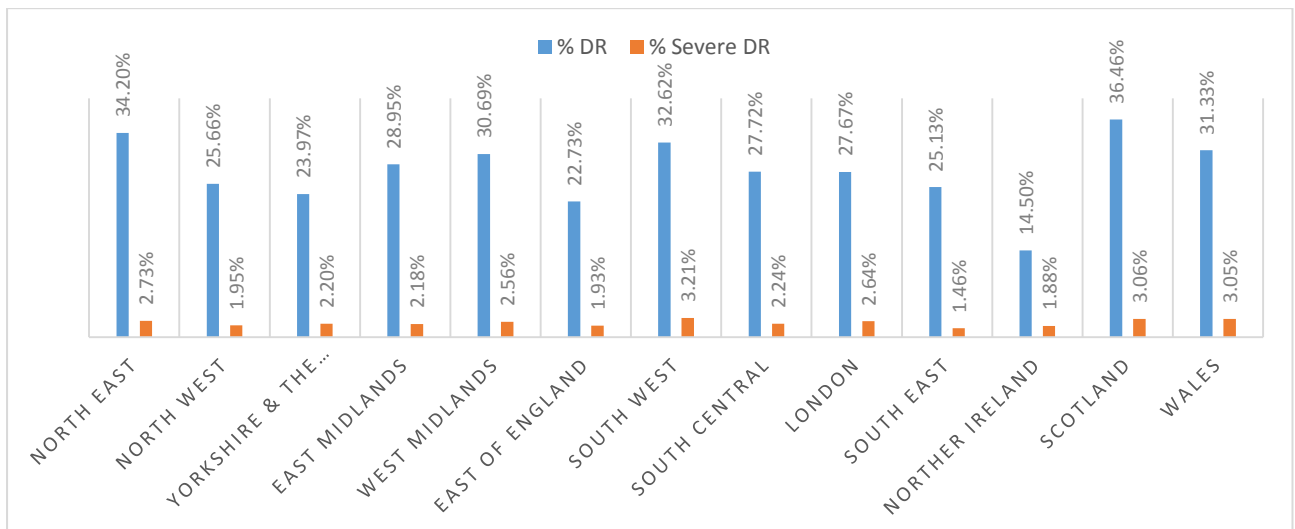
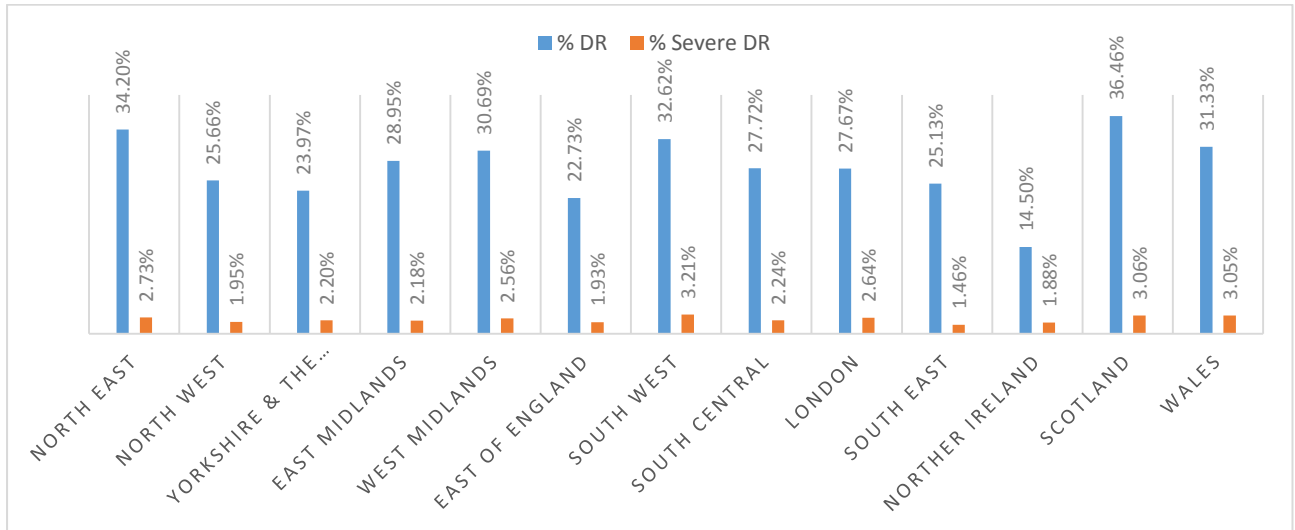


Figure 32. Prevalence of retinopathy in the T2DM population by region

Prevalence of both retinopathy and severe retinopathy increases over time in all regions, with the rate of change higher in some regions such as the North East of England, the East Midlands and Scotland than in other regions such as Ireland and the East of England.

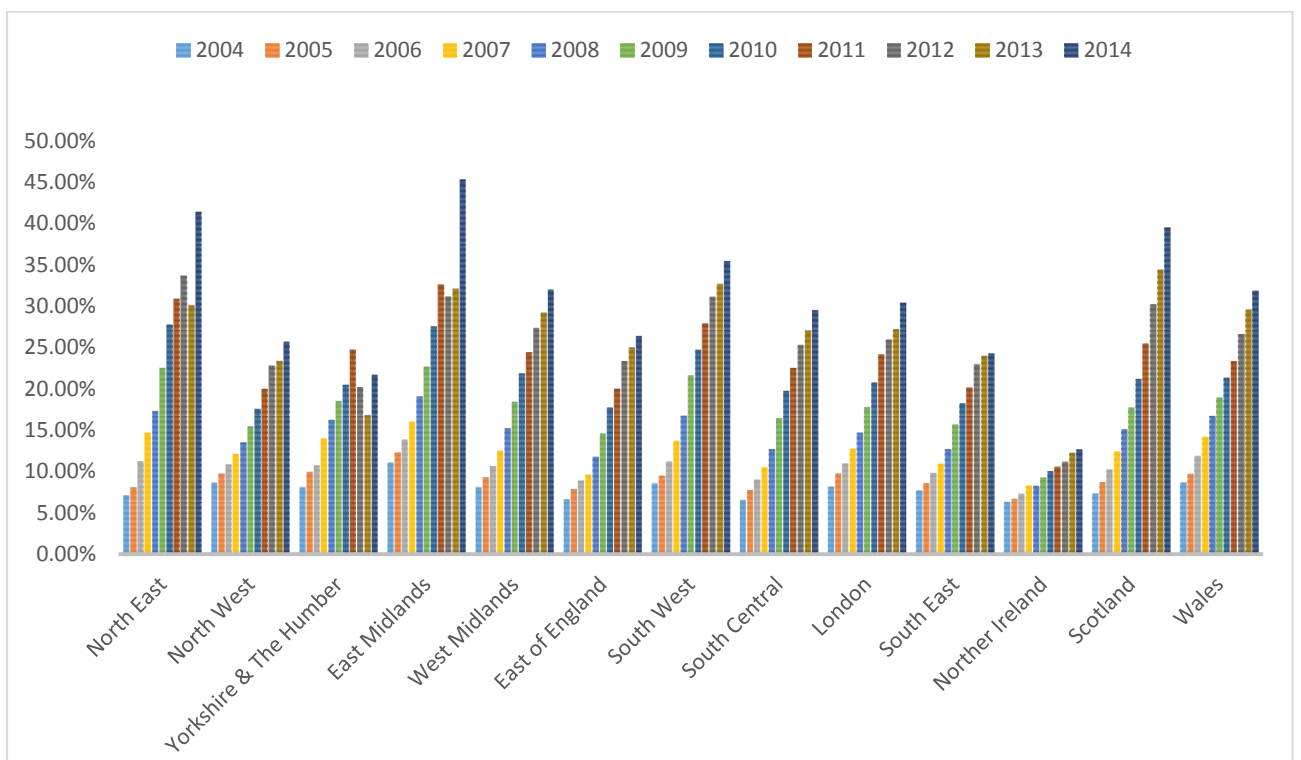
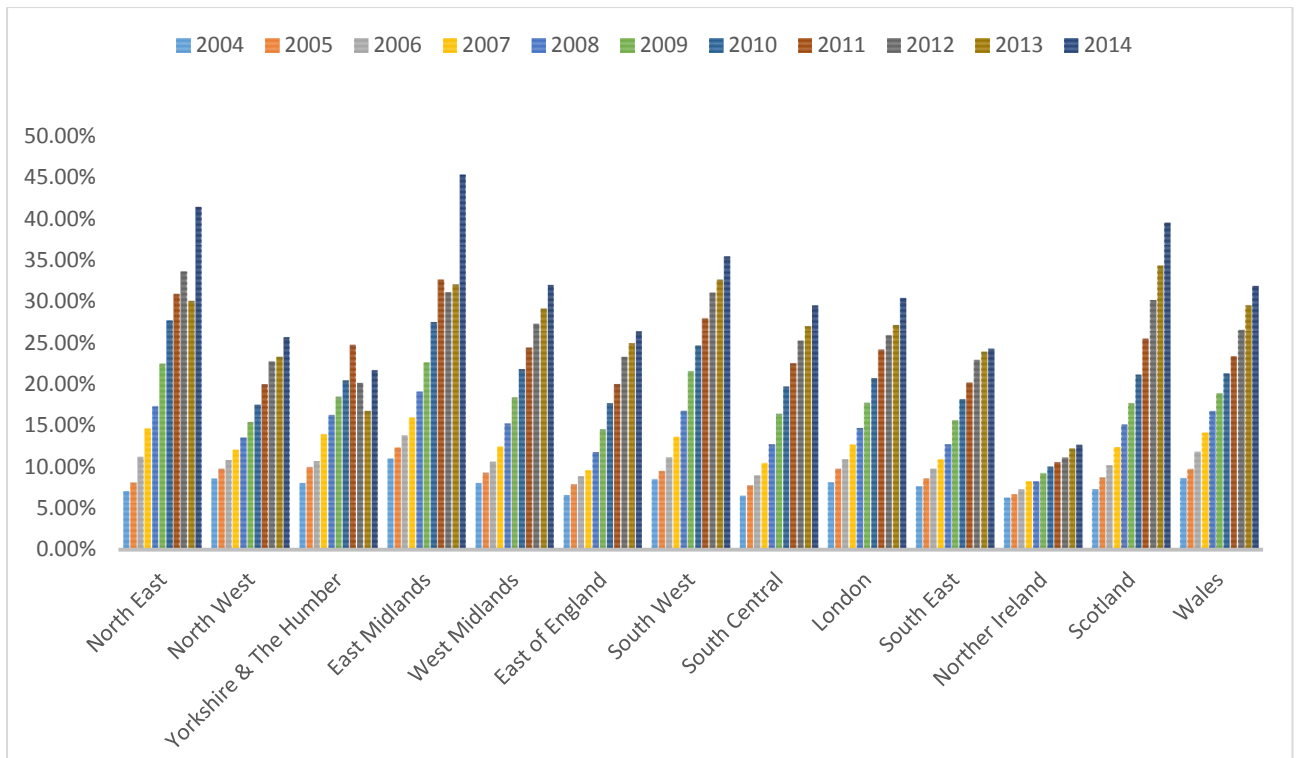


Figure 33. Prevalence of retinopathy in the T2DM population 2004-2014 by region

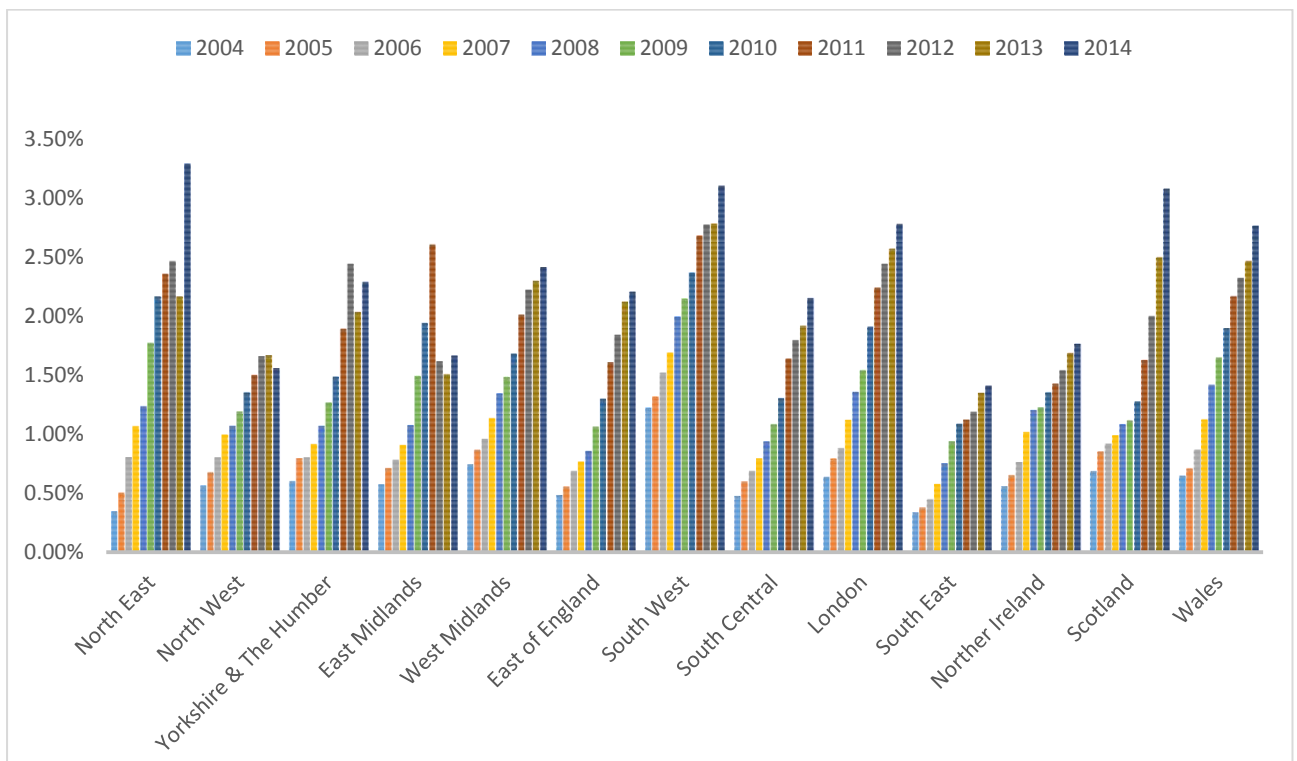
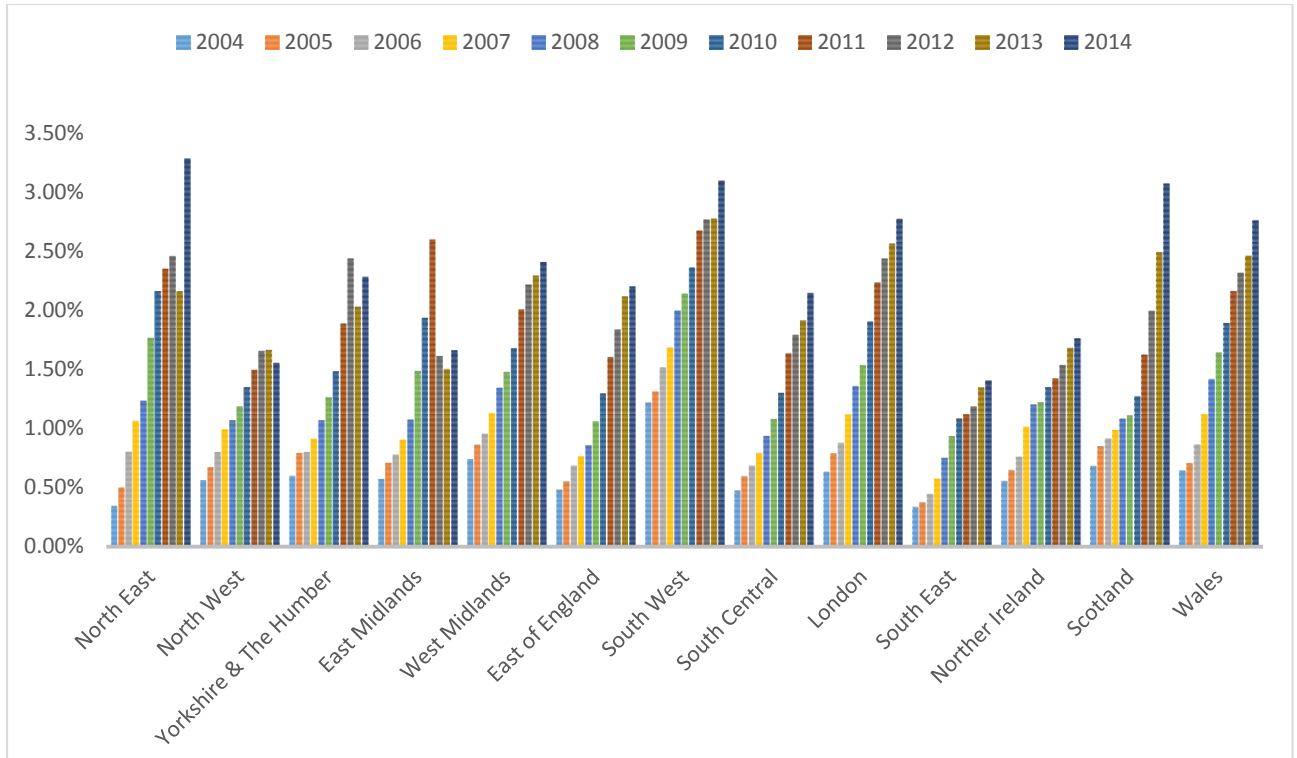


Figure 34. Prevalence of severe retinopathy in the T2DM population 2004-2014 by region

Prevalence of retinopathy in patients with Type 1 diabetes By Gender

Amongst individuals with type 1 diabetes the prevalence of retinopathy is comparable between females and males.

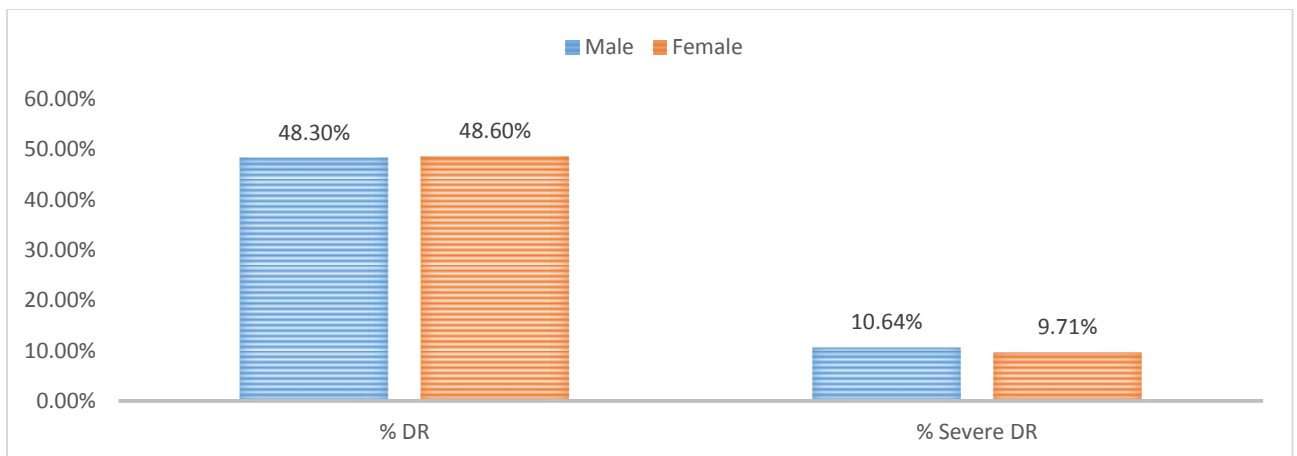
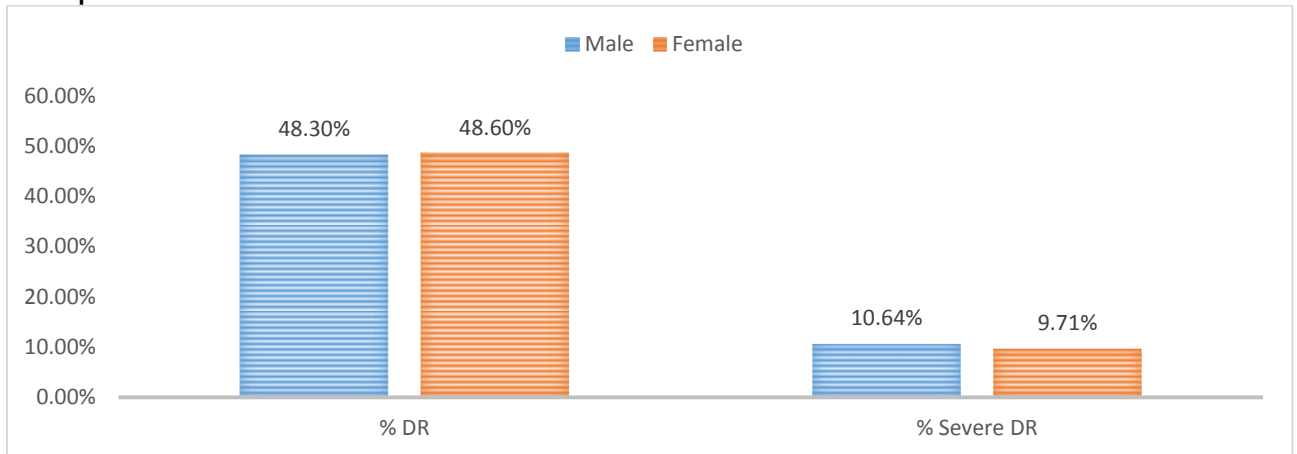


Figure 35. Prevalence of retinopathy in the T1DM population by gender

Over time, the prevalence of all retinopathy is similar between males and females while the prevalence of severe retinopathy is higher for males compared to females in all years except 2004.

