Severe mental illness and quality of care for type 2 diabetes

Severe mental illness and quality of care for type 2 diabetes: a retrospective population-based cohort study

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ABSTRACT

AIMS

To compare quality of care for type 2 diabetes in people with severe mental illness (SMI) versus no mental illness.

METHODS

We used routinely collected linked data to create a retrospective cohort study. We included 158,901 people diagnosed with type 2 diabetes in Scotland during 2009-2018 of whom 1701 (1%), 768 (0.5%) and 5211 (3%) had a prior hospital admission record for schizophrenia, bipolar disorder, and major depression, respectively. We compared recording of HbA1c, cholesterol, creatinine, blood pressure, urinary albumin, foot examination, retinopathy screening, body mass index and smoking during the first year after diabetes diagnosis using logistic regression and recording of HbA1c and retinopathy screening over longer follow-up using generalised linear mixed effects model, adjusting for confounding factors.

RESULTS

Receipt of care during the first year was generally similar, or better, for people with each SMI than for people without any mental illness. During mean follow up of 4.8 (SD 2.5) years, depression and bipolar disorder were associated with lower odds of receiving retinopathy screening.

CONCLUSIONS

Receipt of diabetes care was similar or better among people with SMI versus without SMI. However, mechanisms to support improved retinopathy screening for people with SMI are needed.

KEYWORDS: type 2 diabetes; quality of care; severe mental illness; comorbidity; health disparities

1. INTRODUCTION

The life expectancy of people with a severe mental illness (SMI), including schizophrenia, bipolar disorder or major depression, is 10-20 years shorter than that of the general population [1-3]. This is attributed to an excess risk of physical disease, particularly cardiovascular disease [4, 5], for which type 2 diabetes is a major risk factor. Cohort studies have established that SMI is associated with a two- to three-fold increased risk of type 2 diabetes [1-3, 6-8], a health gap that may be widening for some mental disorders [7]. Although relatively under-studied, risk of poor diabetes outcomes, including macrovascular and microvascular complications, may, in some settings, be higher among people with versus without SMI [9-12]. Good clinical care for, and self-management of, diabetes helps to reduce the risk of complications, as reflected in clinical guidelines in the US and Europe [13-15] that are aimed at supporting provision of optimal diabetes care.

Previous reports have indicated that people with a SMI may receive sub-optimal clinical care. However, much of this evidence stems from non-universal healthcare settings [16-19], where access to care may be influenced by possession of healthcare insurance, with study findings not necessarily generalizable to universal healthcare settings. Findings from universal healthcare settings are mixed, with two UK-based studies reporting that receipt of care did not differ by SMI status [20, 21], whereas other studies reported differences in receipt of at least some of the care measures examined [9, 22-26]. However, many of these studies included only people with schizophrenia [9, 23, 24, 26], with fewer studies of people with bipolar disorder and major depression. Many investigated only a few care indicators [9, 20, 22, 25] and most analysed receipt of care during a short follow-up period only [9, 20, 21, 24, 25].

In the present study we therefore sought to determine, among people with type 2 diabetes, whether having schizophrenia, bipolar disorder or major depression is associated with receipt of guideline-recommended diabetes care indicators in a universal healthcare setting, in the short- and long-term following diabetes diagnosis.

2. SUBJECTS MATERIALS AND METHODS

This article is written in accordance with the STrengthening the Reporting of OBservational Studies in Epidemiology (STROBE) [27] and REporting of Studies Conducted using Observational Routinely-collected Data (RECORD) [28] statements.

2.1 Study design & setting

We used a retrospective cohort study design to examine receipt of diabetes care by SMI status, in Scotland.

2.2 Study population

We used a 2019 extract of the Scottish Care Information – Diabetes (SCI-diabetes) database to identify people with type 2 diabetes. SCI-Diabetes includes more than 99% of all individuals diagnosed with diabetes in Scotland since 2004 and includes demographic and clinical information from primary and secondary care diabetes outpatient clinics [29]. It is linked to national routinely collected health datasets, including general and psychiatric hospital admission data and death data via the Community Health Index number, a unique identifier for people registered with the National Health Service in Scotland. Type 1 and type 2 diabetes were differentiated using information on prescribed medicines, clinically-recorded diagnosis and age at diagnosis of diabetes. We included all adults aged 18 years or over diagnosed with type 2 diabetes from 1st January 2009. We included participants from 2009 since this was when retinopathy screening was implemented in all health boards in Scotland.