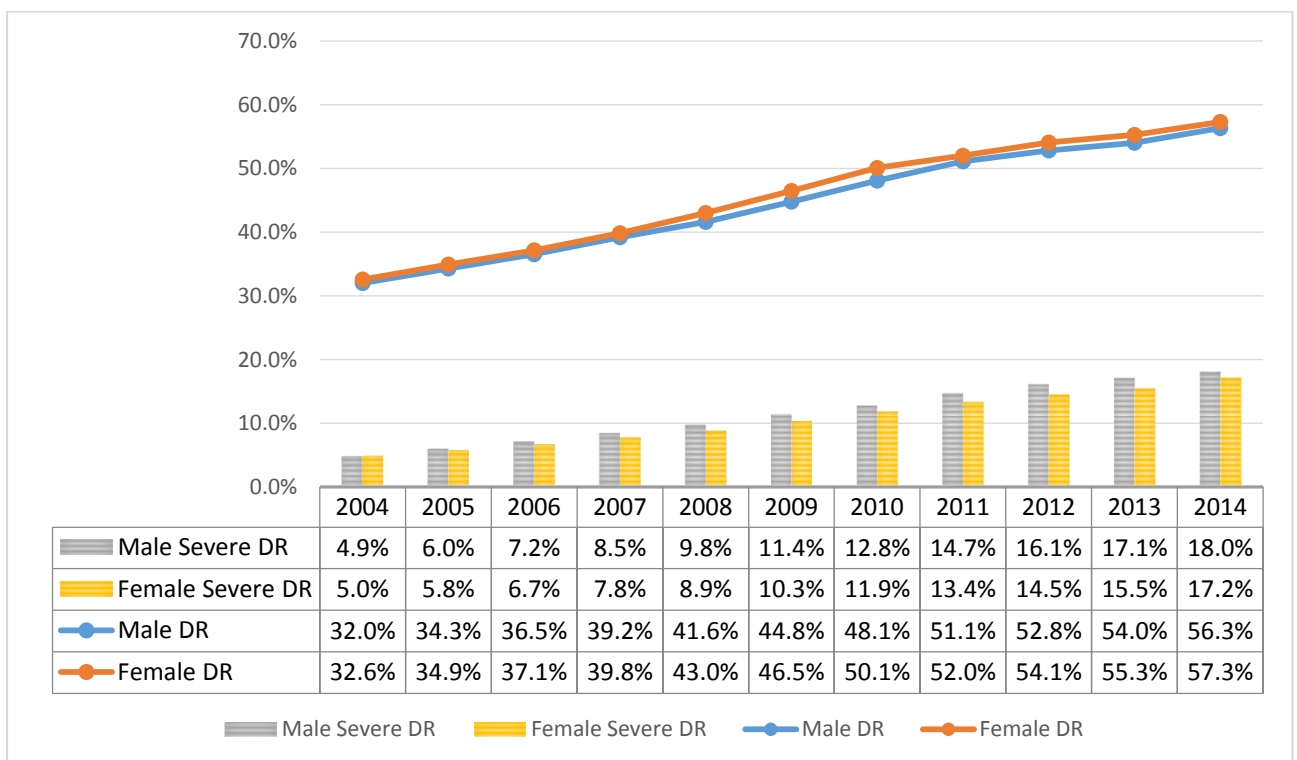
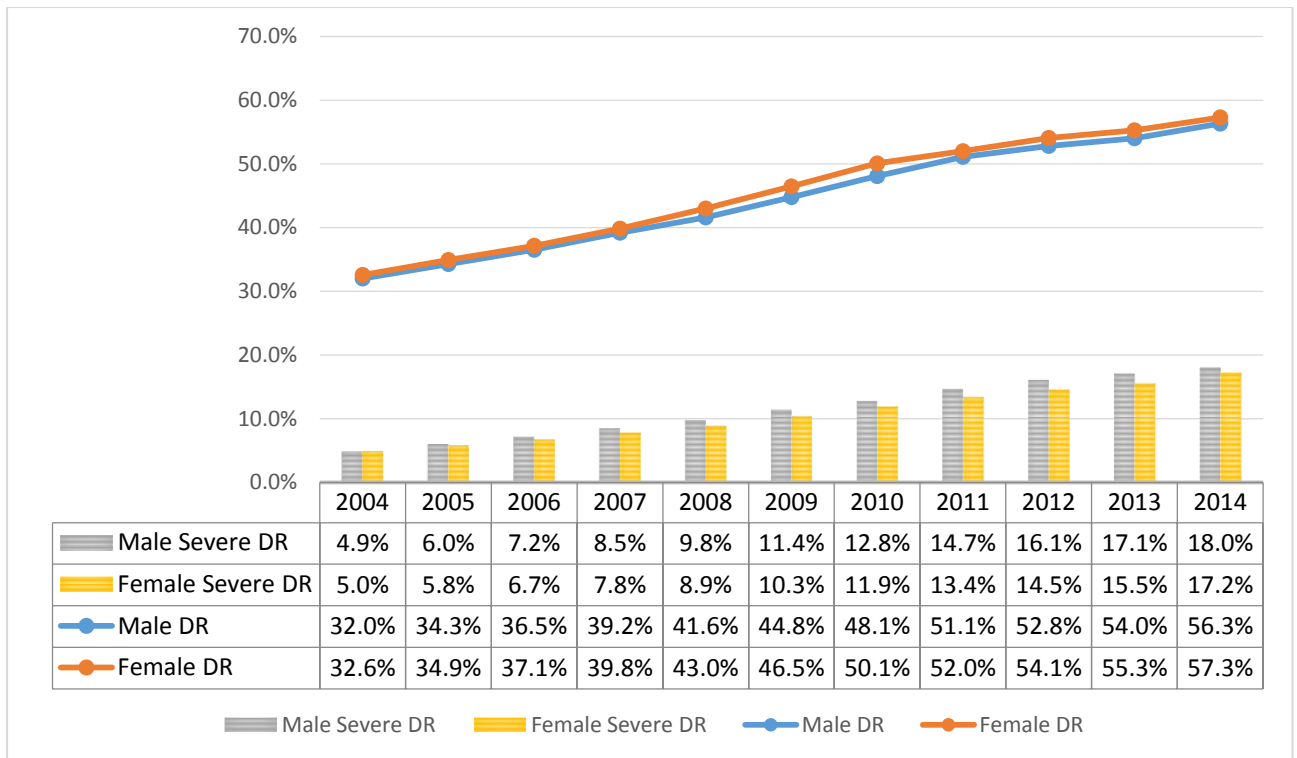


Figure 36. Prevalence of retinopathy in the T1DM population 2004-2014 by gender

By Age Group

By age group, the prevalence of retinopathy differs significantly for those aged 16-44, but overlaps for those aged 45 and over, particularly

from 2010 onwards. In most years, the prevalence of severe retinopathy increases by age group until age 65 and then drops again for those in the highest age group of age 75 and older.

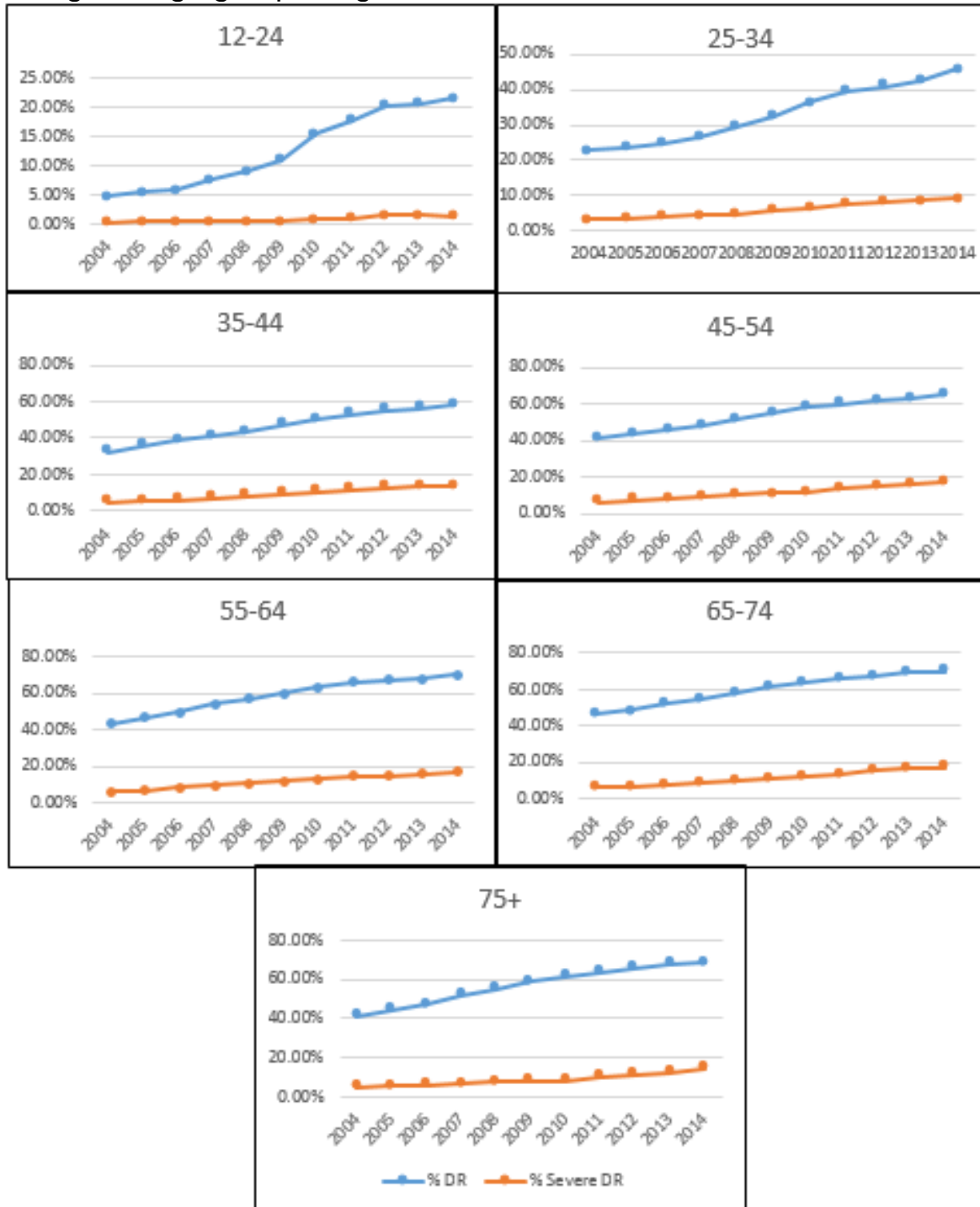


Figure 37. Prevalence of retinopathy in the T1DM population 2004-2014 by age group

By Ethnic Group

The overall prevalence of both types of retinopathy is highest in the White population. All retinopathy is lowest in the Black African/Caribbean group while severe retinopathy is lowest in the Mixed group.

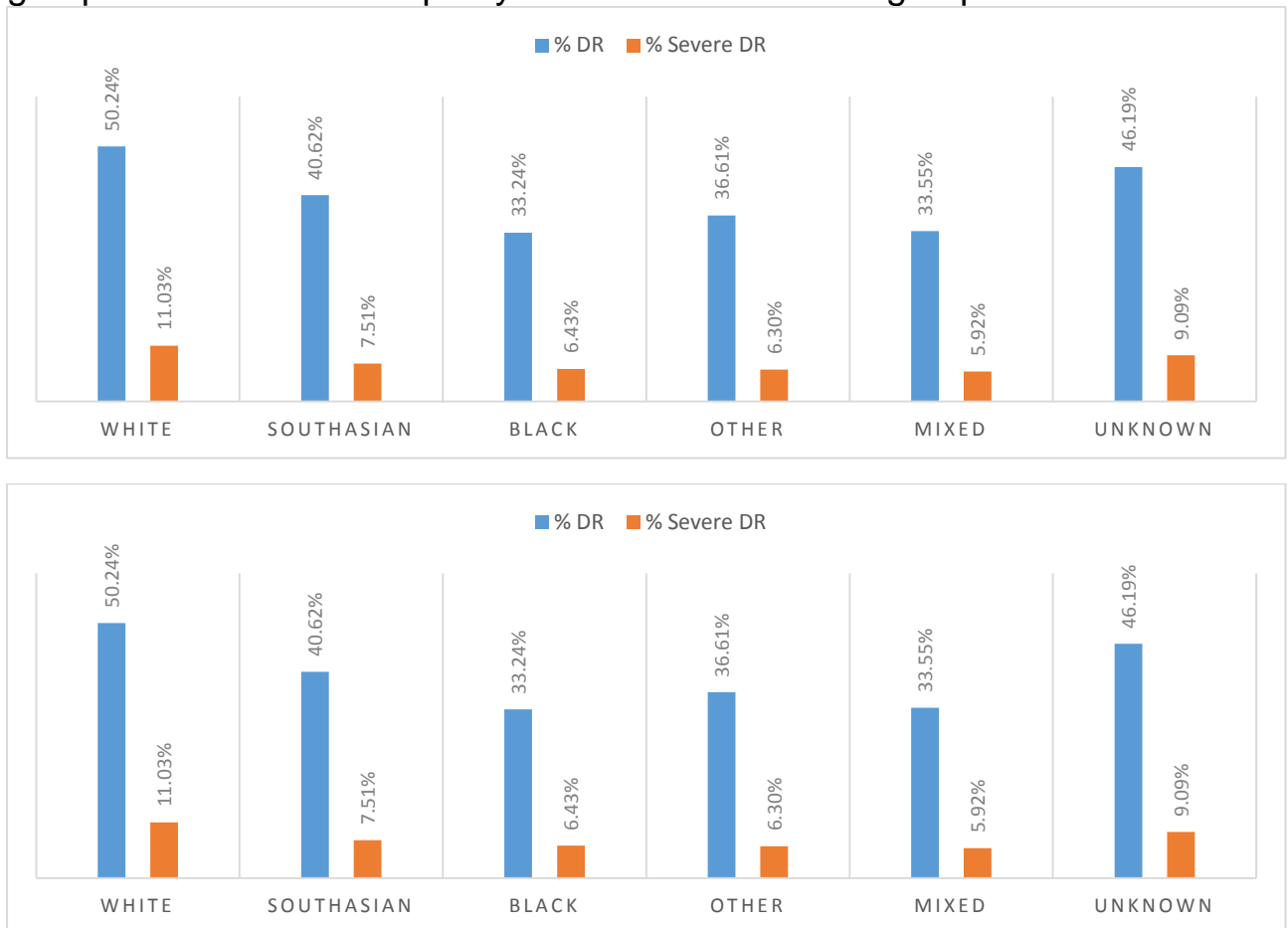


Figure 38. Prevalence of diabetic retinopathy in the T1DM population by ethnic group

Over time, there is a trend towards raised and equivalent prevalence of retinopathy in the White and Unknown ethnic groups. Prevalence for all other ethnic groups is lower. In most years the prevalence of retinopathy is lowest for the Black African/Population, though this difference disappears after 2012. The prevalence of severe retinopathy is highest in the Mixed group from 2004-2012 and lowest in the Black African/Caribbean group from 2004-2010 after which time it is lowest in the Other ethnic group.

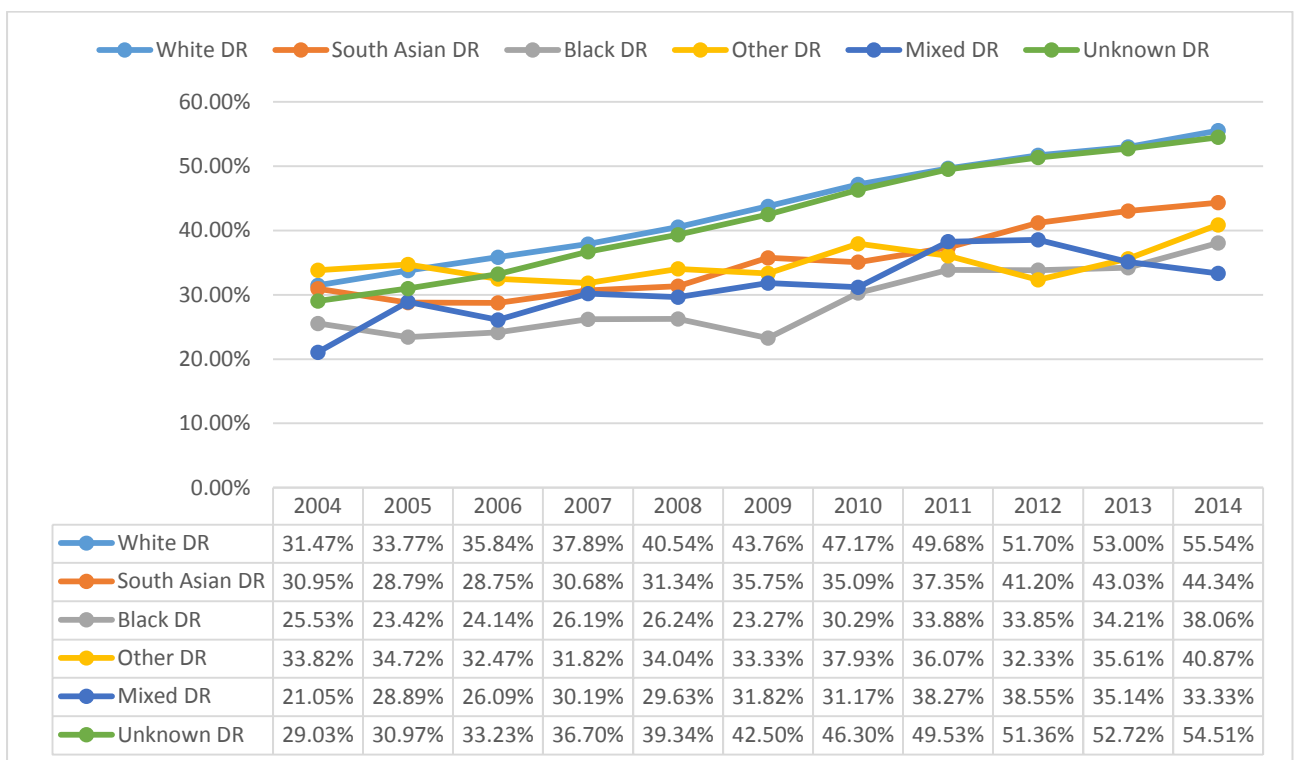
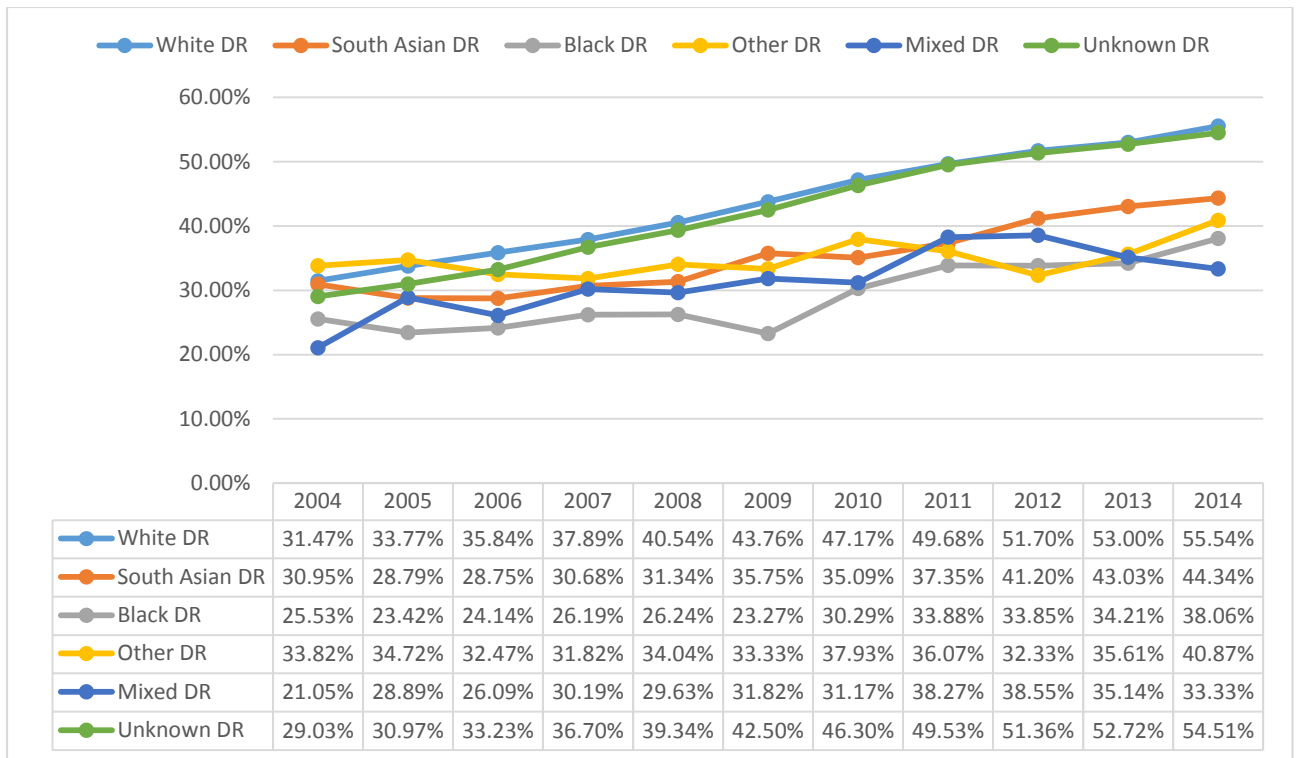


Figure 39. Prevalence of all diabetic retinopathy in the T1DM population 2004-2014 by ethnic group