2.3 Definition of severe mental illness

We determined history of a SMI from routinely collected national general and psychiatric hospital records, available from 1981 onwards. We identified SMI from diagnosis fields of hospital admissions that occurred after the individual's 18th birthday and before their diabetes diagnosis. We defined each SMI using the international Classification of Disease (ICD)-10 and ICD-9 codes as follows: schizophrenia (ICD-10 F20 and F25 and ICD-9 295.0–295.3 and 295.6–295.9); bipolar disorder (ICD-10 F30 to F31 and ICD-9 296.0–296.1 and 296.4–296.7); and depression (ICD-10 F32 to F33 and ICD-9 296.2–296.3, 298.0, and 311). SMI groups were mutually exclusive, and where multiple SMIs were recorded we used a severity hierarchy to assign people to one group only, ranking disorders as schizophrenia, bipolar disorder, and depression. Thus, someone with diagnoses of depression and schizophrenia were included in the schizophrenia group only. We compared quality of care indicators in people with a history of each of these three disorders versus the general population with type 2 diabetes excluding those with a prior hospitalisation record for any mental illness (Supplementary Table 1).

2.4 Definition of quality of care indicators

We examined receipt of the nine process of care indicators, recommended by the National Institute for Health and Care Excellence and adopted across the UK, which, for the period of interest, clinical guidelines recommended should be monitored annually [14, 15]: HbA1c; cholesterol; urinary albumin; serum creatinine; blood pressure; retinopathy screening; foot examination; body mass index (BMI) status; and smoking status. A recent systematic review found that average numbers needed to screen to detect one case of sight-threatening diabetic retinopathy were 175 and 19 in people without retinopathy and with mild retinopathy at previous

screening, respectively [30]. We obtained information on the process of care indicators from the SCI-Diabetes register, which draws data in real-time from general practitioners, diabetes outpatient clinics, laboratories and opticians/other settings in which retinopathy screening is performed. Monitoring of most of these indicators (with the exception of retinopathy screening) takes place in primary care for the majority of people with type 2 diabetes in Scotland. Results of blood tests for HbA1c and cardiovascular risk factors collected in all primary and secondary care settings are included for all people on SCI-diabetes. We examined receipt of care indicators during the first year following type 2 diabetes diagnosis (first year analysis) and from type 2 diabetes diagnosis to end of follow-up (31st Dec 2018) (longitudinal analysis). For the first year analysis we examined each care indicator individually and created a composite measure to examine overall care defined as having received all 9 care indicators. For the longitudinal analysis we examined HbA1c (a proxy for indicators routinely measured in primary care settings) and retinopathy screening~~, which is performed at an opticians or mobile bus and not at the primary care practice.~~

2.5 Definition of covariates

We included the following covariates in both the first year and longitudinal analyses: sex; age; calendar year of type 2 diabetes; health board; ethnicity; area-based deprivation; history of cardiovascular disease (CVD); history of other comorbidity; history of alcohol use disorder; and smoking status. In the longitudinal analysis we additionally included diabetes duration. Area-based deprivation was defined using the Scottish Index of Multiple Deprivation (SIMD), categorised into quintiles. The index uses information on seven domains of an area including income, employment, education, health, access to services, crime and housing to assign a deprivation score to the area) [31]. Information on ethnicity was obtained from the SCI-Diabetes

register and hospital admission records and classified into mixed, other, and white ethnicity. History of CVD and alcohol use disorder were ascertained from hospital admission records using a 10-year look-back period from the date of diabetes diagnosis (see Supplementary Tables 2 and 3 for ICD codes). We defined history of comorbidity using an adaption of the Charlson Comorbidity Index [32]. The Charlson Index provides an overall measure of the number of comorbid conditions with weight from 0-6 indicating their seriousness (Supplementary Table 4). We excluded the conditions diabetes and diabetes complications and used a 10-year look back period from the date of diabetes diagnosis. The Charlson index was highly skewed and therefore we categorized it as 0, 1-8, >8, to create similarly sized groups. Smoking status at diabetes diagnosis was obtained from the SCI-diabetes register using a window of six months before and after diabetes diagnosis and categorized as: smoker, ex-smoker and never smoked.