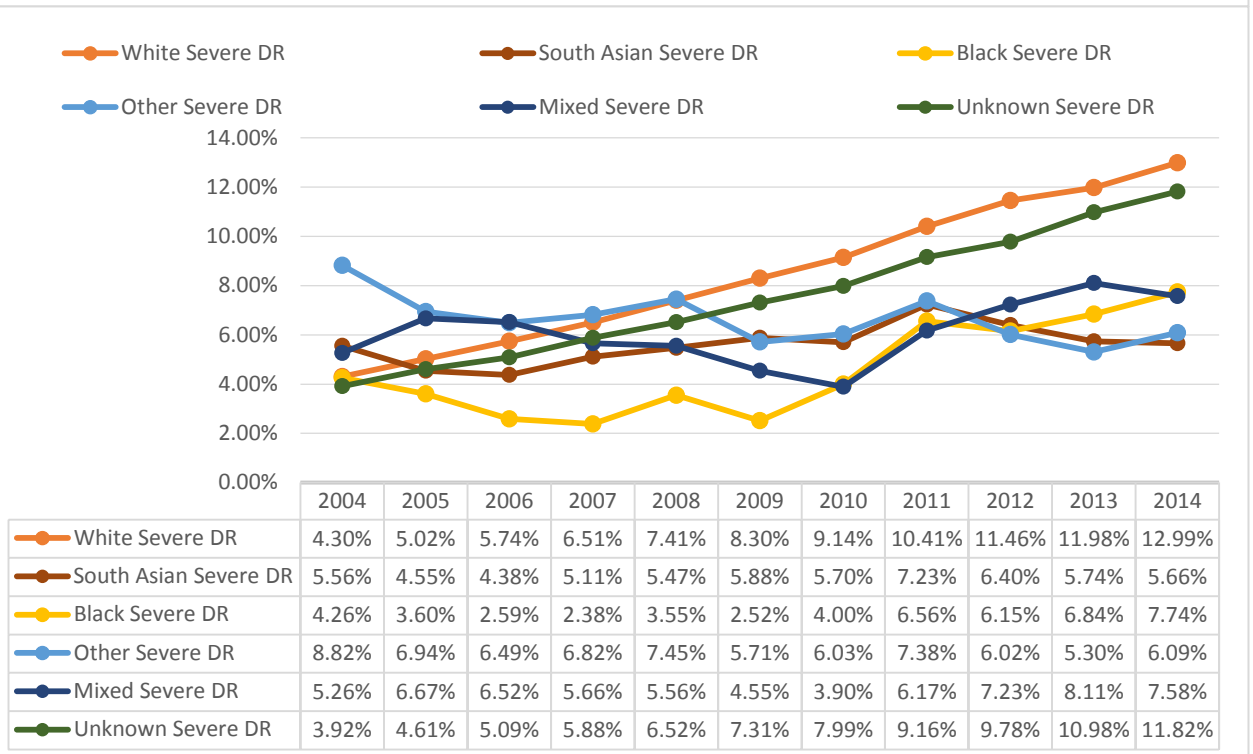
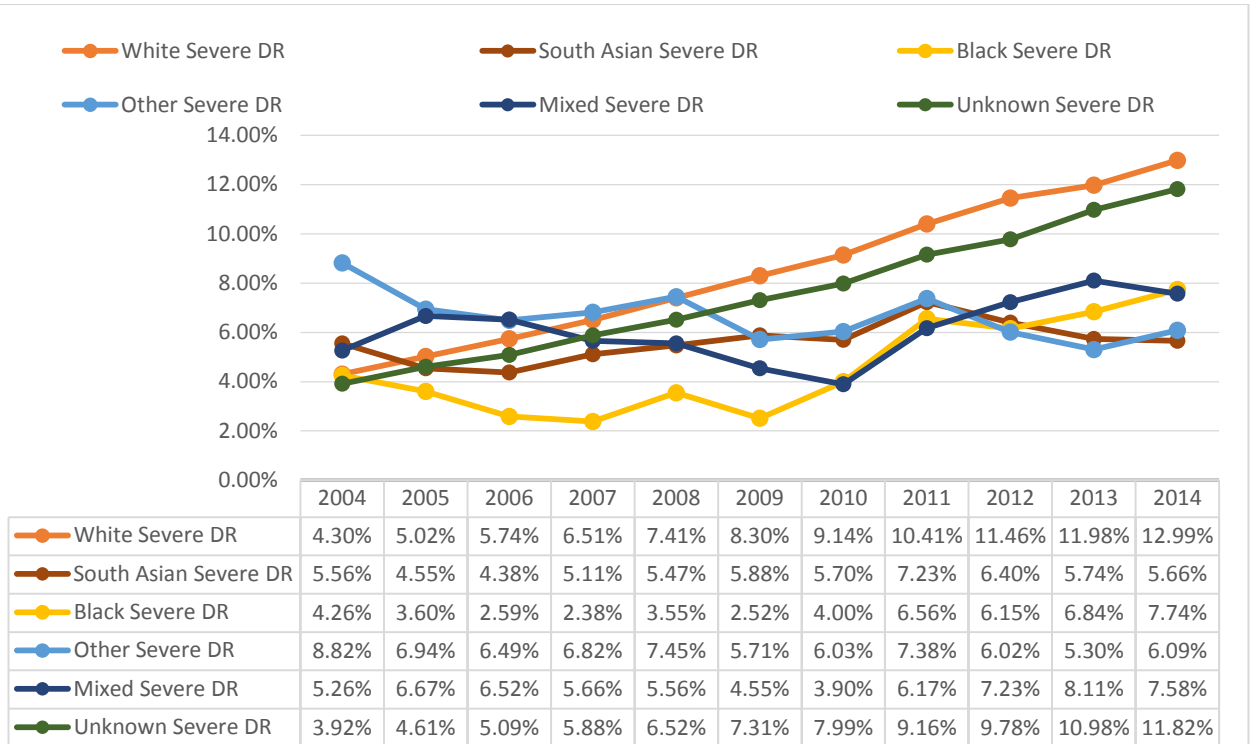


Figure 40. Prevalence of severe diabetic retinopathy in the T1DM population 2004-2014 by ethnic group

By Index of Multiple Deprivation Quintile

In the population with type 1 diabetes, the prevalence of diabetic retinopathy is highest in the most affluent quintile and lowest in the fourth quintile.

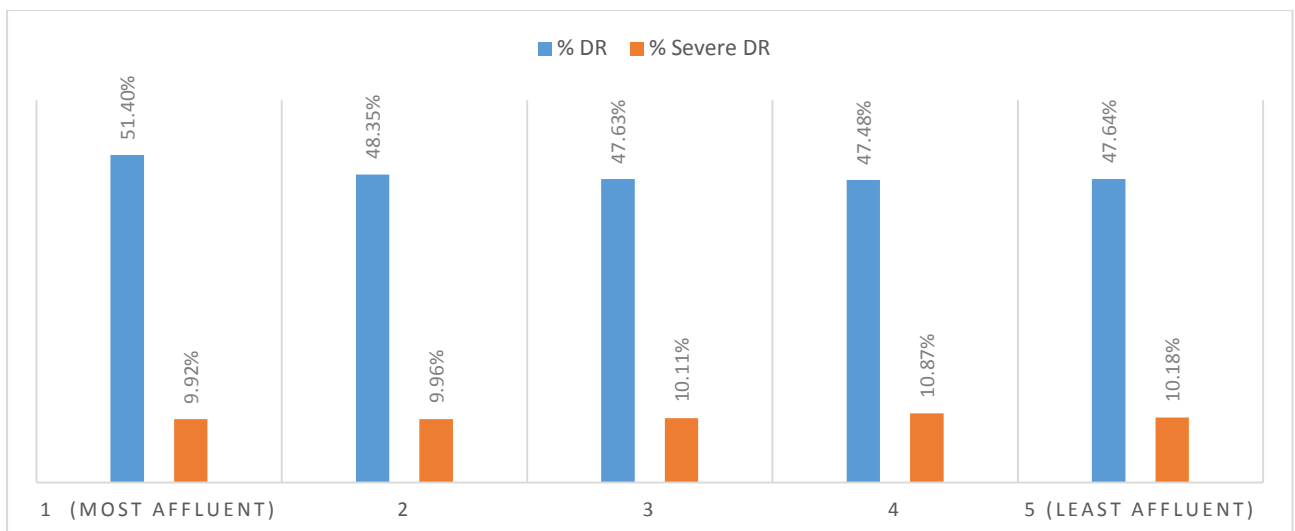
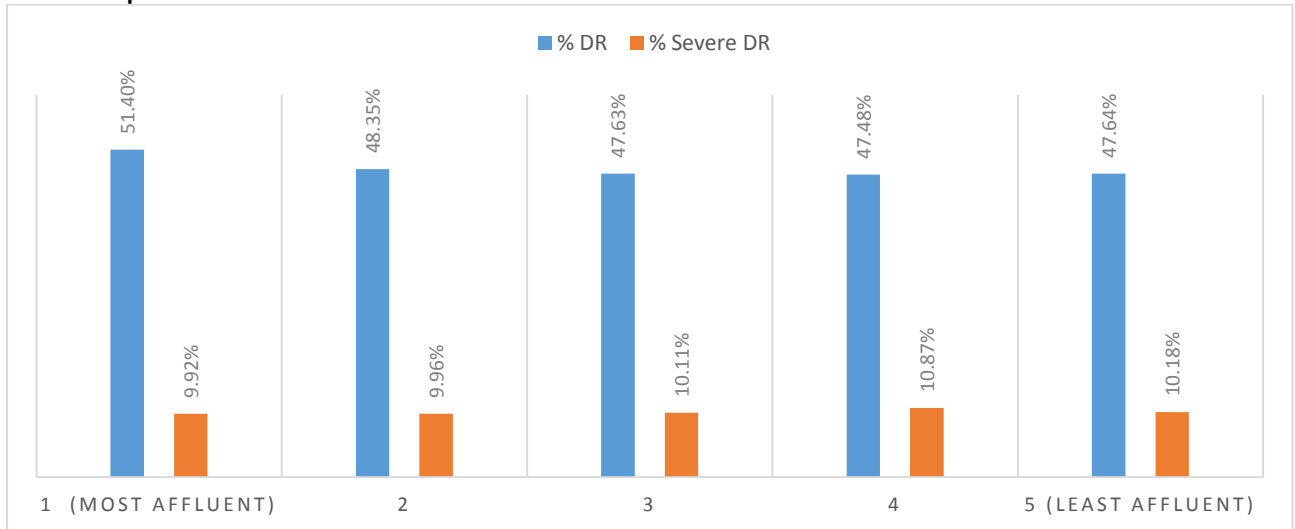


Figure 41. Prevalence of diabetic retinopathy in the T1DM population by deprivation quintile

The prevalence of retinopathy is highest in the least deprived quintile in all years until 2013, after which the prevalence becomes equivalent in all groups except the most deprived quintile, for whom prevalence is lower.

Prevalence of severe retinopathy is highest in the 2nd least deprived quintile in most years, with prevalence largely equivalent between all other groups until 2014, where there is a trend towards decreasing prevalence as deprivation increases.

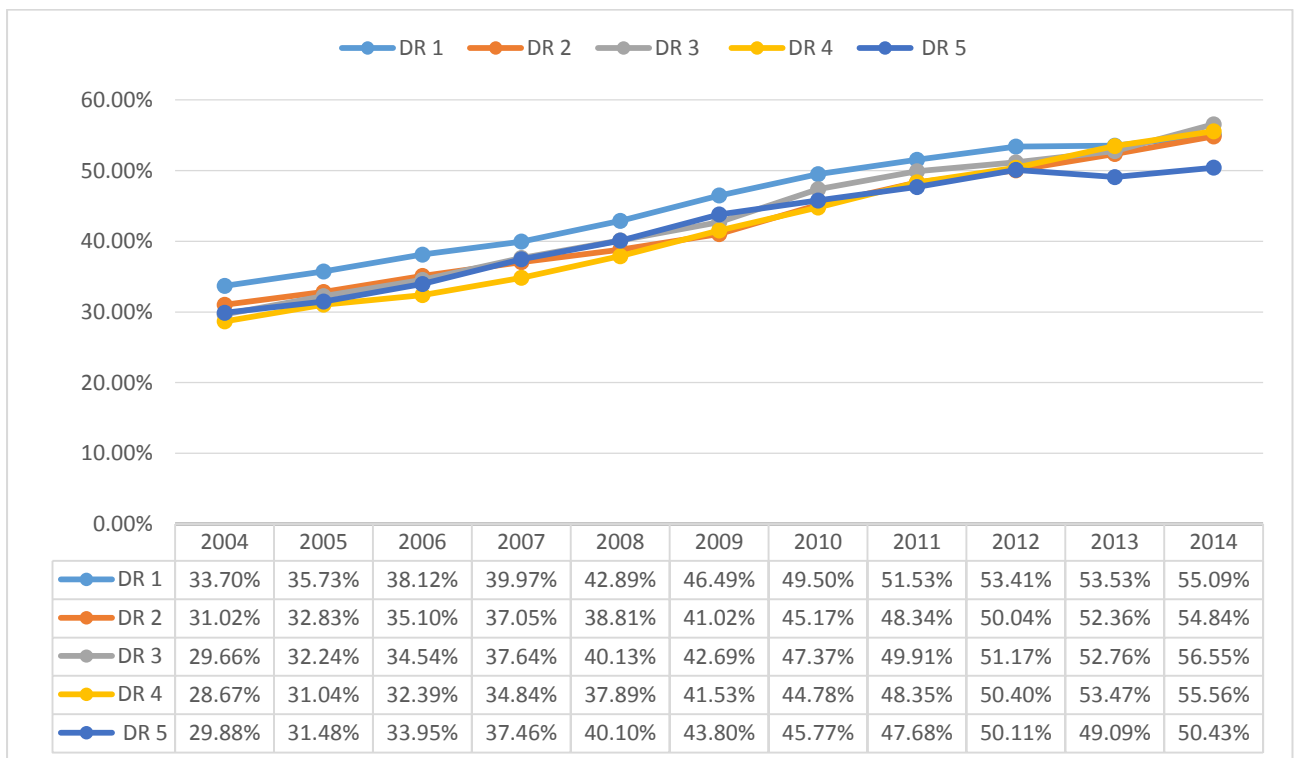
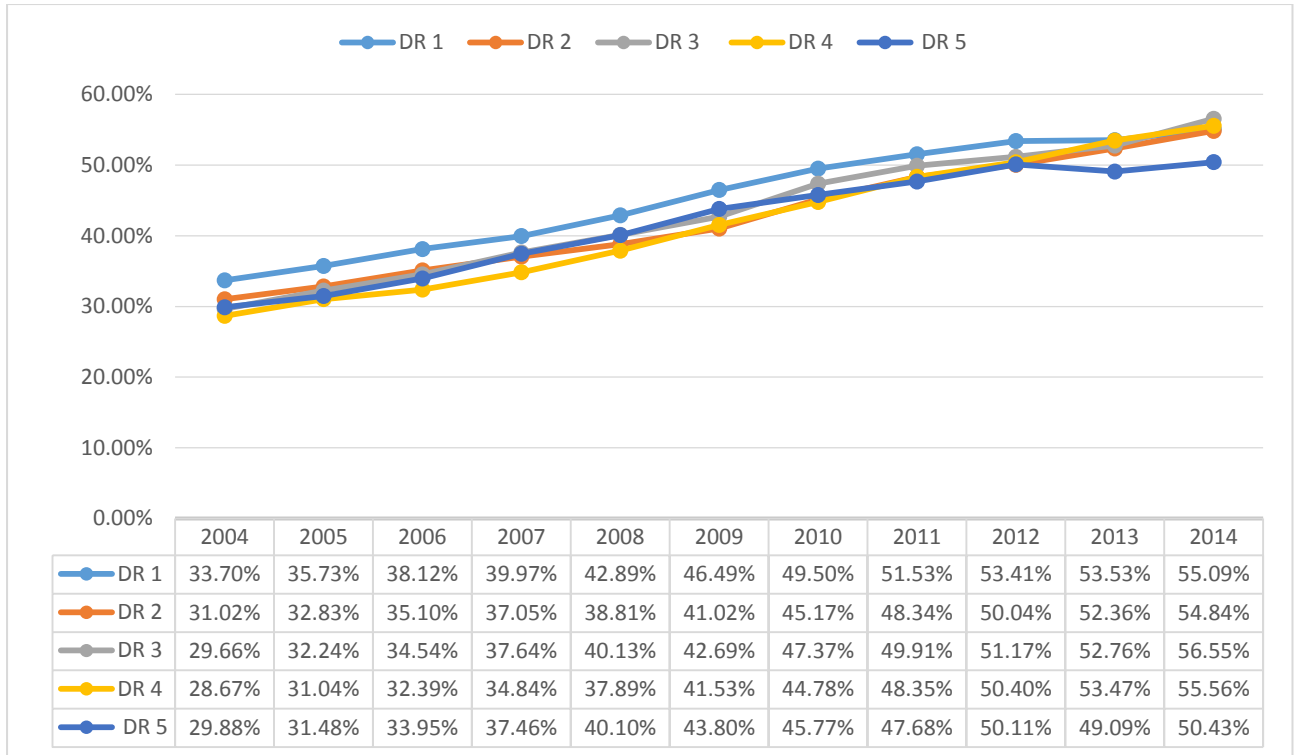


Figure 42. Prevalence of all diabetic retinopathy in the T1DM population 2004-2014 by deprivation quintile

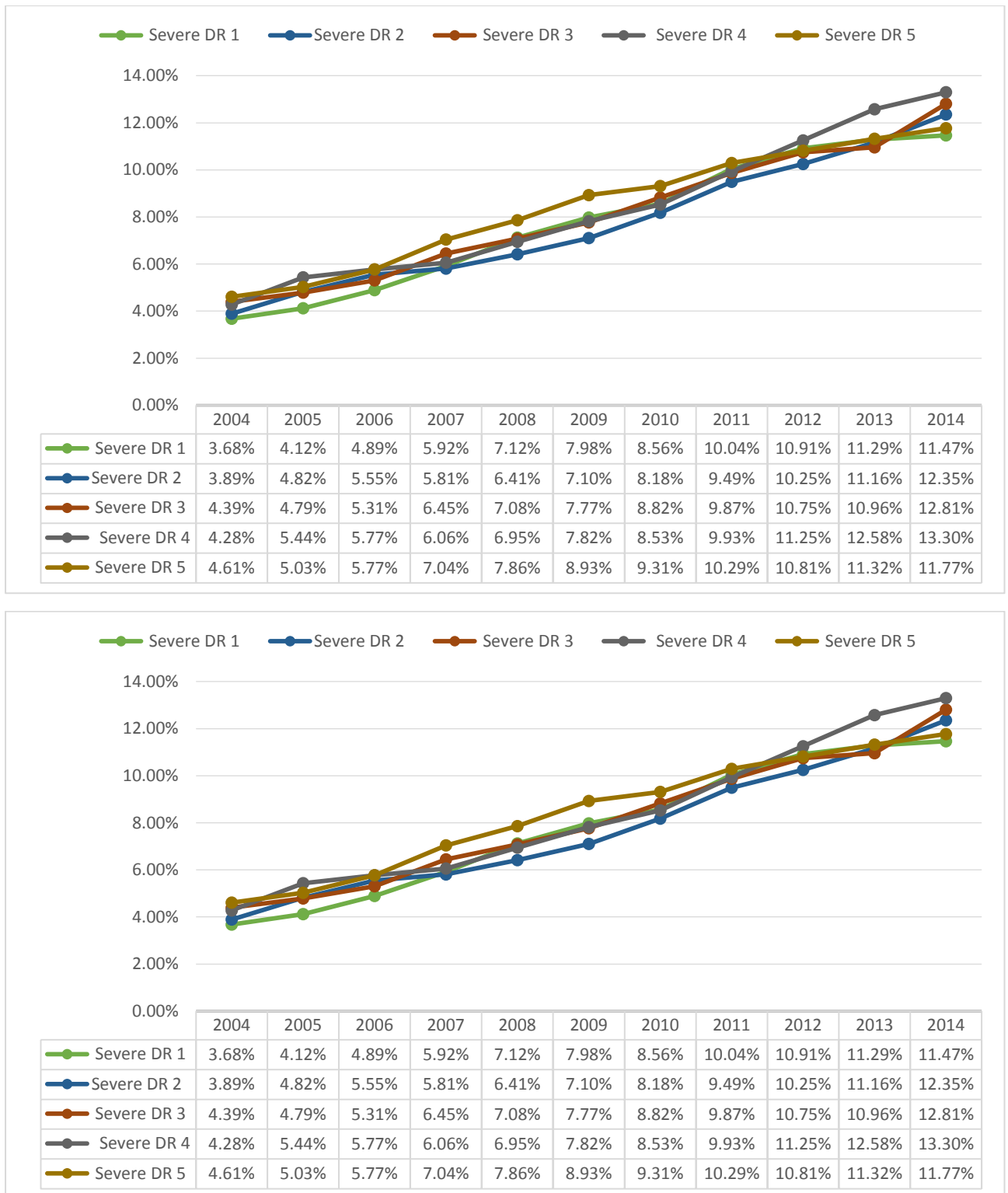


Figure 43. Prevalence of severe diabetic retinopathy in the T1DM population 2004-2014 by deprivation quintile

By Geographic Region

In the population with type 1 diabetes, the prevalence of retinopathy is largely equivalent between regions, with the prevalence of all diabetic retinopathy highest in Scotland and the prevalence of severe retinopathy highest in Wales.

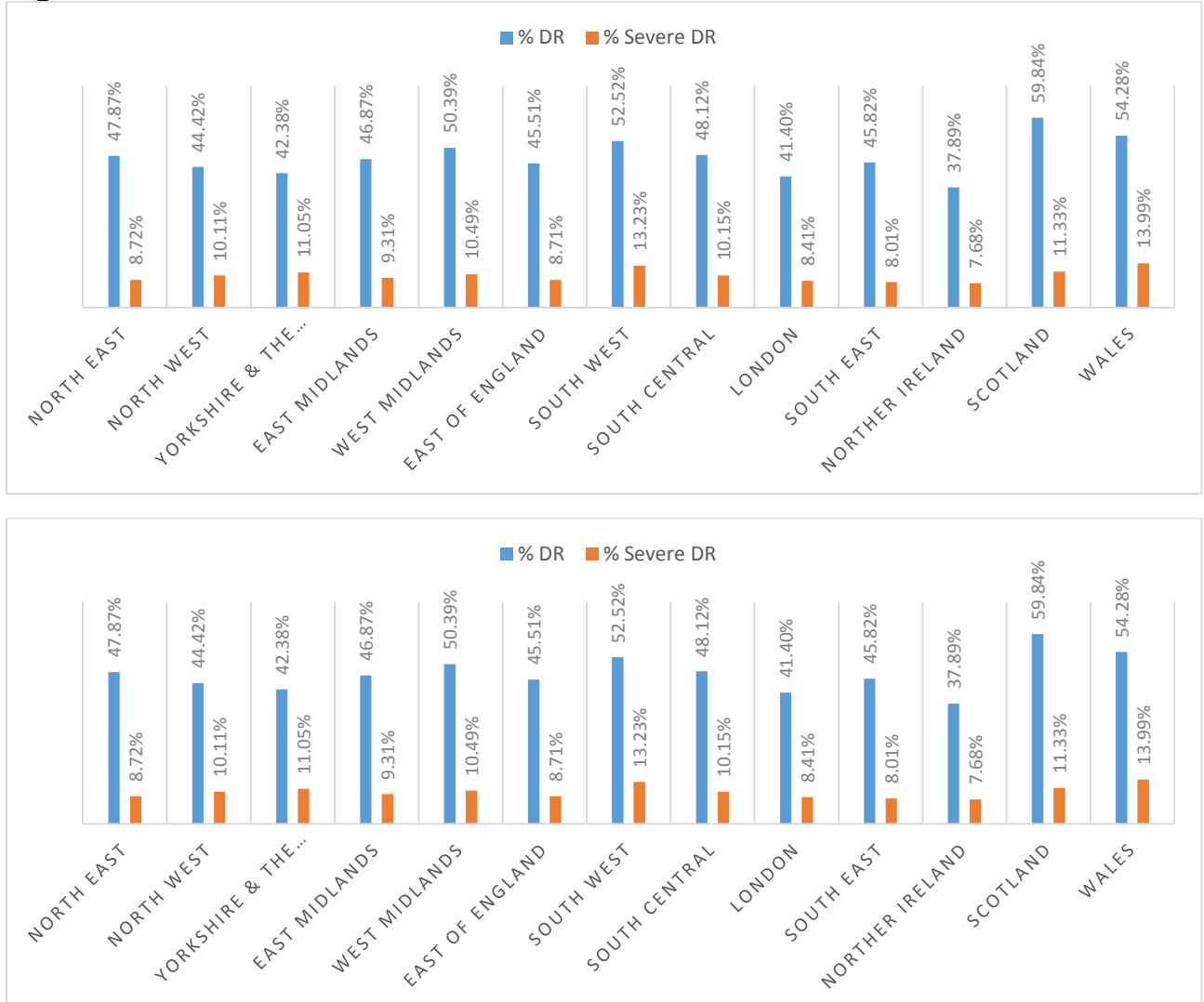


Figure 44. Prevalence of retinopathy in the T1DM population by region

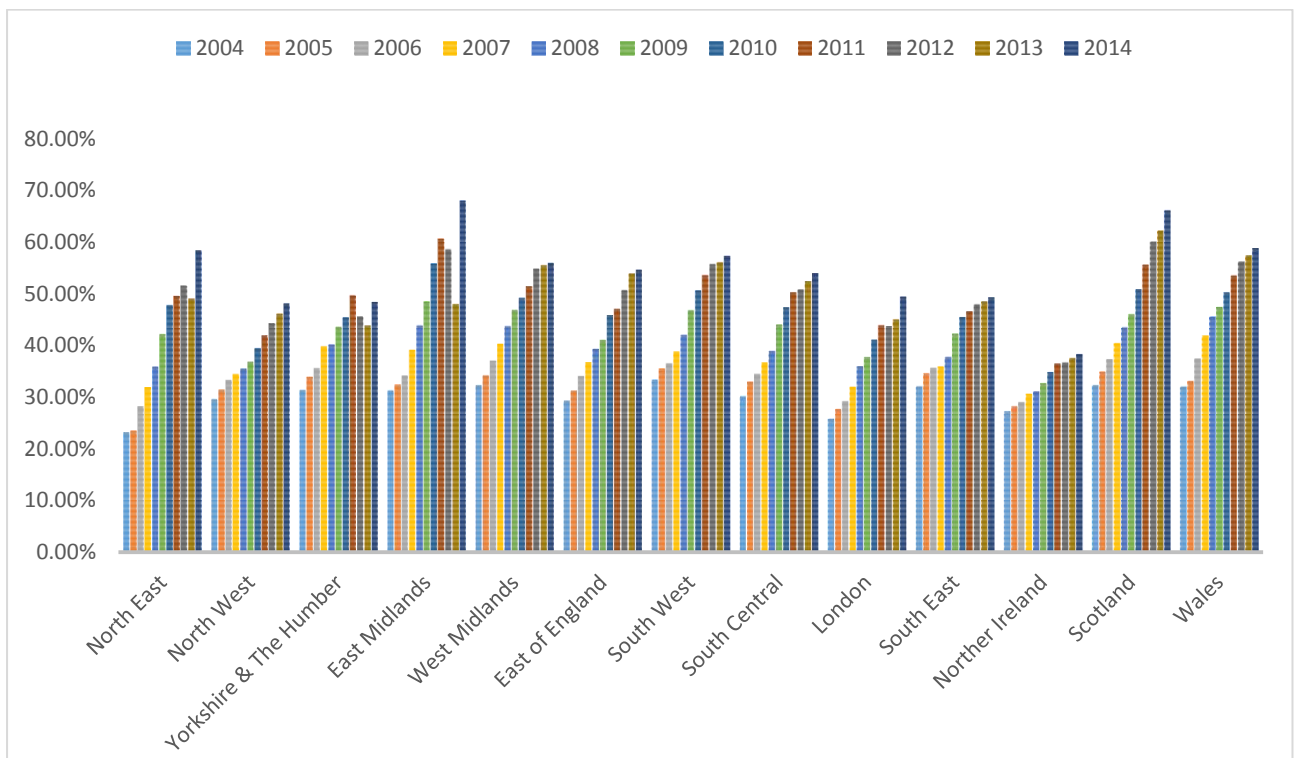
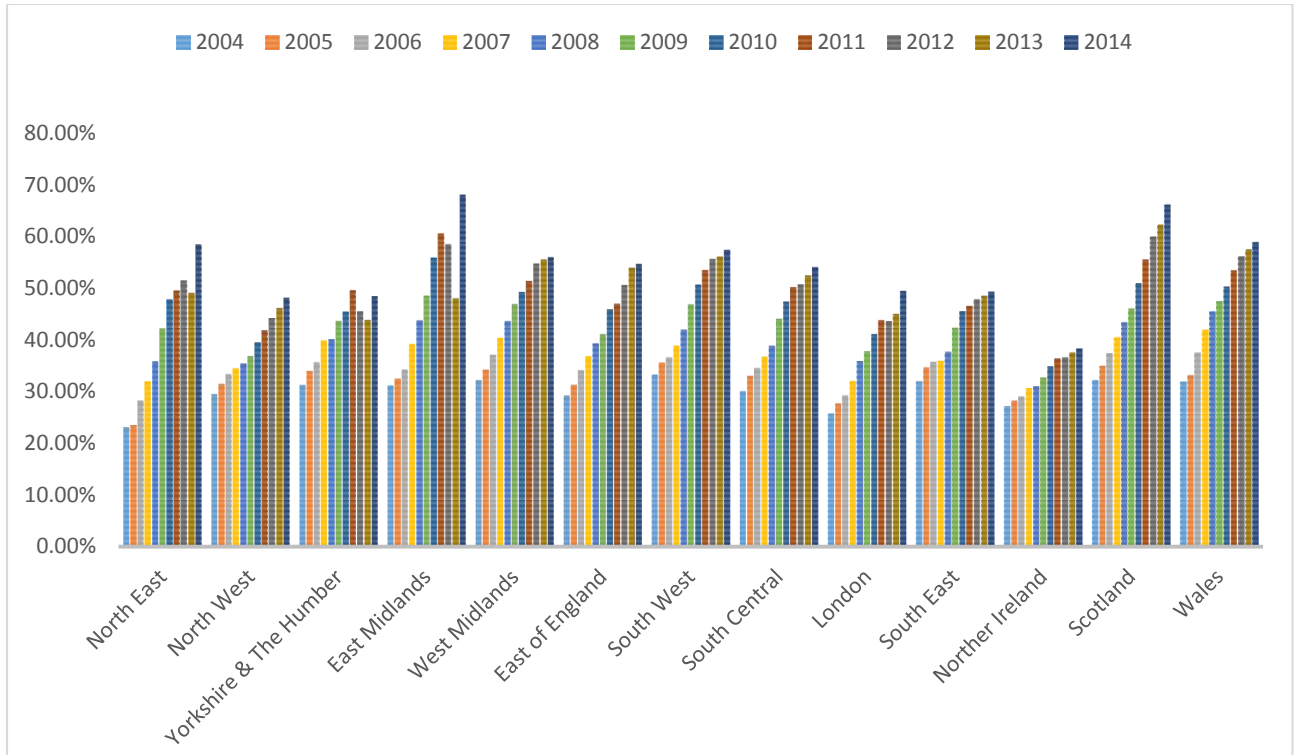


Figure 45. Prevalence of retinopathy in the T1DM population 2004-2014 by region

A similar trend is apparent for the prevalence of severe diabetic retinopathy, with one outlier in the East Midlands for 2014, due to small population size in the CPRD.

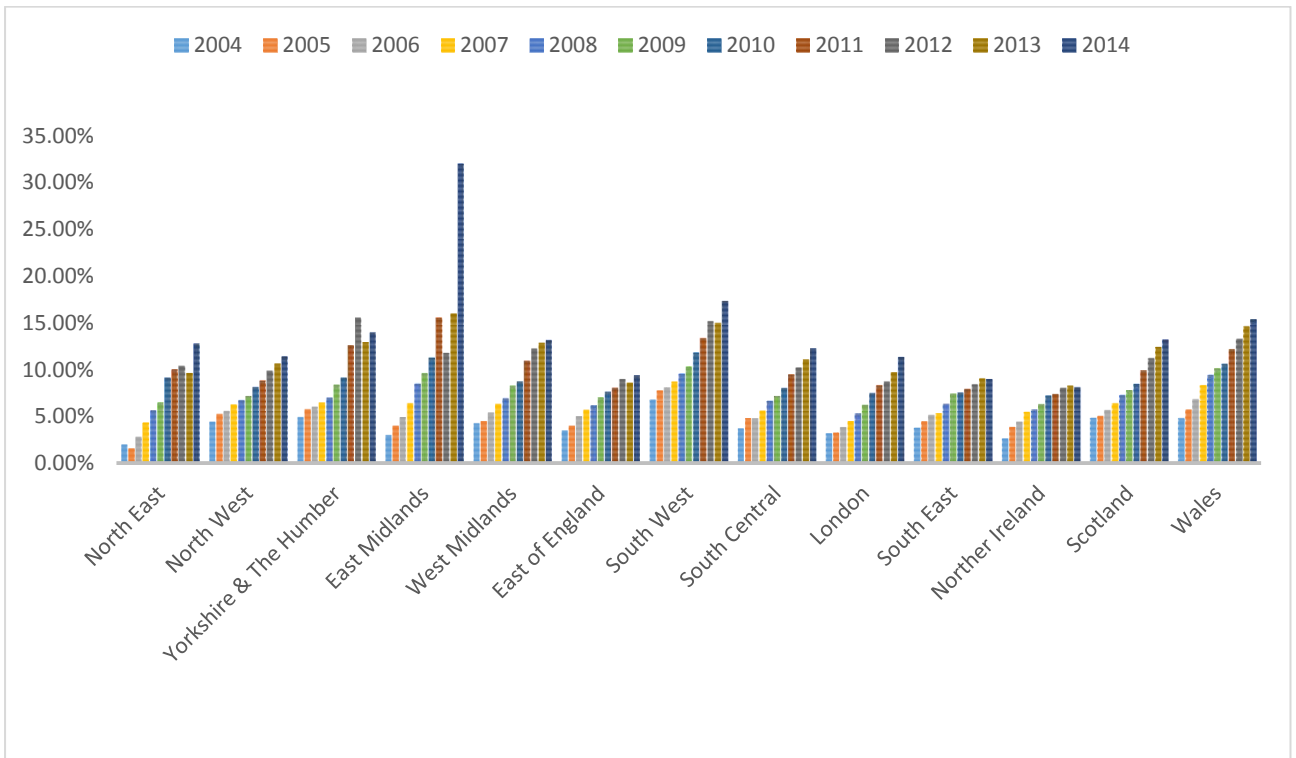
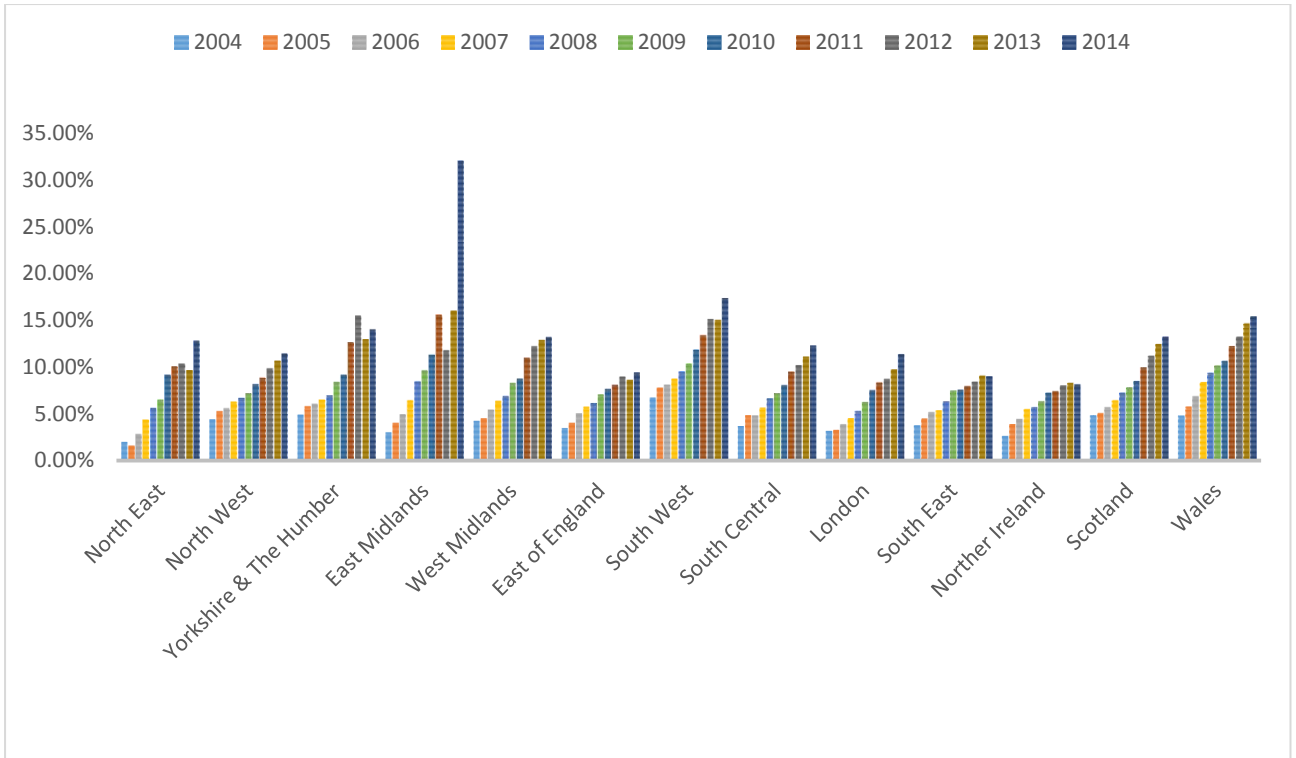


Figure 46. Prevalence of severe diabetic retinopathy in the T1DM population by region

Results of incidence analysis

In the CPRD, a total of 86,522 incident cases of diabetic retinopathy occurred over the study period of January 2004 to December 2014. Of these cases, 5,536 were incident cases of severe diabetic retinopathy.

Incidence of diabetic retinopathy in the total CPRD population

The crude incidence rate of diabetic retinopathy is 21.60 per 10,000 person years of follow-up. The crude incidence rate of severe diabetic retinopathy is 1.38 per 10,000 person years of follow-up. Hazard ratios resulting from Cox proportional-hazards regression show that the risk of developing retinopathy is reduced in females compared to males by 29% (Hazard ratio 0.71, CI95% 0.70-0.72) for all retinopathy and by 37% for severe retinopathy (HR 0.63, CI95% 0.60-0.67).

Relative to the youngest age group, the risk of developing diabetic retinopathy increases with each age group, with risk 24 times higher in those aged 75 and over compared to those aged 12-24 (HR 24.04, CI95% 22.86-25.28). Risk increases by age are more moderate for severe retinopathy, with risk peaking in those aged 65-74 instead of for those aged 75 and over (HR 14.40, CI95% 12.10-17.13).

By calendar year, risk of all retinopathy peaks in 2009 (HR 1.80, CI95% 1.74-1.85), after which point the risk decreases in each year till 2014. Risk of severe retinopathy peaks in 2007, (HR 1.14 CI95% 1.02-1.27) with a continuous reduction in risk thereafter.

By region, risk of all retinopathy is lowest in Northern Ireland and highest in the North East of England and Scotland. Risk of severe retinopathy is highest in the North East and South East of England and significantly reduced in all other regions.

By deprivation, risk of diabetic retinopathy is increased in all deprivation quintiles relative to the most affluent group, with risk increased by 31% in the least affluent group relative to the most affluent group (HR 1.31, CI95% 1.28-1.34). Risk of severe retinopathy is also higher in all deprivation quintiles relative to the most affluent group- and equivalent for those in the 2nd and 5th quintiles.

Table 12. Incidence of Diabetic Retinopathy in the CPRD

CPRD	Diabetic Retinopathy						Severe Diabetic Retinopathy					
	Events	Rate per 10,000	HR	CI 95	P. val		Events	Rate per 10,000	HR	CI 95	P. val	
Overall	86,522	21.60					5536	1.38				
Gender												
Male	48238	24.35	1.00	--	--		3294	1.66	1.00	--	--	
Female	38284	18.90	0.71	0.70	0.72	<0.001	2242	1.11	0.63	0.60	0.67 <0.001	
Age group												
12-24	1638	2.37	1.00	--	--		142	0.21	1.00	--	--	
25-34	2330	4.07	1.73	1.62	1.84	<0.001	304	0.53	2.59	2.12	3.16 <0.001	
35-44	6014	8.54	3.62	3.43	3.82	<0.001	573	0.81	3.89	3.24	4.67 <0.001	
45-54	12515	18.58	7.84	7.45	8.26	<0.001	1052	1.56	7.64	6.41	9.11 <0.001	
55-64	19932	34.42	14.55	13.84	15.30	<0.001	1383	2.39	11.51	9.69	13.68 <0.001	
65-74	23131	55.50	23.52	22.37	24.73	<0.001	1224	2.94	14.40	12.10	17.13 <0.001	
75+	20962	56.74	24.04	22.86	25.28	<0.001	858	2.32	11.27	9.43	13.45 <0.001	
Ethnic Group												
White	55804	26.54	1.00	--	--		3446	1.64	1.00	--	--	
South Asian	2989	37.57	2.44	2.35	2.54	<0.001	247	3.10	2.74	2.40	3.12 <0.001	
Black	1288	26.63	1.74	1.64	1.83	<0.001	89	1.84	1.62	1.31	1.99 <0.001	
Other	816	21.43	1.24	1.16	1.33	<0.001	41	1.08	0.87	0.64	1.18 0.376	
Mixed	262	18.28	1.52	1.35	1.72	<0.001	19	1.33	1.43	0.91	2.24 0.121	
Unknown	25363	14.72	0.67	0.66	0.68	<0.001	1694	0.98	0.68	0.65	0.73 <0.001	
Calendar Year												
2004	5660	14.99	1.00	--	--		595	1.58	1.00	--	--	
2005	6116	16.26	1.09	1.05	1.13	<0.001	647	1.72	1.09	0.98	1.22 0.123	
2006	7080	18.63	1.25	1.21	1.30	<0.001	648	1.71	1.08	0.97	1.21 0.171	
2007	8313	21.70	1.46	1.41	1.51	<0.001	689	1.80	1.14	1.02	1.27 0.020	
2008	9324	24.33	1.63	1.58	1.69	<0.001	615	1.60	1.02	0.91	1.14 0.777	
2009	10265	26.79	1.80	1.74	1.85	<0.001	552	1.44	0.91	0.81	1.02 0.12	
2010	9991	26.53	1.78	1.72	1.84	<0.001	523	1.39	0.88	0.78	0.99 0.03	
2011	9696	26.43	1.77	1.71	1.83	<0.001	465	1.27	0.80	0.71	0.90 <0.001	
2012	8314	23.12	1.54	1.49	1.59	<0.001	353	0.98	0.62	0.54	0.71 <0.001	
2013	6955	20.50	1.36	1.31	1.41	<0.001	292	0.86	0.54	0.47	0.62 <0.001	
2014	4808	17.11	1.12	1.07	1.16	<0.001	157	0.56	0.34	0.29	0.41 <0.001	
Geographical Region												
North East	1898	28.00	1.00	--	--		110	1.62	1.00	--	--	
North West	9025	19.58	0.71	0.68	0.75	<0.001	513	1.11	0.69	0.56	0.85 <0.001	
Yorkshire & The Humber	2392	20.78	0.72	0.68	0.77	<0.001	189	1.64	0.99	0.78	1.25 0.909	
East Midlands	2956	24.51	0.88	0.83	0.93	<0.001	157	1.30	0.80	0.63	1.02 0.077	
West Midlands	8333	23.96	0.85	0.81	0.89	<0.001	534	1.54	0.94	0.77	1.16 0.571	
East of England	6021	17.09	0.61	0.58	0.64	<0.001	339	0.96	0.59	0.48	0.74 <0.001	
South West	8874	27.11	0.91	0.86	0.95	<0.001	569	1.74	1.02	0.83	1.26 0.824	
South Central	8943	19.76	0.70	0.67	0.74	<0.001	579	1.28	0.78	0.64	0.96 0.019	
London	8744	20.59	0.83	0.79	0.88	<0.001	621	1.46	0.98	0.80	1.20 0.845	
South East	7540	18.05	0.62	0.59	0.65	<0.001	370	0.89	0.53	0.43	0.66 <0.001	
Norther Ireland	1216	8.86	0.33	0.31	0.36	<0.001	153	1.12	0.71	0.56	0.91 0.007	
Scotland	11488	26.76	0.98	0.94	1.03	0.497	723	1.68	1.05	0.86	1.28 0.653	
Wales	9092	25.73	0.88	0.84	0.92	<0.001	679	1.92	1.15	0.94	1.40 0.184	
Deprivation Quintile												
1 (most affluent)	14444	19.44	1.00	--	--		827	1.11				
2	16237	20.58	1.08	1.05	1.10	<0.001	1031	1.31	1.19	1.09	1.31 <0.001	
3	17040	20.72	1.07	1.04	1.09	<0.001	1037	1.26	1.14	1.04	1.25 0.005	
4	20298	23.45	1.25	1.23	1.28	<0.001	1423	1.64	1.53	1.40	1.67 <0.001	
5 (least affluent)	17695	23.35	1.31	1.28	1.34	<0.001	1140	1.50	1.45	1.32	1.58 <0.001	

Incidence of diabetic retinopathy in patients with Type 2 diabetes

Amongst patients with type 2 diabetes, hazard ratios show that the risk of developing retinopathy is reduced in females compared to males by 8% (Hazard ratio 0.92, CI95% 0.91-0.93) for all retinopathy and by 20% for severe retinopathy (HR 0.80, CI95% 0.75-0.86). Relative to the youngest age group, the risk of developing diabetic retinopathy increases with each age group, with risk 2.8 times higher in those aged 75 and over compared to those aged 12-24 (HR 2.83, CI95% 2.33-3.45). Risk increases by age are slightly larger for severe retinopathy, with risk peaking in those aged 45-54 instead of for those aged 75 and over (HR 4.60, CI95% 1.72-12.29).