2.6 Statistical analyses

Statistical analyses were performed using R, version 4.0.2 [33].

Since SCI-Diabetes data were available for analysis up until April 2019, in the first year analysis we included people diagnosed with type 2 diabetes from 1st Jan 2009-30th April 2018 to allow for one-year follow-up and excluded those who died within the first year after diabetes diagnosis. In the longitudinal analysis we analysed data by calendar year and included people diagnosed with type 2 diabetes from 1st Jan 2009 to 31st Dec 2017 and followed these until end of follow-up (31st Dec 2018) or death, whichever came first (having excluded those who died within one full calendar year after diabetes diagnosis). Flowcharts of the two study populations are provided in Figure 1.

In descriptive analyses we summarized and compared baseline characteristics and receipt of care indicators for each SMI and the no mental illness group, using chi-square tests or t-tests.

In the primary analysis we included participants with complete data on all variables, thus conducting a complete-case analysis. In the first year analysis we used logistic regression to examine the association between each SMI and each process of care indicators. In the longitudinal analysis we used a generalized linear mixed effect model to examine the receipt of repeat measurements of each care indicator. We included individual-specific random intercept to account for correlation between care indicators from the same individual. We included SMI and covariates as fixed effects. In both analyses we used a serial adjustment modelling approach to adjust for factors that could potentially confounding and/or mediate the association between SMI and receipt of care, based on our descriptive analyses and clinical understanding.factors in both analyses : mModel 1 included basic demographic factors (age and, sex), and calendar year, whilst; model 2 additionally included further relevant sociodemographic factors (deprivation and, ethnicity), and health board. In model 3 we additionally ; and model 3 additionally included factors that could confound the associations or potentially lie or on the causal pathway (history of CVD, alcohol use disorder, comorbidity and smoking status). Model 1 of the longitudinal analyses also included diabetes duration.

For age, year of diagnosis of type 2 diabetes and diabetes duration, Akaike information criterion was used to determine whether a linear term or a spline term gave the best fit. The continuous variables which were included as natural splines were included with 4 knots. Knots were allocated so that events were evenly distributed between the knots.

2.6.1 Sensitivity analysis

We had complete data for all variables other than ethnicity, deprivation and smoking status, with 9% of participants having at least one missing value for one of these three variables. Given that it was computationally challenging to incorporate multiple imputation of variables with missing values into the longitudinal analysis (with models taking multiple weeks to run), we conducted a sensitivity analysis where we performed multiple imputation on the data analysed in the first year analyses. We used Multivariate Imputations by Chained Equations (MICE) under the missing-at-random (MAR) assumption to impute missing data on ethnicity, deprivation and smoking [34]. The data was imputed from a dataset including all variables included in the models and using nine imputations. Each of the nine data sets was analyzed and Rubin's rules was used to pool the results [34, 35] (more information on the multiple imputation can be found in Supplementary Table 10).

In our primary analysis, SMI was defined based on both general and psychiatric hospital admission records. This approach likely identifies people with less severe depression than would be identified from psychiatric hospital admission records alone. Therefore, in a second sensitivity analysis, we explored the effect of defining major depression based on psychiatric hospital admission records only.

2.7 Ethics approval

Approval for the linkage of the administrative health data sets used in this study was provided by the NHS Scotland Public Benefit and Privacy Panel for Health and social Care (ref 1617-0147). Approval for the use of the linked data for research purposes was obtained from the ~~a~~ Scotland multi-centre research ethics committee (ref 11-AL-0225)

3. RESULTS

We included 158,901 individuals with type 2 diabetes (43% female) with a mean age of 59.7 (±13.2 SD) years at diabetes diagnosis. Of these, 1,701 (1%) had a previous hospital record for schizophrenia, 768 (0.5%) for bipolar disorder and 5,211 (3%) for depression. Compared to those with no hospital admission record for a mental illness, those with SMI were more likely to: be younger; have a mixed or other ethnicity; live in more deprived areas; have a history of alcohol use disorder and CVD; have a higher comorbidity score; and be current smokers (Table 1; supplementary Table 11). Mean follow up in the longitudinal analyses was 4.8 (±2.5 SD) years in the no mental illness group and slightly shorter in the SMI groups. Around 60-90% received each of the indicators the first year after diabetes diagnosis, with the lowest proportion found for urinary albumin and foot examination. Only around 35% received all 9 indicators in the first year. In people with SMI, a higher proportion received the cholesterol, serum creatinine and smoking review, whereas a lower proportion received the urinary albumin and retinopathy screening when compared to the no mental illness group. We found the same pattern when examining the receipt of care during the entire follow-up (Table 1).

In fully adjusted analyses, during the first year following type 2 diabetes diagnosis, compared to people with no mental illness, those with schizophrenia, bipolar disorder and depression had a higher odds of receiving a cholesterol measurement (OR 1.49, 95% CI 1.29-1.72; OR 1.36, 95% CI 1.10-1.69 and OR 1.11, 95% CI 1.03-1.20, respectively) and serum creatinine measurement (OR 1.36, 95% CI 1.16-1.60; OR 1.66, 95% CI 1.27-2.17 and OR 1.19, 95% CI 1.08-1.31, respectively; Figure 1). Compared to those with no mental illness, people with schizophrenia also had higher odds of receiving a HbA1c measurement (OR 1.22, 95% CI 1.03-1.44), whereas

there was no difference for people with bipolar disorder or depression. People with depression – but not schizophrenia or bipolar disorder - had higher odds of receiving a smoking review. In contrast, the odds of a urinary albumin measurement was slightly lower in those with depression compared to no mental illness, but not significantly lower for schizophrenia and bipolar disorder. There was no difference by mental illness of any of the other care indicators, including retinopathy screening, within the first year post- type 2 diabetes diagnosis. The odds of receiving all 9 care indicators the first year after diabetes diagnosis was slightly lower for those with depression, but similar for those with schizophrenia and bipolar disorder, compared to people with no mental illness.

In the longitudinal analysis, after adjusting for all covariates, odds of receipt of HbA1c measurements over time remained higher in those with schizophrenia (OR 1.34 95% CI 1.17-1.53), but similar among those with bipolar disorder and depression, compared to people with no mental illness. Individuals with bipolar disorder and depression had lower odds of retinopathy screening during the entire follow-up period compared to the no mental illness group (OR 0.81, 95% CI 0.70-0.94 and OR 0.72, 95% CI 0.72-0.81, respectively).There was no difference in receipt of retinopathy screening among people with schizophrenia versus no mental illness. Adjustment for potential confounders only slightly attenuated effect estimates (results of models 1 and 2 presented in supplementary Table 6 and 7).

When we repeated our first year analyses having conducted multiple imputation results were similar to those from the primary, complete case analysis. We also obtained similar results to those of our primary analysis when we defined depression based on psychiatric hospital admission data only (supplementary Tables 8 and 9).

4. DISCUSSION

Receipt of type 2 diabetes clinical care indicators routinely delivered in primary care was generally similar, or better, in those with a prior hospital record of SMI compared to no hospital record for mental illness, in both the short and ~~long~~medium term after ~~diagnosis of~~ diabetes diagnosis. Receipt of urinary albumin measurement in the first year was however marginally lower in those with depression only, with the direction of association similar, but not significant, for schizophrenia and bipolar disorder. In contrast to findings for other care indicators, people with a SMI were less likely to receive retinopathy screening within a year of diagnosis of diabetes, although effect estimates did not reach statistical significance. This difference widened thereafter, with people with bipolar disorder and depression having about a 20% lower odds of receiving retinopathy screening compared to those with no mental illness. There was, however, no clear difference in receipt of retinopathy screening among those with schizophrenia versus no mental illness. Retinopathy screening uptake was lowest in <40 year olds regardless of mental health status and the adjusted estimates take differences in age into account.