By calendar time, risk of all retinopathy peaks in 2011 (HR 2.70 CI95% 2.60-2.81), after which point the risk decreases in each year till 2014. Risk of severe retinopathy peaks in 2007, (HR 1.34 CI95% 1.17-1.53) with a continuous reduction in risk thereafter. By 2014, the risk of severe retinopathy is reduced by 50% compared to the start of follow-up in 2004 (HR 0.50 CI95% 0.40-0.63).

By region, risk of all retinopathy is lowest in Northern Ireland and highest in the North East of England and Scotland. Risk of severe retinopathy is comparable between most regions with notable reductions in the North West, East and South East of England, and Northern Ireland. By deprivation, risk of diabetic retinopathy is increased in most deprivation quintiles relative to the most affluent group, with risk increased by 14% in the quintile 4 relative to the most affluent group (HR 1.14, CI95% 1.12-1.17). Differences in risk of severe retinopathy are more pronounced, with risk increased by 65% in quintile 4 relative to the most affluent group (HR 1.65, CI95% 1.47-1.84).

Table 13. Incidence of Diabetic Retinopathy in the population with type 2 diabetes

T2DM	Diabetic Retinopathy						Severe Diabetic Retinopathy					
	Events	Rate per 10,000	HR	CI 95		P. val	Events	Rate per 10,000	HR	CI 95		P. val
Overall	64,924	322.25					3,682	18.28				
Gender												
Male	36,873	331.58	1.00	--	--		2,265	20.37	1.00	--	--	
Female	28,051	310.75	0.92	0.91	0.93	<0.001	1,417	15.70	0.80	0.75	0.86	<0.001
Age group												
12-24	100	121.80	1.00	--	--		**	4.87	1.00	--	--	
25-34	575	165.58	1.36	1.10	1.68	0.005	38	10.94	2.25	0.80	6.29	0.124
35-44	3,231	218.21	1.77	1.45	2.16	<0.001	282	19.05	3.91	1.46	10.48	0.01
45-54	9,180	275.02	2.17	1.78	2.64	<0.001	738	22.11	4.60	1.72	12.29	0.002
55-64	16,017	313.33	2.46	2.02	2.99	<0.001	1,035	20.25	4.21	1.58	11.25	0.00
65-74	19,075	359.30	2.80	2.30	3.40	<0.001	965	18.18	3.82	1.43	10.20	0.007
75+	16,746	373.94	2.83	2.33	3.45	<0.001	620	13.84	2.94	1.10	7.87	0.031
Ethnic Group												
White	42199	342.7	1	--	--		2,250	18.27				
South Asian	2602	350.34	1.14	1.10	1.19	<0.001	215	28.95	1.51	1.31	1.74	<0.001
Black	1050	341.4	1.08	1.02	1.15	0.014	65	21.13	1.10	0.86	1.41	0.442
Other	655	345.11	1.08	1.00	1.16	0.057	32	16.86	0.88	0.62	1.25	0.473
Mixed	191	380.99	1.23	1.06	1.41	0.005	14	27.93	1.47	0.87	2.48	0.154
Unknown	18227	278.56	0.83	0.81	0.84	<0.001	1,106	16.90	0.91	0.85	0.98	0.014
Calendar Year												
2004	3,723	163.54	1.00	--	--		385	16.91	1.00	--	--	
2005	4,222	191.69	1.16	1.11	1.22	<0.001	455	20.66	1.22	1.07	1.40	0.004
2006	5,129	235.22	1.42	1.36	1.48	<0.001	445	20.41	1.21	1.06	1.39	0.006
2007	6,218	291.81	1.76	1.69	1.83	<0.001	480	22.53	1.34	1.17	1.53	<0.001
2008	7,281	355.95	2.14	2.05	2.22	<0.001	435	21.27	1.27	1.11	1.46	0.001
2009	8,039	415.51	2.48	2.39	2.58	<0.001	367	18.97	1.13	0.98	1.31	0.083
2010	7,891	438.46	2.61	2.51	2.72	<0.001	344	19.11	1.15	0.99	1.33	0.067
2011	7,571	455.33	2.70	2.60	2.81	<0.001	293	17.62	1.06	0.91	1.23	0.450
2012	6,408	419.55	2.48	2.38	2.58	<0.001	214	14.01	0.85	0.71	1.00	0.049
2013	5,078	374.47	2.20	2.11	2.30	<0.001	177	13.05	0.79	0.66	0.94	0.009
2014	3,364	326.41	1.87	1.78	1.96	<0.001	87	8.44	0.50	0.40	0.63	<0.001
Geographical Region												
North East	1,441	433.39	1.00	--	--		75	22.56	1.00	--	--	
North West	6,838	262.97	0.60	0.56	0.632	<0.001	324	12.46	0.55	0.43	0.71	<0.001
Yorkshire & The Humber	1,742	309.81	0.70	0.65	0.746	<0.001	122	21.70	0.97	0.73	1.30	0.861
East Midlands	2,204	379.23	0.86	0.80	0.915	<0.001	98	16.86	0.76	0.56	1.02	0.068
West Midlands	6,368	351.05	0.80	0.76	0.848	<0.001	347	19.13	0.85	0.66	1.09	0.208
East of England	4,234	256.17	0.58	0.55	0.615	<0.001	213	12.89	0.58	0.44	0.75	<0.001
South West	6,882	411.12	0.92	0.87	0.977	0.006	386	23.06	1.04	0.81	1.33	0.754
South Central	6,426	314.20	0.72	0.68	0.758	<0.001	360	17.60	0.79	0.61	1.01	0.058
London	6,688	332.27	0.77	0.73	0.815	<0.001	435	21.61	0.95	0.74	1.21	0.676
South East	5,558	267.94	0.60	0.57	0.639	<0.001	231	11.14	0.50	0.39	0.65	<0.001
Norther Ireland	805	110.98	0.25	0.23	0.276	<0.001	90	12.41	0.55	0.41	0.75	<0.001
Scotland	8,832	439.34	1.00	0.95	1.062	0.877	529	26.31	1.16	0.91	1.47	0.235
Wales	6,906	334.90	0.76	0.72	0.801	<0.001	472	22.89	1.02	0.80	1.30	0.865
Deprivation Quintile												
1 (most affluent)	10,165	308.42	1.00	--	--		431	13.08	1.00	--	--	
2	12,044	324.22	1.06	1.03	1.09	<0.001	691	18.60	1.42	1.26	1.60	<0.001
3	12,640	297.07	0.97	0.95	1.00	0.024	676	15.89	1.21	1.07	1.37	0.002
4	15,702	346.81	1.14	1.12	1.17	<0.001	983	21.71	1.65	1.47	1.84	<0.001
5 (least affluent)	13,810	324.10	1.08	1.05	1.11	<0.001	839	19.69	1.48	1.32	1.67	<0.001

**cells with fewer than 5 individuals cannot be included due to concerns over patient anonymity

Incidence of diabetic retinopathy in patients with Type 1 diabetes

Amongst individuals with type 1 diabetes, the crude incidence rate of diabetic retinopathy is double that of individuals with type 2 diabetes at 642.71 events per 10,000 person years. The crude incidence rate of severe diabetic retinopathy is almost five times higher in the T1DM population compared to the T2DM population at 86.89 events per 10,000 person years.

Hazard ratios resulting from Cox proportional-hazards regression show that the risk of developing retinopathy is comparable between males and females. Relative to the youngest age group, the risk of developing diabetic retinopathy increases until age group 45-54, with risk 1.85 times higher in those aged 45-54 and over compared to those aged 12-24 (HR 1.85 CI95% 1.71-2.01). Risk increases by age are slightly larger for those with severe retinopathy, with risk peaking in those aged 25-34 and declining thereafter (HR 2.79 CI95% 2.23-3.49).

By calendar time, risk of all retinopathy peaks in 2009 (HR 1.64 CI95% 1.47-1.83), after which point the risk decreases in each year till 2014. Risk of severe retinopathy does not vary significantly between 2004-2012, and reduces thereafter. By 2014, the risk of severe retinopathy is reduced by 72% compared to the start of follow-up in 2004 (HR 0.28 CI95% 0.17-0.47).

By region, risk of all retinopathy is comparable between most regions with notable reductions in Northern Ireland and Scotland. No significant variations in the risk of severe retinopathy by region is evident, with weak evidence for an increase in Wales relative to the rest of the UK (HR 1.77 CI95% 1.10-3.10). By deprivation, risk of both overall and severe diabetic retinopathy is comparable between the least affluent and most affluent quintiles.

Table 14. Incidence of Diabetic Retinopathy in the population with type one diabetes

T1DM	Diabetic Retinopathy						Severe Diabetic Retinopathy					
	Events	Rate per 10,000	HR	CI 95		P. val	Events	Rate per 10,000	HR	CI 95		P. val
Overall	6213	642.71					840	86.89				
Gender												
Male	3588	630.84	1.00	--	--		498	87.56	1.00	--	--	
Female	2625	659.67	1.05	1.01	1.11	0.03	342	85.95	1.02	0.88	1.17	0.832
Age group												
12-24	1168	433.25	1.00	--	--		119	44.14	1.00	--	--	
25-34	1193	689.48	1.61	1.48	1.74	<0.001	216	124.83	2.79	2.23	3.49	<0.001
35-44	1400	729.33	1.71	1.58	1.84	<0.001	203	105.75	2.30	1.83	2.88	<0.001
45-54	1209	798.1	1.85	1.71	2.01	<0.001	173	114.20	2.55	2.02	3.23	<0.001
55-64	689	754.75	1.77	1.61	1.94	<0.001	92	100.78	2.23	1.70	2.93	<0.001
65-74	361	651.31	1.53	1.36	1.72	<0.001	26	46.91	1.05	0.68	1.60	0.833
75+	193	569.07	1.34	1.15	1.56	<0.001	11	32.43	0.72	0.39	1.34	0.299
Ethnic Group												
White	4058	665.52	1.00	--	--		571	93.65	1.00	--	--	
South Asian	69	582.21	0.87	0.68	1.10	0.237	6	50.63	0.53	0.24	1.18	0.119
Black	50	518.9	0.79	0.59	1.04	0.091	5	51.89	0.54	0.22	1.31	0.172
Other	31	509.56	0.74	0.54	1.09	0.136	**	32.88	0.33	0.08	1.33	0.12
Mixed	25	636.48	1.12	0.76	1.66	0.569	**	50.92	0.69	0.17	2.75	0.593
Unknown	1980	608.39	0.92	0.87	0.97	0.003	254	78.05	0.84	0.73	0.97	0.021
Calendar Year												
2004	543	510.13	1.00	--	--		108	101.46				
2005	569	548.14	1.08	0.96	1.21	0.212	101	97.30	0.94	0.72	1.24	0.678
2006	630	615.86	1.22	1.09	1.37	0.001	99	96.78	0.95	0.72	1.24	0.689
2007	637	639.89	1.27	1.13	1.42	<0.001	112	112.51	1.11	0.85	1.44	0.457
2008	659	684.71	1.37	1.22	1.53	<0.001	96	99.75	0.99	0.75	1.30	0.931
2009	751	815.64	1.64	1.47	1.83	<0.001	90	97.75	0.98	0.74	1.29	0.868
2010	660	767.9	1.55	1.39	1.74	<0.001	71	82.61	0.83	0.61	1.11	0.21
2011	597	747.56	1.52	1.35	1.70	<0.001	68	85.15	0.85	0.63	1.15	0.303
2012	477	633.22	1.28	1.13	1.45	<0.001	46	61.07	0.61	0.44	0.87	0.006
2013	411	593.34	1.21	1.06	1.37	0.004	33	47.64	0.48	0.33	0.71	0
2014	279	499.35	1.00	0.87	1.16	0.998	16	28.64	0.28	0.17	0.47	0
Geographical Region												
North East	126	655.86	1.00	--	--		14	72.87	1.00	--	--	
North West	580	487.88	0.75	0.62	0.92	0.004	80	67.29	0.95	0.54	1.68	0.87
Yorkshire & The Humbe	163	552.69	0.85	0.68	1.08	0.186	34	115.29	1.67	0.89	3.11	0.107
East Midlands	230	731.81	1.10	0.88	1.36	0.412	29	92.27	1.27	0.67	2.40	0.467
West Midlands	494	671.18	1.05	0.86	1.28	0.628	60	81.52	1.19	0.66	2.12	0.563
East of England	550	609.48	0.93	0.77	1.13	0.467	65	72.03	1.03	0.58	1.83	0.93
South West	547	743.16	1.14	0.94	1.38	0.198	79	107.33	1.52	0.86	2.68	0.149
South Central	626	615.94	0.95	0.78	1.14	0.564	98	96.42	1.36	0.78	2.38	0.281
London	536	623.68	0.95	0.79	1.16	0.634	88	102.40	1.42	0.81	2.49	0.227
South East	544	536.81	0.83	0.69	1.01	0.064	59	58.22	0.85	0.47	1.52	0.575
Norther Ireland	157	354.08	0.55	0.44	0.70	<0.001	26	58.64	0.83	0.43	1.59	0.578
Scotland	1063	925.46	1.47	1.23	1.77	<0.001	107	93.16	1.36	0.78	2.38	0.275
Wales	597	727.06	1.13	0.93	1.37	0.213	101	123.00	1.77	1.01	3.10	0.045
Deprivation Quintile												
1 (most affluent)	1146	686.89	1.00	--	--		137	82.12	1.00	--	--	
2	1157	607.86	0.88	0.81	0.95	0.002	163	85.64	1.04	0.83	1.30	0.755
3	1253	627.84	0.91	0.84	0.99	0.023	170	85.18	1.04	0.83	1.30	0.739
4	1404	645.88	0.93	0.86	1.00	0.065	210	96.61	1.16	0.93	1.43	0.189
5 (least affluent)	1207	643.45	0.94	0.87	1.02	0.128	155	82.63	0.99	0.79	1.25	0.942

**cells with fewer than 5 individuals cannot be included due to concerns over patient anonymity

Time to visual impairment amongst those with diabetic retinopathy

From the 144,736 prevalent cases of diabetic retinopathy in the CPRD, 4,358 individuals whose first visual impairment diagnosis was prior to their first diagnosis of diabetic retinopathy or major eye disease were removed from the dataset, leaving a final study sample of 139,173 individuals with diabetic retinopathy, with or without co-morbid eye disease. Within the study sample, 6,585 individuals had diagnosis of visual impairment subsequent to their retinopathy or eye disease diagnosis.

For patients with both diabetic retinopathy and major eye disease, the first recorded diagnosis of eye disease is tabulated below. The most common co-morbid eye disease was cataract, followed by glaucoma and macular degeneration.

Table 15. Breakdown of major eye disease categories for patients with diabetic retinopathy

Eye disease category	N	%
Cataract	26871	68.2
Glaucoma	7137	18.1
Macular degeneration	2212	5.6
Age related macular degeneration	3173	8.1
Total	39390	100

The analysis was conducted separately for the 98,823 patients with diabetic retinopathy alone and the 39,390 patients with diabetic retinopathy plus co-morbid glaucoma, cataracts, or macular degeneration. In all subgroup analyses, the time to visual impairment is shorter for individuals with more than one eye disease than for those with retinopathy alone. The median time to visual impairment is 4.74 years for patients with retinopathy alone (range 0-47.6 years) and 4.03 years for those with retinopathy and co-morbid eye disease (range 0-28.6 years).

By diabetic status, visual impairment occurs approximately two years earlier in the population with type 2 diabetes compared to the population with type 1 diabetes. By gender, time to visual impairment is comparable for those with retinopathy alone, and shorter for males amongst those with retinopathy and co-morbid eye disease. By ethnic group, time to visual impairment is shortest for the Black African/Caribbean group and longest for the White/Unknown group amongst those with retinopathy alone. Amongst those with co-morbid eye disease, the trend is reversed. By deprivation quintile, time to visual impairment decreases as deprivation increases amongst those with retinopathy alone. In the population with co-morbid eye disease, no consistent trend is apparent.

Table 16. Time to visual impairment amongst people with Diabetic Retinopathy

Population	DR only (n=98,823)				DR plus major eye disease (n=39,390)			
	Denominator	# of incident events	Median time to event	Crude incidence rate per	Denominator	# of incident events	Median time to event	Crude incidence rate per
All CPRD	98,823	1,937	4.75	32.34	39,390	1,573	4.03	80.87
T2DM	63,306	1,397	4.21	42.84	27,164	1,224	3.81	98.30
T1DM	11,888	281	6.15	31.45	2,577	136	5.34	81.84
Gender								
Male	57,790	1,092	4.74	31.11	19,334	756	3.92	80.71
Female	41,033	845	4.75	34.08	20,056	817	4.14	81.03
Ethnic Group								
White	62,435	1,127	4.71	29.90	25,322	992	3.93	80.62
South Asian	3,716	51	4.48	25.55	1,842	87	4.22	92.28
Black	1832	25	4.17	25.72	808	31	4.60	69.27
Other	1021	12	4.39	21.28	397	17	3.99	89.83
Mixed	350	6	4.47	30.42	130	**	4.35	15.11
Unknown	29,469	716	4.92	38.75	10,881	445	4.16	80.91
Deprivation Quintile								
1 (most affluent)	16,476	312	5.06	29.68	6,448	286	3.98	88.96
2	18,741	247	4.71	21.78	7,458	265	3.84	73.43
3	19,746	436	4.75	36.25	8,257	384	4.25	92.20
4	22,598	509	4.62	35.56	8,962	344	3.94	79.33
5 (least affluent)	20,437	417	4.71	33.67	7,943	286	4.10	71.89

*Major eye disease includes glaucoma, cataracts, and macular degeneration

**cells with fewer than 5 individuals cannot be included due to concerns over patient anonymity

Discussion

According to the Office for National Statistics, the size of the UK population at the midpoint of 2014 was 64.6 million people.(21) Given that the CPRD is representative of the UK population structure, we estimate that the absolute number of people with any form of diabetic retinopathy in the UK is approximately 1.5 million and that the absolute number of people with severe diabetic retinopathy is around 140,000.

Main findings

Over the study period of 2004-2014, the average prevalence of DR is 48.3% in T1DM and 28.3% in T2DM. In 2014, prevalence of diabetic retinopathy is 54.6% in T1DM and 30.0% in T2DM rising to 68% and 35% respectively in the oldest age group.

The overall prevalence of diabetic retinopathy found in the CPRD is comparable to that of smaller, regional contemporaneous studies. A 2015 study of the Welsh National Diabetic Retinopathy Screening Service has reported that the prevalence of diabetic retinopathy is 56% in those with type 1 diabetes and 30.3% in those with type 2 diabetes.(4) These figures tally closely with the respective figures of 48.4% and 28.3% from our study. Similarities extend to severe diabetic retinopathy also; the same study reports prevalences of 11.2% in those with type 1 diabetes and 2.9% in those with type 2 diabetes. Our study has found the prevalence to be 10.3% and 2.4% respectively

The differences in prevalence by gender and ethnic group found here confirm those of recent smaller UK based studies. In 2012, Sivaprasad et al. reported reduced odds of prevalent retinopathy in women compared to men (OR 0.93 CI95% 0.90-0.97) and raised odds in South Asian and Black African/Caribbean groups compared to White (South Asian OR 1.10 CI95% 1.02-1.18, Black OR 1.79, CI95% 1.70-1.89) amongst individuals with diabetes in the UK. (7)

The overall prevalence of DR has been increasing steadily over the last 10 years in parallel to that of T2DM. Increases in prevalence of DR are likely to be related to increasing prevalence of T2DM and potentially increased ascertainment through nationwide screening programs.

In the general CPRD population, several inequalities by socio-demographic group are apparent, with prevalence of diabetic retinopathy highest in the South Asian population and in the least affluent quintile. Within the T2DM population, differences by ethnicity and IMD are small, reaching equivalency in later years. This suggests that the overall increase in DR prevalence is driven by the increasing prevalence of T2DM. The pattern differs for incident DR, with risk of new events significantly raised for ethnic minority groups compared to White.

Turning to patients with type 1 diabetes, the prevalence of both T1DM and retinopathy within T1DM relatively stable over time. This is to be expected as the

prevalence and incidence of T1DM is not subject to large increases due to an increasingly obesogenic environment, as is the case with the current epidemic of type 2 diabetes. Within this group, the patterns of incidence are similar to those of prevalence, with no apparent differences by ethnic group or deprivation.

Median time to visual impairment was found to be shorter for those with both diabetic retinopathy and major eye disease compared to those with diabetic retinopathy alone (4.03 years vs. 4.75 years). In the group with retinopathy alone we can be fairly confident that the subsequent visual impairment is due to the presence of retinopathy and the progression of diabetes. In those with multiple eye diseases, we can infer that diabetic retinopathy contributed to the visual impairment, but it is impossible to attribute cause to retinopathy alone due to the overlapping disease processes at work.

Strengths of the study

This study made use of high levels of ethnicity recording and linkage with ONS to describe patterns by ethnicity and IMD. This study constitutes the largest ever sample size to examine trends in the burden of diabetes and diabetic retinopathy in the UK. This allowed for sufficient power to detect relationships between populations stratified by gender, ethnic group, geographic region and deprivation, which is often unfeasible in smaller studies where population sizes do not allow for such granular comparisons.

At the time of publication, this is the only national study to examine ethnicity and IMD in relation to the prevalence and incidence of diabetic retinopathy.

The advantage of routine electronic health databases is that they are regularly updated and can be used to provide timely information on the demographic makeup of the general population and on areas of growing healthcare need.

The data in the CPRD are prospectively collected and, as a result, the data are not subject to recall bias (the presence of a disease outcome affects the reporting of exposure status) or observer bias (the knowledge of the patient's disease status influences ascertainment or recording of exposure).

Limitations

The primary purpose of the clinical data held in the CPRD is for patient care, rather than research. By its nature it only includes information gathered at consultation and is thus routinely collected rather than researcher-led. As a result, the completeness and accuracy of data are subject to temporal changes in coding practices, health priorities and population need. Anything not reported to the general practitioner is necessarily not recorded. The absence of a code does not necessarily mean that an individual is free from that condition, but must also be interpreted as being unknown.

In addition to incomplete data, a further potential problem with routinely electronic health records is incorrect coding stemming from errors in the way data is entered. A

wide range of studies have found the validity of diagnoses and process of care measures in CPRD to be high.(22–24) Combined with the fact that the CPRD data are subject to ongoing internal quality checks and that concerns with data quality are fed back to the general practices, researchers can be reassured that errors which do occur in the database are kept to a minimum.

This study relied solely on the coded diagnoses of diabetes, retinopathy, eye disease, and visual impairment. We did not have access to data from other sources such as retinal photography or practitioner letters, which could have been used to validate the diagnoses. As the recording all of these codes is incentivised under the Quality and Outcomes Framework, it is likely that the quality and accuracy of these coded data was high.

References

4. Diabetes UK. Eyes (Retinopathy) [Internet]. 2015. Available from: <https://www.diabetes.org.uk/Guide-to-diabetes/Complications/Retinopathy/>
5. Kostev K, Rathmann W. Diabetic retinopathy at diagnosis of type 2 diabetes in the UK: A database analysis. *Diabetologia*. Germany: IMS Health, Epidemiology, Darmstadter Landstrasse 108, 60598 Frankfurt am Main, Germany. kkostev@de.imshealth.com; 2013;56(1):109–11.
6. Looker HC, Cromie D. Diabetic retinopathy at diagnosis of type 2 diabetes in Scotland. *Diabetes*. H.C. Looker, Dundee United Kingdom: American Diabetes Association Inc.; 2011. p. A183.
7. Thomas RL, Dunstan FD, Luzio SD, Chowdhury SR, North R V., Hale SL, et al. Prevalence of diabetic retinopathy within a national diabetic retinopathy screening service. *Br J Ophthalmol*. 2015;99(1):64–8.
8. Diabetes UK. Key statistics on diabetes. 2010.
9. Hayward LM, Burden ML, Burden AC, Blackledge H, Raymond NT, Botha JL, et al. What is the prevalence of visual impairment in the general and diabetic populations: are there ethnic and gender differences? *Diabet Med*. 19(1):27–34.
10. Ethnic variations in the prevalence of diabetic retinopathy in people with diabetes attending screening in the United Kingdom (DRIVE UK). *PLoS One*. 2012;7(3).
11. Wong TY, Klein R, Islam FMA, Cotch MF, Folsom AR, Klein BEK, et al. Diabetic retinopathy in a multi-ethnic cohort in the United States. *Am J Ophthalmol*. 141(3):446–55.
12. Cappuccio FP, Barbato A, Kerry S. Hypertension, diabetes and cardiovascular risk in ethnic minorities in the UK. *British Journal of Diabetes and Vascular Disease*. F.P. Cappuccio, Dept. of Community Health Sciences, St George's Hospital Medical School, Cranmer Terrace, London SW17 0RE, United Kingdom. E-mail: f.cappuccio@sghms.ac.uk: MediNews (Diabetes) Ltd; 2003. p. 286–93.
13. Tillin. T, Hughes AD, Whincup P, Forouhi NG, Godsland IF, Sattar N, et al. Excess diabetes in ethnic minorities-incidence and predictors. *Diabetologia*. T. Tillin, National Heart and Lung Institute, Imperial College, London, United Kingdom: Springer Verlag; 2011;Conference:47th Annual Meeting of the European Association fo.
14. Bakker LE, Sleddering MA, Schoones JW, Meinders AE, Jazet IM. Pathogenesis of type 2 diabetes in South Asians. *Eur J Endocrinol*. 2013/08/14 ed. 2013;169(5):R99–114.
15. Bhopal RS. A four-stage model explaining the higher risk of Type 2 diabetes mellitus in South Asians compared with European populations. *Diabet Med*. England: Edinburgh Ethnicity and Health Research Group, Centre for Population Health Sciences, University of Edinburgh, Edinburgh, UK. raj.bhopal@ed.ac.uk; 2013;30(1):35–42.
16. Davis TME, Coleman RL, Holman RR. Ethnicity and long-term vascular outcomes in Type 2 diabetes: A prospective observational study (UKPDS 83). *Diabetic Medicine*. T.M.E. Davis, School of Medicine and Pharmacology,

- University of Western Australia, Fremantle Hospital, Fremantle, WA, Australia.
E-mail: tim.davis@uwa.edu.au: Blackwell Publishing Ltd (9600 Garsington Road, Oxford OX4 2XG, United Kingdom); 2014. p. 200–7.
17. Stratton IM, Adler AI, Neil HA, Matthews DR, Manley SE, Cull CA, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *BMJ*. 2000 Aug 12;321(7258):405–12.
 18. Doran T, Fullwood C, Gravelle H, Reeves D, Kontopantelis E, Hiroeh U, et al. Pay-for-Performance Programs in Family Practices in the United Kingdom [Internet]. *New England Journal of Medicine*. 2006 [cited 2015 Jul 27]. Available from: <http://www.nejm.org/doi/full/10.1056/NEJMsa055505>
 19. Khunti K, Gadsby R, Millett C, Majeed a., Davies M. Quality of diabetes care in the UK: Comparison of published quality-of-care reports with results of the Quality and Outcomes Framework for Diabetes. *Diabet Med*. 2007 Dec;24(12):1436–41.
 20. Herrett E, Gallagher AM, Bhaskaran K, Forbes H, Mathur R, van Staa T, et al. Data Resource Profile: Clinical Practice Research Datalink (CPRD). *Int J Epidemiol*. 2015 Jun 6;
 21. Mathur R, Bhaskaran K, Chaturvedi N, Leon DA, vanStaa T, Grundy E, et al. Completeness and usability of ethnicity data in UK-based primary care and hospital databases. *J Public Heal*. 2013/12/11 ed. 2013 Dec;36(4):684–92.
 22. Allen N, Sudlow C, Downey P, Peakman T, Danesh J, Elliott P, et al. UK Biobank: Current status and what it means for epidemiology. *Heal Policy Technol*. Elsevier; 2012 Sep;1(3):123–6.
 23. Mclennan D, Barnes H, Noble M, Davies J, Garratt E. The English Indices of Deprivation 2010 - technical report. *Soc Policy*. 2011;
 24. ONS. Total Population (UK) Mid-2014 Estimate [Internet]. 2014 [cited 2015 Jul 30]. Available from: <http://ons.gov.uk/ons/taxonomy/index.html?nscl=Population>
 25. Herrett E, Thomas SL, Schoonen WM, Smeeth L, Hall AJ. Validation and validity of diagnoses in the General Practice Research Database: a systematic review. *Br J Clin Pharmacol*. 2010/01/19 ed. 2010;69(1):4–14.
 26. Khan NF, Harrison SE, Rose PW. Validity of diagnostic coding within the General Practice Research Database: a systematic review. *Br J Gen Pract*. 2010 Mar;60(572):e128–36.
 27. Jick SS, Kaye JA, Vasilakis-Scaramozza C, Garcia Rodriguez LA, Ruigomez A, Meier CR, et al. Validity of the general practice research database. *Pharmacotherapy*. 2003/05/14 ed. 2003;23(5):686–9.

Appendix

Read codes for Diabetes Mellitus

medcode	readcode	readterm	category
28622	2126300	Diabetes resolved	Diabetes ceased
18766	212H.00	Diabetes resolved	Diabetes ceased
711	C10..00	Diabetes mellitus	Vague codes
38986	C100.00	Diabetes mellitus with no mention of complication	Vague codes
24490	C100000	Diabetes mellitus, juvenile type, no mention of complication	Possible T1 codes
1038	C100011	Insulin dependent diabetes mellitus	Possible T1 codes
14803	C100100	Diabetes mellitus, adult onset, no mention of complication	Possible T2 codes
14889	C100111	Maturity onset diabetes	Possible T2 codes
506	C100112	Non-insulin dependent diabetes mellitus	Possible T2 codes
50972	C100z00	Diabetes mellitus NOS with no mention of complication	Vague codes
1682	C101.00	Diabetes mellitus with ketoacidosis	Vague codes
53200	C101000	Diabetes mellitus, juvenile type, with ketoacidosis	Possible T1 codes
54856	C101100	Diabetes mellitus, adult onset, with ketoacidosis	Vague codes
38617	C101y00	Other specified diabetes mellitus with ketoacidosis	Vague codes
42505	C101z00	Diabetes mellitus NOS with ketoacidosis	Vague codes
21482	C102.00	Diabetes mellitus with hyperosmolar coma	Vague codes
40023	C102000	Diabetes mellitus, juvenile type, with hyperosmolar coma	Possible T1 codes
43139	C102100	Diabetes mellitus, adult onset, with hyperosmolar coma	Possible T2 codes
72345	C102z00	Diabetes mellitus NOS with hyperosmolar coma	Vague codes
15690	C103.00	Diabetes mellitus with ketoacidotic coma	Vague codes
42567	C103000	Diabetes mellitus, juvenile type, with ketoacidotic coma	Possible T1 codes
68843	C103100	Diabetes mellitus, adult onset, with ketoacidotic coma	Possible T2 codes
59288	C103y00	Other specified diabetes mellitus with coma	Vague codes
65062	C103z00	Diabetes mellitus NOS with ketoacidotic coma	Vague codes
16502	C104.00	Diabetes mellitus with renal manifestation	Vague codes
2475	C104.11	Diabetic nephropathy	Vague codes
93922	C104000	Diabetes mellitus, juvenile type, with renal manifestation	Possible T1 codes
35105	C104100	Diabetes mellitus, adult onset, with renal manifestation	Possible T2 codes
13279	C104y00	Other specified diabetes mellitus with renal complications	Vague codes

medcode	readcode	readterm	category
35107	C104z00	Diabetes mellitis with nephropathy NOS	Vague codes
33254	C105.00	Diabetes mellitus with ophthalmic manifestation	Vague codes
69748	C105000	Diabetes mellitus, juvenile type, + ophthalmic manifestation	Possible T1 codes
41389	C105100	Diabetes mellitus, adult onset, + ophthalmic manifestation	Possible T2 codes
47377	C105y00	Other specified diabetes mellitus with ophthalmic complicatn	Vague codes
34283	C105z00	Diabetes mellitus NOS with ophthalmic manifestation	Vague codes
16230	C106.00	Diabetes mellitus with neurological manifestation	Vague codes
59903	C106.11	Diabetic amyotrophy	Vague codes
7795	C106.12	Diabetes mellitus with neuropathy	Vague codes
16491	C106.13	Diabetes mellitus with polyneuropathy	Vague codes
67853	C106000	Diabetes mellitus, juvenile, + neurological manifestation	Possible T1 codes
39317	C106100	Diabetes mellitus, adult onset, + neurological manifestation	Possible T2 codes
61523	C106y00	Other specified diabetes mellitus with neurological comps	Vague codes
22573	C106z00	Diabetes mellitus NOS with neurological manifestation	Vague codes
35399	C107.00	Diabetes mellitus with peripheral circulatory disorder	Vague codes
32403	C107.11	Diabetes mellitus with gangrene	Vague codes
32556	C107.12	Diabetes with gangrene	Vague codes
70448	C107000	Diabetes mellitus, juvenile +peripheral circulatory disorder	Possible T1 codes
63357	C107100	Diabetes mellitus, adult, + peripheral circulatory disorder	Possible T2 codes
33807	C107200	Diabetes mellitus, adult with gangrene	Possible T2 codes
69124	C107300	IDDM with peripheral circulatory disorder	Probable T1 codes
56803	C107400	NIDDM with peripheral circulatory disorder	Probable T2 codes
65025	C107z00	Diabetes mellitus NOS with peripheral circulatory disorder	Vague codes
1647	C108.00	Insulin dependent diabetes mellitus	Probable T1 codes
18505	C108.11	IDDM-Insulin dependent diabetes mellitus	Probable T1 codes
17858	C108.12	Type 1 diabetes mellitus	Probable T1 codes
24423	C108.13	Type I diabetes mellitus	Probable T1 codes
46963	C108000	Insulin-dependent diabetes mellitus with renal	Probable T1 codes

medcode	readcode	readterm	category
		complications	
61344	C108011	Type I diabetes mellitus with renal complications	Probable T1 codes
21983	C108012	Type 1 diabetes mellitus with renal complications	Probable T1 codes
49276	C108100	Insulin-dependent diabetes mellitus with ophthalmic comps	Probable T1 codes
52283	C108200	Insulin-dependent diabetes mellitus with neurological comps	Probable T1 codes
49146	C108211	Type I diabetes mellitus with neurological complications	Probable T1 codes
61829	C108212	Type 1 diabetes mellitus with neurological complications	Probable T1 codes
52104	C108300	Insulin dependent diabetes mellitus with multiple complicatn	Probable T1 codes
26855	C108400	Unstable insulin dependant diabetes mellitus	Probable T1 codes
60107	C108411	Unstable type I diabetes mellitus	Probable T1 codes
97474	C108412	Unstable type 1 diabetes mellitus	Probable T1 codes
44443	C108500	Insulin dependent diabetes mellitus with ulcer	Probable T1 codes
51957	C108511	Type I diabetes mellitus with ulcer	Probable T1 codes
68390	C108512	Type 1 diabetes mellitus with ulcer	Probable T1 codes
60499	C108600	Insulin dependent diabetes mellitus with gangrene	Probable T1 codes
6509	C108700	Insulin dependent diabetes mellitus with retinopathy	Probable T1 codes
38161	C108711	Type I diabetes mellitus with retinopathy	Probable T1 codes
41049	C108712	Type 1 diabetes mellitus with retinopathy	Probable T1 codes
6791	C108800	Insulin dependant diabetes mellitus - poor control	Probable T1 codes
46850	C108811	Type I diabetes mellitus - poor control	Probable T1 codes
45914	C108812	Type 1 diabetes mellitus - poor control	Probable T1 codes
31310	C108900	Insulin dependant diabetes maturity onset	Probable T1 codes
63017	C108911	Type I diabetes mellitus maturity onset	Probable T1 codes
97446	C108912	Type 1 diabetes mellitus maturity onset	Probable T1 codes
56448	C108A00	Insulin-dependent diabetes without complication	Probable T1 codes
95992	C108A11	Type I diabetes mellitus without complication	Probable T1 codes
24694	C108B00	Insulin dependent diabetes mellitus with mononeuropathy	Probable T1 codes
99231	C108B11	Type I diabetes mellitus with mononeuropathy	Probable T1 codes
41716	C108C00	Insulin dependent diabetes mellitus with polyneuropathy	Probable T1 codes
57621	C108D00	Insulin dependent diabetes mellitus with nephropathy	Probable T1 codes
66872	C108D11	Type I diabetes mellitus with nephropathy	Probable T1 codes

medcode	readcode	readterm	category
44440	C108E00	Insulin dependent diabetes mellitus with hypoglycaemic coma	Probable T1 codes
42729	C108E11	Type I diabetes mellitus with hypoglycaemic coma	Probable T1 codes
70766	C108E12	Type 1 diabetes mellitus with hypoglycaemic coma	Probable T1 codes
44260	C108F00	Insulin dependent diabetes mellitus with diabetic cataract	Probable T1 codes
17545	C108F11	Type I diabetes mellitus with diabetic cataract	Probable T1 codes
64446	C108G00	Insulin dependent diab mell with peripheral angiopathy	Probable T1 codes
65616	C108H00	Insulin dependent diabetes mellitus with arthropathy	Probable T1 codes
62352	C108H11	Type I diabetes mellitus with arthropathy	Probable T1 codes
39809	C108J00	Insulin dependent diab mell with neuropathic arthropathy	Probable T1 codes
60208	C108J11	Type I diabetes mellitus with neuropathic arthropathy	Probable T1 codes
18230	C108J12	Type 1 diabetes mellitus with neuropathic arthropathy	Probable T1 codes
46290	C108y00	Other specified diabetes mellitus with multiple comps	Vague codes
64449	C108z00	Unspecified diabetes mellitus with multiple complications	Vague codes
4513	C109.00	Non-insulin dependent diabetes mellitus	Probable T2 codes
5884	C109.11	NIDDM - Non-insulin dependent diabetes mellitus	Probable T2 codes
17859	C109.12	Type 2 diabetes mellitus	Probable T2 codes
18219	C109.13	Type II diabetes mellitus	Probable T2 codes
52303	C109000	Non-insulin-dependent diabetes mellitus with renal comps	Probable T2 codes
50225	C109011	Type II diabetes mellitus with renal complications	Probable T2 codes
18209	C109012	Type 2 diabetes mellitus with renal complications	Probable T2 codes
50429	C109100	Non-insulin-dependent diabetes mellitus with ophthalm comps	Probable T2 codes
59725	C109111	Type II diabetes mellitus with ophthalmic complications	Probable T2 codes
70316	C109112	Type 2 diabetes mellitus with ophthalmic complications	Probable T2 codes
55842	C109200	Non-insulin-dependent diabetes mellitus with neuro comps	Probable T2 codes
67905	C109211	Type II diabetes mellitus with neurological complications	Probable T2 codes
45919	C109212	Type 2 diabetes mellitus with neurological complications	Probable T2 codes
62146	C109300	Non-insulin-dependent diabetes mellitus with multiple comps	Probable T2 codes
34912	C109400	Non-insulin dependent diabetes mellitus with ulcer	Probable T2 codes

medcode	readcode	readterm	category
55075	C109411	Type II diabetes mellitus with ulcer	Probable T2 codes
65704	C109412	Type 2 diabetes mellitus with ulcer	Probable T2 codes
40401	C109500	Non-insulin dependent diabetes mellitus with gangrene	Probable T2 codes
62107	C109511	Type II diabetes mellitus with gangrene	Probable T2 codes
46150	C109512	Type 2 diabetes mellitus with gangrene	Probable T2 codes
17262	C109600	Non-insulin-dependent diabetes mellitus with retinopathy	Probable T2 codes
58604	C109611	Type II diabetes mellitus with retinopathy	Probable T2 codes
42762	C109612	Type 2 diabetes mellitus with retinopathy	Probable T2 codes
8403	C109700	Non-insulin dependant diabetes mellitus - poor control	Probable T2 codes
24458	C109711	Type II diabetes mellitus - poor control	Probable T2 codes
45913	C109712	Type 2 diabetes mellitus - poor control	Probable T2 codes
39406	C109800	Reaven's syndrome	Not diabetes
29979	C109900	Non-insulin-dependent diabetes mellitus without complication	Probable T2 codes
72320	C109A00	Non-insulin dependent diabetes mellitus with mononeuropathy	Probable T2 codes
50813	C109A11	Type II diabetes mellitus with mononeuropathy	Probable T2 codes
45467	C109B00	Non-insulin dependent diabetes mellitus with polyneuropathy	Probable T2 codes
47409	C109B11	Type II diabetes mellitus with polyneuropathy	Probable T2 codes
59365	C109C00	Non-insulin dependent diabetes mellitus with nephropathy	Probable T2 codes
64571	C109C11	Type II diabetes mellitus with nephropathy	Probable T2 codes
24836	C109C12	Type 2 diabetes mellitus with nephropathy	Probable T2 codes
43785	C109D00	Non-insulin dependent diabetes mellitus with hypoglyca coma	Probable T2 codes
56268	C109D11	Type II diabetes mellitus with hypoglycaemic coma	Probable T2 codes
61071	C109D12	Type 2 diabetes mellitus with hypoglycaemic coma	Probable T2 codes
69278	C109E00	Non-insulin depend diabetes mellitus with diabetic cataract	Probable T2 codes
48192	C109E11	Type II diabetes mellitus with diabetic cataract	Probable T2 codes
44779	C109E12	Type 2 diabetes mellitus with diabetic cataract	Probable T2 codes
54212	C109F00	Non-insulin-dependent d m with peripheral angiopath	Probable T2 codes
54899	C109F11	Type II diabetes mellitus with peripheral angiopathy	Probable T2 codes

medcode	readcode	readterm	category
60699	C109F12	Type 2 diabetes mellitus with peripheral angiopathy	Probable T2 codes
24693	C109G00	Non-insulin dependent diabetes mellitus with arthropathy	Probable T2 codes
18143	C109G11	Type II diabetes mellitus with arthropathy	Probable T2 codes
49869	C109G12	Type 2 diabetes mellitus with arthropathy	Probable T2 codes
40962	C109H00	Non-insulin dependent d m with neuropathic arthropathy	Probable T2 codes
47816	C109H11	Type II diabetes mellitus with neuropathic arthropathy	Probable T2 codes
66965	C109H12	Type 2 diabetes mellitus with neuropathic arthropathy	Probable T2 codes
18278	C109J00	Insulin treated Type 2 diabetes mellitus	Probable T2 codes
37648	C109J11	Insulin treated non-insulin dependent diabetes mellitus	Probable T2 codes
18264	C109J12	Insulin treated Type II diabetes mellitus	Probable T2 codes
36633	C109K00	Hyperosmolar non-ketotic state in type 2 diabetes mellitus	Probable T2 codes
52236	C10A.00	Malnutrition-related diabetes mellitus	Secondary / Other types
66675	C10A000	Malnutrition-related diabetes mellitus with coma	Secondary / Other types
33969	C10A100	Malnutrition-related diabetes mellitus with ketoacidosis	Secondary / Other types
100347	C10A500	Malnutritn-relat diabetes melitus wth periph circul complctn	Secondary / Other types
11551	C10B.00	Diabetes mellitus induced by steroids	Secondary / Other types
26108	C10B000	Steroid induced diabetes mellitus without complication	Secondary / Other types
43453	C10C.00	Diabetes mellitus autosomal dominant	Genetic
46624	C10C.11	Maturity onset diabetes in youth	Genetic
98392	C10C.12	Maturity onset diabetes in youth type 1	Genetic
36695	C10D.00	Diabetes mellitus autosomal dominant type 2	Genetic
59991	C10D.11	Maturity onset diabetes in youth type 2	Genetic
1549	C10E.00	Type 1 diabetes mellitus	Definite T1 codes
12455	C10E.11	Type I diabetes mellitus	Definite T1 codes
51261	C10E.12	Insulin dependent diabetes mellitus	Definite T1 codes
47582	C10E000	Type 1 diabetes mellitus with renal complications	Definite T1 codes
47649	C10E100	Type 1 diabetes mellitus with ophthalmic complications	Definite T1 codes
99311	C10E111	Type I diabetes mellitus with ophthalmic complications	Definite T1 codes
98071	C10E112	Insulin-dependent diabetes mellitus with ophthalmic comps	Definite T1 codes
42831	C10E200	Type 1 diabetes mellitus with neurological complications	Definite T1 codes
47650	C10E300	Type 1 diabetes mellitus with multiple complications	Definite T1 codes

medcode	readcode	readterm	category
91942	C10E311	Type I diabetes mellitus with multiple complications	Definite T1 codes
45276	C10E312	Insulin dependent diabetes mellitus with multiple complicat	Definite T1 codes
43921	C10E400	Unstable type 1 diabetes mellitus	Definite T1 codes
49949	C10E411	Unstable type I diabetes mellitus	Definite T1 codes
54600	C10E412	Unstable insulin dependent diabetes mellitus	Definite T1 codes
18683	C10E500	Type 1 diabetes mellitus with ulcer	Definite T1 codes
93878	C10E511	Type I diabetes mellitus with ulcer	Definite T1 codes
98704	C10E512	Insulin dependent diabetes mellitus with ulcer	Definite T1 codes
69993	C10E600	Type 1 diabetes mellitus with gangrene	Definite T1 codes
18387	C10E700	Type 1 diabetes mellitus with retinopathy	Definite T1 codes
95343	C10E711	Type I diabetes mellitus with retinopathy	Definite T1 codes
93875	C10E712	Insulin dependent diabetes mellitus with retinopathy	Definite T1 codes
35288	C10E800	Type 1 diabetes mellitus - poor control	Definite T1 codes
72702	C10E812	Insulin dependent diabetes mellitus - poor control	Definite T1 codes
40682	C10E900	Type 1 diabetes mellitus maturity onset	Definite T1 codes
96235	C10E911	Type I diabetes mellitus maturity onset	Definite T1 codes
97849	C10E912	Insulin dependent diabetes maturity onset	Definite T1 codes
69676	C10EA00	Type 1 diabetes mellitus without complication	Definite T1 codes
62613	C10EA11	Type I diabetes mellitus without complication	Definite T1 codes
99719	C10EA12	Insulin-dependent diabetes without complication	Definite T1 codes
68105	C10EB00	Type 1 diabetes mellitus with mononeuropathy	Definite T1 codes
46301	C10EC00	Type 1 diabetes mellitus with polyneuropathy	Definite T1 codes
91943	C10EC11	Type I diabetes mellitus with polyneuropathy	Definite T1 codes
101311	C10EC12	Insulin dependent diabetes mellitus with polyneuropathy	Definite T1 codes
10418	C10ED00	Type 1 diabetes mellitus with nephropathy	Definite T1 codes
39070	C10EE00	Type 1 diabetes mellitus with hypoglycaemic coma	Definite T1 codes
99716	C10EE12	Insulin dependent diabetes mellitus with hypoglycaemic coma	Definite T1 codes
49554	C10EF00	Type 1 diabetes mellitus with diabetic cataract	Definite T1 codes
100770	C10EF12	Insulin dependent diabetes mellitus with diabetic cataract	Definite T1 codes
93468	C10EG00	Type 1 diabetes mellitus with peripheral angiopathy	Definite T1 codes
18642	C10EH00	Type 1 diabetes mellitus with arthropathy	Definite T1 codes
54008	C10EJ00	Type 1 diabetes mellitus with neuropathic arthropathy	Definite T1 codes

medcode	readcode	readterm	category
30323	C10EK00	Type 1 diabetes mellitus with persistent proteinuria	Definite T1 codes
30294	C10EL00	Type 1 diabetes mellitus with persistent microalbuminuria	Definite T1 codes
10692	C10EM00	Type 1 diabetes mellitus with ketoacidosis	Definite T1 codes
62209	C10EM11	Type I diabetes mellitus with ketoacidosis	Definite T1 codes
40837	C10EN00	Type 1 diabetes mellitus with ketoacidotic coma	Definite T1 codes
66145	C10EN11	Type I diabetes mellitus with ketoacidotic coma	Definite T1 codes
22871	C10EP00	Type 1 diabetes mellitus with exudative maculopathy	Definite T1 codes
97894	C10EP11	Type I diabetes mellitus with exudative maculopathy	Definite T1 codes
55239	C10EQ00	Type 1 diabetes mellitus with gastroparesis	Definite T1 codes
95636	C10ER00	Latent autoimmune diabetes mellitus in adult	Secondary / Other types
758	C10F.00	Type 2 diabetes mellitus	Definite T2 codes
22884	C10F.11	Type II diabetes mellitus	Definite T2 codes
18777	C10F000	Type 2 diabetes mellitus with renal complications	Definite T2 codes
57278	C10F011	Type II diabetes mellitus with renal complications	Definite T2 codes
47321	C10F100	Type 2 diabetes mellitus with ophthalmic complications	Definite T2 codes
100964	C10F111	Type II diabetes mellitus with ophthalmic complications	Definite T2 codes
34268	C10F200	Type 2 diabetes mellitus with neurological complications	Definite T2 codes
98616	C10F211	Type II diabetes mellitus with neurological complications	Definite T2 codes
65267	C10F300	Type 2 diabetes mellitus with multiple complications	Definite T2 codes
43227	C10F311	Type II diabetes mellitus with multiple complications	Definite T2 codes
49074	C10F400	Type 2 diabetes mellitus with ulcer	Definite T2 codes
91646	C10F411	Type II diabetes mellitus with ulcer	Definite T2 codes
12736	C10F500	Type 2 diabetes mellitus with gangrene	Definite T2 codes
18496	C10F600	Type 2 diabetes mellitus with retinopathy	Definite T2 codes
49655	C10F611	Type II diabetes mellitus with retinopathy	Definite T2 codes
25627	C10F700	Type 2 diabetes mellitus - poor control	Definite T2 codes
47315	C10F711	Type II diabetes mellitus - poor control	Definite T2 codes
54773	C10F800	Reaven's syndrome	Not diabetes
39481	C10F811	Metabolic syndrome X	Not diabetes
47954	C10F900	Type 2 diabetes mellitus without complication	Definite T2 codes
53392	C10F911	Type II diabetes mellitus without complication	Definite T2 codes
62674	C10FA00	Type 2 diabetes mellitus with mononeuropathy	Definite T2 codes
95351	C10FA11	Type II diabetes mellitus with mononeuropathy	Definite T2 codes
18425	C10FB00	Type 2 diabetes mellitus with polyneuropathy	Definite T2 codes

medcode	readcode	readterm	category
50527	C10FB11	Type II diabetes mellitus with polyneuropathy	Definite T2 codes
12640	C10FC00	Type 2 diabetes mellitus with nephropathy	Definite T2 codes
46917	C10FD00	Type 2 diabetes mellitus with hypoglycaemic coma	Definite T2 codes
98723	C10FD11	Type II diabetes mellitus with hypoglycaemic coma	Definite T2 codes
44982	C10FE00	Type 2 diabetes mellitus with diabetic cataract	Definite T2 codes
93727	C10FE11	Type II diabetes mellitus with diabetic cataract	Definite T2 codes
37806	C10FF00	Type 2 diabetes mellitus with peripheral angiopathy	Definite T2 codes
59253	C10FG00	Type 2 diabetes mellitus with arthropathy	Definite T2 codes
35385	C10FH00	Type 2 diabetes mellitus with neuropathic arthropathy	Definite T2 codes
1407	C10FJ00	Insulin treated Type 2 diabetes mellitus	Definite T2 codes
64668	C10FJ11	Insulin treated Type II diabetes mellitus	Definite T2 codes
34450	C10FK00	Hyperosmolar non-ketotic state in type 2 diabetes mellitus	Definite T2 codes
26054	C10FL00	Type 2 diabetes mellitus with persistent proteinuria	Definite T2 codes
60796	C10FL11	Type II diabetes mellitus with persistent proteinuria	Definite T2 codes
18390	C10FM00	Type 2 diabetes mellitus with persistent microalbuminuria	Definite T2 codes
85991	C10FM11	Type II diabetes mellitus with persistent microalbuminuria	Definite T2 codes
32627	C10FN00	Type 2 diabetes mellitus with ketoacidosis	Definite T2 codes
51756	C10FP00	Type 2 diabetes mellitus with ketoacidotic coma	Definite T2 codes
25591	C10FQ00	Type 2 diabetes mellitus with exudative maculopathy	Definite T2 codes
63690	C10FR00	Type 2 diabetes mellitus with gastroparesis	Definite T2 codes
95539	C10FS00	Maternally inherited diabetes mellitus	Genetic
51697	C10G.00	Secondary pancreatic diabetes mellitus	Secondary / Other types
96506	C10G000	Secondary pancreatic diabetes mellitus without complication	Secondary / Other types
61122	C10H.00	Diabetes mellitus induced by non-steroid drugs	Secondary / Other types
67212	C10H000	DM induced by non-steroid drugs without complication	Secondary / Other types
68517	C10J.00	Insulin autoimmune syndrome	Secondary / Other types
37957	C10K.00	Type A insulin resistance	Not diabetes
56885	C10K000	Type A insulin resistance without complication	Not diabetes
43857	C10M.00	Lipoatrophic diabetes mellitus	Secondary / Other types
22487	C10N.00	Secondary diabetes mellitus	Secondary / Other types
94383	C10N000	Secondary diabetes mellitus without complication	Secondary / Other types

medcode	readcode	readterm	category
93380	C10N100	Cystic fibrosis related diabetes mellitus	Secondary / Other types
33343	C10y.00	Diabetes mellitus with other specified manifestation	Vague codes
63371	C10y100	Diabetes mellitus, adult, + other specified manifestation	Probable T2 codes
10098	C10yy00	Other specified diabetes mellitus with other spec comps	Vague codes
70821	C10yz00	Diabetes mellitus NOS with other specified manifestation	Vague codes
45491	C10z.00	Diabetes mellitus with unspecified complication	Vague codes
68792	C10z000	Diabetes mellitus, juvenile type, + unspecified complication	Possible T1 codes
63762	C10z100	Diabetes mellitus, adult onset, + unspecified complication	Probable T2 codes
64283	C10zy00	Other specified diabetes mellitus with unspecified comps	Vague codes
64357	C10zz00	Diabetes mellitus NOS with unspecified complication	Vague codes
2472	C110.00	Hypoglycaemic coma	Possible T1 codes
53630	C110.11	Insulin coma	Possible T1 codes
61520	C110000	Iatrogenic hyperinsulinism	Secondary / Other types
72882	C110100	Self-induced hyperinsulinism	Probable T1 codes
51371	C110z00	Hypoglycaemic coma NOS	Possible T1 codes
1410	C112.00	Hypoglycaemia unspecified	Possible T2 codes
4563	C112000	Reactive hypoglycaemia NOS	Possible T2 codes
24405	C112100	Spontaneous hypoglycaemia NOS	Possible T2 codes
20368	C112z00	Hypoglycaemia unspecified NOS	Possible T2 codes
11359	L180.00	Diabetes mellitus during pregnancy/childbirth/puerperium	Probable Gestational diabetes
67635	L180000	Diabetes mellitus - unspec whether in pregnancy/puerperium	Probable Gestational diabetes
34639	L180100	Diabetes mellitus during pregnancy - baby delivered	Probable Gestational diabetes
49559	L180300	Diabetes mellitus during pregnancy - baby not yet delivered	Probable Gestational diabetes
96823	L180400	Diabetes mellitus in puerperium - baby previously delivered	Probable T1 codes
50960	L180500	Pre-existing diabetes mellitus, insulin-dependent	Probable T1 codes
50609	L180600	Pre-existing diabetes mellitus, non-insulin-dependent	Probable T2 codes
10278	L180800	Diabetes mellitus arising in pregnancy	Probable Gestational diabetes
8446	L180811	Gestational diabetes mellitus	Probable Gestational diabetes

medcode	readcode	readterm	category
2664	L180900	Gestational diabetes mellitus	Probable Gestational diabetes
55431	L180X00	Pre-existing diabetes mellitus, unspecified	Vague codes
64384	L180z00	Diabetes mellitus in pregnancy/childbirth/puerperium NOS	Probable Gestational diabetes

Read codes for Diabetic Retinopathy diagnosis

medcode	readcode	readterm	severe
52041	2BBl.00	O/E - left eye stable treated prolif diabetic retinopathy	0
52630	2BBo.00	O/E - sight threatening diabetic retinopathy	0
19533	2BBY.00	O/E - referable retinopathy	0
3837	F420400	Diabetic maculopathy	0
47328	2BBk.00	O/E - right eye stable treated prolif diabetic retinopathy	0
101881	2BBr.00	Impaired vision due to diabetic retinopathy	0
3914	2BB9.00	O/E - retinal pigmentation	0
9339	F421.00	Other background retinopathy	0
10882	F421400	Exudative retinopathy	0
48751	2BB3.00	O/E - retinal A-V nipping	0
42762	C109612	Type 2 diabetes mellitus with retinopathy	0
35659	2BB7.00	O/E - retinal vascular prolif.	0
38161	C108711	Type I diabetes mellitus with retinopathy	0
72424	7270B00	Vitrectomy using anterior approach	0
9835	2BBL.00	O/E - diabetic maculopathy present both eyes	0
39457	F421C00	Other intraretinal microvascular abnormality	0
55026	7270B11	Anterior vitrectomy	0
11053	F421800	Retinal microaneurysms NOS	0
18387	C10E700	Type 1 diabetes mellitus with retinopathy	0
4514	7270011	Anterior vitrectomy	0
13102	2BBW.00	O/E - right eye diabetic maculopathy	0
13108	2BBX.00	O/E - left eye diabetic maculopathy	0
36119	F421111	Arteriosclerotic retinopathy	0
93875	C10E712	Insulin dependent diabetes mellitus with retinopathy	0
8595	F42y600	Retinal exudate or deposit	0
102242	2BBs.00	Retinal arteries silverwire	0
17916	F422011	Retinopathy of prematurity	0
22871	C10EP00	Type 1 diabetes mellitus with exudative maculopathy	0
1411	3128100	Fundoscopy abnormal	0
11626	F420z00	Diabetic retinopathy NOS	0
34455	F421112	Atheroscleritic retinopathy	0
66964	F426500	Pseudoretinitis pigmentosa	0
2254	F424100	Central serous retinopathy	0
36867	2BBa.00	O/E- non-referable retinopathy	0
11129	2BBQ.00	O/E - left eye background diabetic retinopathy	0
88368	7270411	Vitrectomy using pars plana approach	0
6509	C108700	Insulin dependent diabetes mellitus with retinopathy	0
45876	F421200	Renal retinopathy	0
8742	2BB5.00	O/E - retinal haemorrhages	0
17262	C109600	Non-insulin-dependent diabetes mellitus with retinopathy	0
13107	2BBn.00	O/E - left eye clinically significant macular oedema	0
104263	F425900	Maculopathy	0
58604	C109611	Type II diabetes mellitus with retinopathy	0
41049	C108712	Type 1 diabetes mellitus with retinopathy	0

1323	F420.00	Diabetic retinopathy	0
40982	F421z00	Other background retinopathy NOS	0
50656	2BBc.00	O/E - No retinal laser photocoagulation scars	0
36855	2BBG.00	Retinal abnormality - non-diabetes	0
3822	2BB8.00	O/E - vitreous haemorrhages	0
49655	C10F611	Type II diabetes mellitus with retinopathy	0
11433	2BBP.00	O/E - right eye background diabetic retinopathy	0
17293	727..00	Retina and other parts of eye operations	0
69662	F421G00	Venostasis retinopathy	0
7069	F420000	Background diabetic retinopathy	0
1438	F421000	Unspecified background retinopathy	0
97894	C10EP11	Type I diabetes mellitus with exudative maculopathy	0
13106	2BB6.00	O/E - retinal exudates	0
22967	2BBF.00	Retinal abnormality - diabetes related	0
25888	2BBm.00	O/E - right eye clinically significant macular oedema	0
25591	C10FQ00	Type 2 diabetes mellitus with exudative maculopathy	0
18496	C10F600	Type 2 diabetes mellitus with retinopathy	0
31829	F433100	Solar retinopathy	0
41229	F421100	Atherosclerotic retinopathy	0
19532	2BB4.00	O/E - retinal microaneurysms	0
95343	C10E711	Type I diabetes mellitus with retinopathy	0
11858	7270400	Pars plana vitrectomy	0
6702	F421300	Hypertensive retinopathy	0
45145	2BB2.00	O/E - retinal vessel narrowing	0
27022	5B42.00	Laser therapy - retinal lesion	1
86068	7272800	Panretinal laser photocoagulation to lesion of retina	1
13097	2BBT.00	O/E - right eye proliferative diabetic retinopathy	1
100979	7272900	Focal laser photocoagulation of retina	1
11874	F422100	Proliferative retinopathy due to sickle cell disease	1
96926	FyuF700	[X]Other proliferative retinopathy	1
6836	7271100	Laser photocoagulation of retina for detachment	1
11912	5B4..11	Retinal laser therapy	1
30477	F420700	High risk proliferative diabetic retinopathy	1
9318	7272300	Laser destruction of lesion of retina	1
36035	F422y00	Other specified other proliferative retinopathy	1
18775	2BBO.00	O/E - Laser photocoagulation scars	1
10099	F420300	Advanced diabetic maculopathy	1
2986	F420200	Preproliferative diabetic retinopathy	1
13103	2BBS.00	O/E - left eye preproliferative diabetic retinopathy	1
13099	2BBR.00	O/E - right eye preproliferative diabetic retinopathy	1
46068	7272500	Panretinal laser photocoagulation to lesion of retina NEC	1
10755	F420600	Non proliferative diabetic retinopathy	1
13101	2BBV.00	O/E - left eye proliferative diabetic retinopathy	1
38096	F422z00	Proliferative retinopathy NOS	1
3286	F420100	Proliferative diabetic retinopathy	1
65463	F420800	High risk non proliferative diabetic retinopathy	1
7890	F422.00	Other proliferative retinopathy	1

Read codes for Eye disease

medcode	readcode	categorycode
2762	F4250	Macular degeneration
10343	F4251	Macular degeneration
4410	F4H20	Macular degeneration
6350	F425	Macular degeneration
57600	F427G	Macular degeneration
26205	F4252	Macular degeneration
57319	F4255	Age-related macular degeneration
12125	F4256	Age-related macular degeneration
38393	F4254	Age-related macular degeneration
4424	F4257	Age-related macular degeneration
8518	2BBH	Age-related macular degeneration
2789	F4253	Age-related macular degeneration
16751	22EE	Cataract
6317	F46z	Cataract
9931	2BT1	Cataract
1622	22E5	Cataract
22022	F4618	Cataract
47566	F4610	Cataract
7793	F4607	Cataract
10010	F461	Cataract
296	F46	Cataract
6547	2BT0	Cataract
7257	F4605	Cataract
703	F466	Cataract
20230	F4H14	Glaucoma
4581	F4511	Glaucoma
41804	F454z	Glaucoma
68633	F4544	Glaucoma
65079	72590	Glaucoma
88142	7259y	Glaucoma
28505	F45y	Glaucoma
70195	FyuG0	Glaucoma
35748	F4502	Glaucoma
22528	F4565	Glaucoma
44295	F45yz	Glaucoma
9469	F4512	Glaucoma
8971	F450	Glaucoma
10070	F4501	Glaucoma
37876	F4561	Glaucoma
65193	F45y1	Glaucoma
41794	F4563	Glaucoma
53521	F456z	Glaucoma
28189	F451z	Glaucoma

41854	F454	Glaucoma
26870	F4562	Glaucoma
20520	F4520	Glaucoma
68094	F4531	Glaucoma
35446	F4523	Glaucoma
48132	F453z	Glaucoma
54262	F455	Glaucoma
8001	F45z	Glaucoma
67413	F4524	Glaucoma
44817	F4521	Glaucoma
98647	FyuG1	Glaucoma
88595	72592	Glaucoma
96707	F4542	Glaucoma
39120	F452z	Glaucoma
12251	F4513	Glaucoma
93967	72594	Glaucoma
35528	F453	Glaucoma
8132	F45y2	Glaucoma
18743	F4551	Glaucoma
63660	F45y0	Glaucoma
34354	F455z	Glaucoma
67341	F4541	Glaucoma
42447	F4510	Glaucoma
24860	F4500	Glaucoma
69195	F4540	Glaucoma
52888	FyuG	Glaucoma
11059	7275	Glaucoma
89934	72591	Glaucoma
22805	F4560	Glaucoma
53127	F456	Glaucoma
91442	72593	Glaucoma
1798	F451	Glaucoma
2074	F45	Glaucoma
9260	F450z	Glaucoma
44798	F4550	Glaucoma
48479	F4564	Glaucoma
11058	F4566	Glaucoma
58645	F4514	Glaucoma
64851	F4543	Glaucoma
46069	7259	Glaucoma
2823	F452	Glaucoma
36737	F4503	Glaucoma
72394	F4515	Glaucoma
28536	F4522	Glaucoma
29764	F4421	Glaucoma
95852	7259z	Glaucoma

Read codes for Visual Impairment

medcode	readcode	categorycode
23027	2B75	Reduced visual acuity (VA 6/12 to 6/36)
38169	2B7G	Reduced visual acuity (VA 6/12 to 6/36)
41055	2B6J	Reduced visual acuity (VA 6/12 to 6/36)
26723	2B66	Reduced visual acuity (VA 6/12 to 6/36)
56814	2B7K	Reduced visual acuity (VA 6/12 to 6/36)
23025	2B74	Reduced visual acuity (VA 6/12 to 6/36)
41059	2B6G	Reduced visual acuity (VA 6/12 to 6/36)
23026	2B77	Reduced visual acuity (VA 6/12 to 6/36)
26726	2B76	Reduced visual acuity (VA 6/12 to 6/36)
23022	2B67	Reduced visual acuity (VA 6/12 to 6/36)
59260	2B6b	Reduced visual acuity (VA 6/12 to 6/36)
59261	2B7b	Reduced visual acuity (VA 6/12 to 6/36)
23021	2B64	Reduced visual acuity (VA 6/12 to 6/36)
20446	2B65	Reduced visual acuity (VA 6/12 to 6/36)
47913	2B7J	Reduced visual acuity (VA 6/12 to 6/36)
40879	2B7H	Reduced visual acuity (VA 6/12 to 6/36)
49306	2B6K	Reduced visual acuity (VA 6/12 to 6/36)
41057	2B6H	Reduced visual acuity (VA 6/12 to 6/36)
49283	2B7Q	Severely sight impaired (VA worse than 3/60)
35515	2B79	Severely sight impaired (VA worse than 3/60)
45030	2B6C	Severely sight impaired (VA worse than 3/60)
48983	2B6P	Severely sight impaired (VA worse than 3/60)
47158	2B6Q	Severely sight impaired (VA worse than 3/60)
45786	2B6T	Severely sight impaired (VA worse than 3/60)
3852	2B7A	Severely sight impaired (VA worse than 3/60)
33016	2B7B	Severely sight impaired (VA worse than 3/60)
33015	2B69	Severely sight impaired (VA worse than 3/60)
47911	2B6V	Severely sight impaired (VA worse than 3/60)
41060	2B6R	Severely sight impaired (VA worse than 3/60)
38167	2B7A	Severely sight impaired (VA worse than 3/60)
60032	2B7V	Severely sight impaired (VA worse than 3/60)
47912	2B7T	Severely sight impaired (VA worse than 3/60)
54514	2B7R	Severely sight impaired (VA worse than 3/60)
33017	2B7C	Severely sight impaired (VA worse than 3/60)
26722	2B6A	Severely sight impaired (VA worse than 3/60)
10388	2B6A	Severely sight impaired (VA worse than 3/60)
50925	2B7P	Severely sight impaired (VA worse than 3/60)
33014	2B6B	Severely sight impaired (VA worse than 3/60)
54513	2B7S	Severely sight impaired (VA worse than 3/60)
51274	2B6S	Severely sight impaired (VA worse than 3/60)
65569	2B7X	Sight impaired (VA 3/60 to 6/60)
39170	2B7E	Sight impaired (VA 3/60 to 6/60)
47910	2B6E	Sight impaired (VA 3/60 to 6/60)
66391	2B6X	Sight impaired (VA 3/60 to 6/60)
23028	2B78	Sight impaired (VA 3/60 to 6/60)

33013	2B68	Sight impaired (VA 3/60 to 6/60)
38168	2B7W	Sight impaired (VA 3/60 to 6/60)
41063	2B7L	Sight impaired (VA 3/60 to 6/60)
38166	2B6W	Sight impaired (VA 3/60 to 6/60)
40877	2B6L	Sight impaired (VA 3/60 to 6/60)

Read codes for Ethnicity

Table reproduced from <http://www.clininf.eu/ethnicity.html>

Grouping of the 9S and 9i ethnic codes to the '16+1' format and the five category classifications			
Five category	16 category framework	9i... Ethnic category hierarchy	9S.. Ethnic group hierarchy
1. White	1. British or Mixed British	9i0 British or mixed British	9S1 White, 9S10 White British, 9S14 Other white British ethnic grp
	2. Irish	9i1 Irish	9S11 White Irish, 9SA9 Irish NMO, 9SI Irish traveller
	3. Other White	9i2 Other White	9S12 Other white ethnic group
		9i20 English	
9i21 Scottish		9S13 White Scottish	
		9i22 Welsh, 9i26 Cypriot part unsp, 9i27 Greek, 9i28 Greek Cypriot, 9i29 Turkish, 9i2A Turkish Cypriot, 9i2B Italian, 9i2C Irish Traveller, 9i2D Traveller, 9i2E Gypsy/Romany, 9i2F Polish, 9i2H Commonwealth of (Russian), 9i2J Kosovan, 9i2K Albanian Serbian, 9i2P Oth repub Yugoslav, 9i2R Oth White/unsp/Mix Eur, 9i2S Oth mixed White, 9i2T Other White or White unspecified.	
2. Mixed	4. White + Black Caribbean	9i3 White & Black Caribbean	9SB5 Black Caribbean and White
	5. White + Black African	9i4 White and Black African	9SB6 Black African and White
	6. White + Asian	9i5 White & Asian	9SB2 Other ethnic, Asian/White orig
	7. Other mixed	9i6 Other Mixed	9SB Other ethnic, mixed origin , 9SB3 Other ethnic, mixed white orig, 9SB4 Other ethnic, other mixed orig, 9S52 Other Black - Black/Asian orig.
9i60 Black & Asian, 9i61 Black & Chinese			
9i62 Black and White		9SB1 Other ethnic, Black/White orig, 9S51 Other Black – Black/White orig	
9i63 Chinese & White, 9i64 Asian & Chinese			
3. Asian or Asia	8. Indian or British	9i7 Indian/British Indians	9S6 Indian

n Briti sh	Indian		
	9. Pakista ni or British Pakista ni	9i8 Pakistani/Brit Pakists	9S7 Pakistani
	10. Bangla deshi or British Bangla deshi	9i9 Bangladeshi/Brit Bangl	9S8 Bangladeshi
	11. Other Asian	9iA Other Asian	9SH Other Asian ethnic group, 9SA8 Other Asian NMO, 9SA7 Indian sub-continent NMO
	9iA3 East African Asian	9SA6 E Afric Asian/Indo-Carib NMO	
	9iA4 Sri Lankan, 9iA5 Tamil, 9iA6 Sinhalese, 9iA7 Carib Asian, 9iA8 Briti Asian, 9iA9 Mixed Asian		
4. Oth er Blac k	12. Caribb ean	9iB Caribbean	9S2 Black Caribbean
	13. African	9iC African	9S3 Black African, 9S44 Black - other African country, 9SA5 Other African countries NMO
	14 Other Black	9iD Other Black	9S4 Black, other, non-mixed origin, 9S42 Black Caribbean/W.I./Guyana, 9S43 Black N African/Arab/Iranian, 9S45 Black E Afric Asia/Indo-Caribb, 9SG Other black ethnic group, 9S47 Black - other Asian, 9S48 Black Black - other, 9S5 Black - other, mixed, 9SA3 Caribbean I./W.I./Guyana NMO
		9iD0 Somali, 9iD1 Nigerian	
		9iD2 Black British	9S41 Black British
5. Oth er eth nic gro ups	15. Chines e	9iE Chinese	9S9 Chinese
	16. Other	9iF Other	9SJ Other ethnic group, 9SA0 Other ethnic non-mixed NMO, 9SA2 Brit. ethnic minor. unsp NMO, 9SAAG Greek/Greek

			Cypriot NMO, 9SAB Turkish/Turkish Cypriot NMO 9SAC Other European NMO, 9SAD Other ethnic NEC NMO
		9iFO Vietnamese	9SC Vietnamese
		9iF1 Japanese, 9iF2 Filipino, 9iF3 Malaysian, 9iF9 Arab	
		9iFA North African	9SA4 N African Arab/Iranian NMO
		9iFB ME ex Isr/Iran/Arab, 9iFD Iranian, 9iFE Kurdish, 9iFG Latin American, 9iFH South/Central American, 9iFJ Multi-ethnic islands: Mauritian or Seychellois or Maldivian or St Helena, 9iFK Any other - ethn categ	
6. Not stated	17. (16+1) Not stated	9iG Ethn cat not stated	9S Ethnic groups census, 9SD Ethnic group - patient refused, 9SE Ethnic group not recorded, 9SZ Ethnic groups census NOS

Results of the diabetes adjudication algorithms

Flowchart 1: Assigning initial diabetic classification

From a total of 13,685,136 acceptable patients, 515,504 had at least one diagnostic Read code for diabetes. At the end of Flowchart 1, which assigns each patient an initial diabetic type based on Read codes alone, 46,135 patients were classified as having type 1 diabetes (8.4%) and 444,824 were classified as having type 2 diabetes (82.3%).

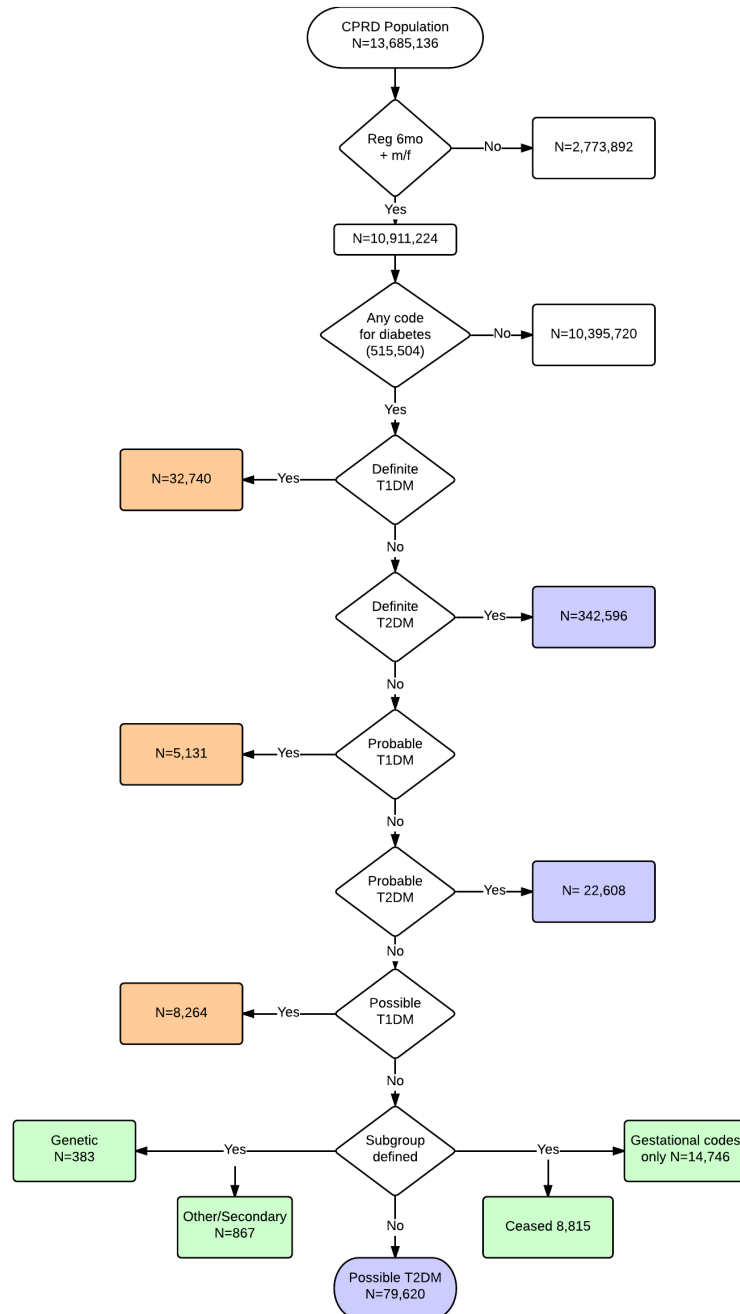


Figure 1. Results from Flowchart 1: Initial Sort and Classification

Flowchart 2: Improving Classification of type 1 diabetes

A total of 46,135 patients initially classified as having type 1 diabetes were entered into Flowchart 2. 85.0% of the initial cohort remained as type 1 diabetics at the end of the flowchart (n=39,231). 6,904 (15.0%) were re-classified as having probable 2 diabetes.

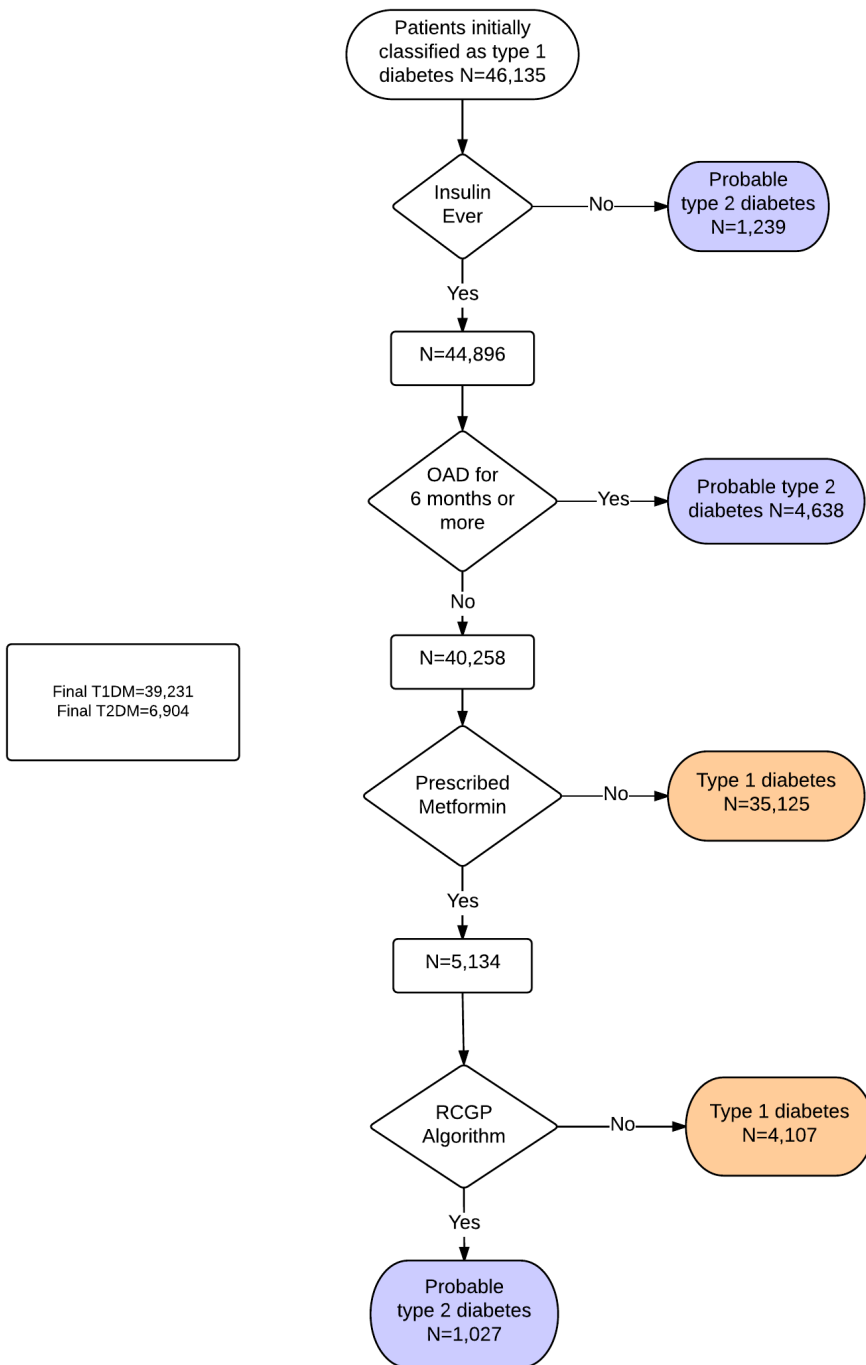


Figure 2. Results from Flowchart 2: Improving classification of type 1 diabetes

Flowchart 3: Improving Classification of type 2 diabetes

A total of 444,824 patients initially classified as having type 2 diabetes were entered into Flowchart 3. 89.9% of the initial cohort remained as type 2 diabetics at the end (n=400,070). 3,951 (0.9%) were re-classified as having probable type 1 diabetes.

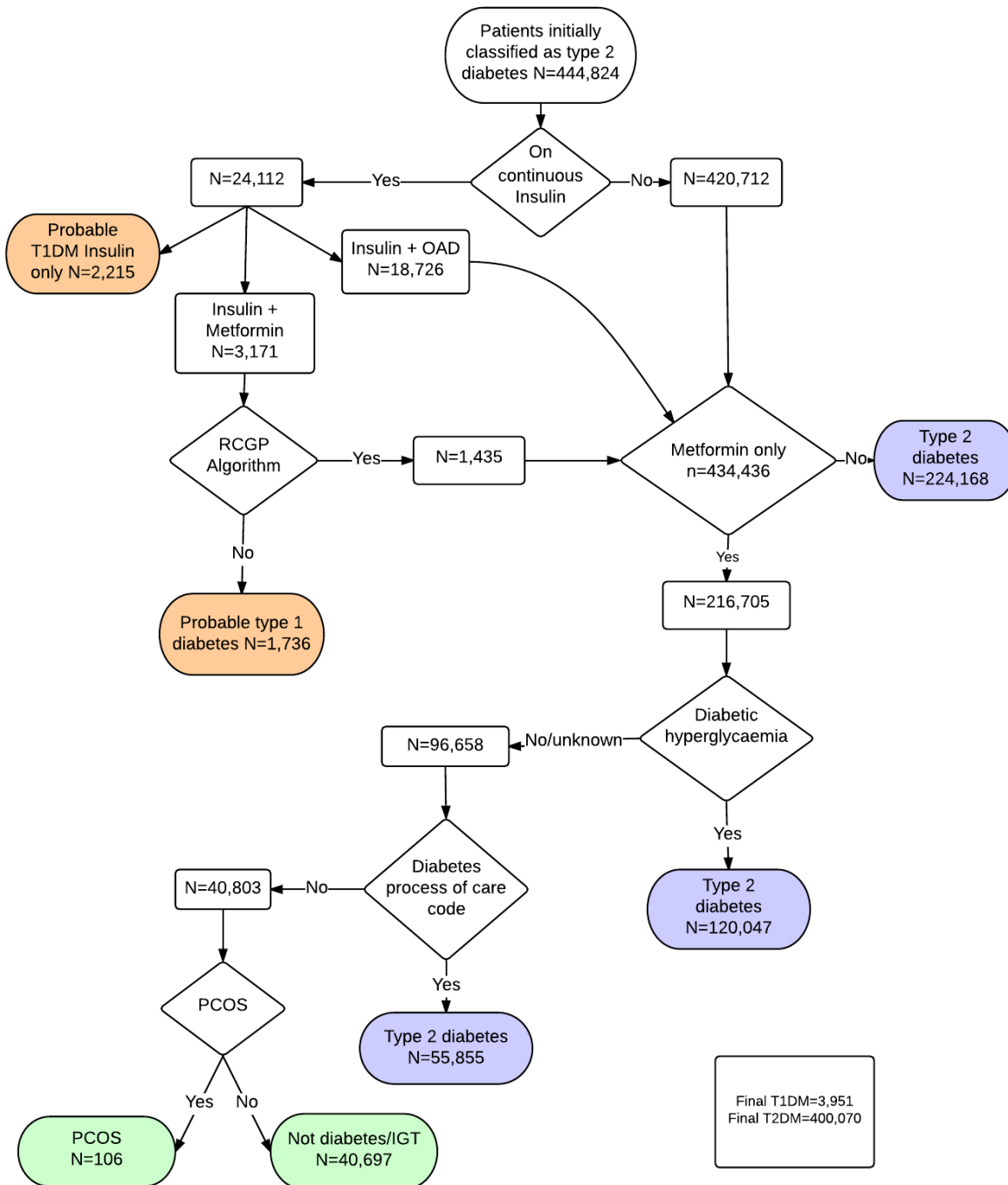


Figure 3. Results from Flowchart 3: Improving classification of type 2 diabetes