These generally reassuring findings on quality of care in people with SMI contrast with a number of non-UK studies, but ~~Our findings~~ are largely consistent with ~~those from~~ the only other studies to have reported on ~~SMI and receipt of routine diabetes~~this ~~care~~ in a UK setting [20, 21]. One study examined four indicators, reporting that people with SMI were slightly more likely to have blood pressure, cholesterol and BMI measured, but equally likely to have HbA1c measured compared to those without SMI [20]. The other, smaller, study, examined a more comprehensive set of indicators and found no difference in receipt of care, including for retinopathy screening [21]. The latter finding contrasts with those in our study.

Possible explanations are that this study included a smaller number of patients with insufficient statistical power to detect a difference, or because they combined patients with schizophrenia and bipolar disorder, and so any differences in receipt of care by mental illness could have been masked. With the exception of Whyte et al, our findings of lower receipt of retinopathy screening in people with SMI align with the results of other studies that examined this indicator [9, 23, 24, 26]. The reason for the lower proportions receiving ~~reduced receipt of~~ retinopathy screening among people with SMI in Scotland is unclear, but it could be related to the different location. ~~fact that retinopathy screening is performed at an optician or at a hospital which could be far from the individual's home as opposed to the other measurements which are conducted at the patient's GP practice.~~ Thus people with SMI may face additional challenges and barriers when receiving care in a setting that is less familiar and possibly~~,~~ more remote and less accessible than the primary care practice ~~from the GP practice and possibly less accessible~~. Understanding of the obstacles to attending diabetic retinopathy screening in general is poor, but studies in the general population of people with diabetes suggest that practical barriers, psychological factors and lack of retinopathy screening awareness may all play a role [36]. Some of these factors may be particularly pertinent to patients with SMI, but further research is needed to ~~unpick~~ identify the reasons for the observed disparity in receipt of screening in this group.

Our results on the receipt of other care indicators align with other UK-based findings [20, 21] and with a Taiwanese study [26], but contrast with those from other non-UK universal healthcare settings, which reported reduced receipt of at least one of the routinely measured blood biomarker or urinary tests in people with versus without SMI [9, 22-25]. We did find that urinary albumin was less likely to be measured in

those with a SMI, but this reached statistical significance only for the group with depression, perhaps reflecting greater statistical power in the largest of the three SMI groups. Only two studies examined receipt of feet examination, one reported on BMI review and no study reported on smoking review. Our contrasting findings may reflect between-setting differences in the route of routine diabetes care delivery and/or engagement with primary care services. In the UK, routine type 2 diabetes care is delivered in primary care ~~through general practice (GP) surgeries~~. Interestingly, SMI is associated with greater consultation frequency with GPs [37, 38] and so the lack of disparities in almost all of the diabetes care indicators could be ascribed to better engagement with GPs. Indeed, we found that people with SMI were more likely to have cholesterol measured. This was particularly marked for people with schizophrenia, perhaps due to more vigilant cholesterol monitoring given the negative metabolic effects of antipsychotic medication [39]. Similarly, serum creatinine was more likely to be measured in those with SMI, particularly bipolar disorder, perhaps due to monitoring for potential side-effects of lithium medication on kidney function [40]. Additionally, during the majority of our study period, the Quality and Outcomes Framework (QOF) was in place in Scotland (from 2004 until 1 April 2016) [41]. This pay-for-performance scheme for primary care offered financial incentives to promote good practice against a set of evidence-based indicators, including monitoring of cardiometabolic risk factors in people with SMI, and could in part explain the lack of difference in receipt of diabetes care measures observed in our study. It was not possible to compare receipt of care during the QOF period with the pre-QOF period due to incomplete SCI-Diabetes data prior to the implementation of QOF.

Our study benefits from a number of strengths. The use of a national diabetes register means that we included >99% of people diagnosed with type 2 diabetes in Scotland during the period of interest, thereby including a large, non-selected study population, with good generalisability. We included objective measurements of receipt of care indicators and adjusted for a wide range of confounding factors, using information routinely collected by clinicians and collated in the SCI-Diabetes database. We also included a long follow-up period of up to 10 years, which allowed us to investigate the links between SMI and receipt of care over the ~~longer~~ medium term, something that to our knowledge, has never been examined before.

The main limitation of our study is that the definition of SMI was based on hospital admissions (and not outpatient) data only and so our findings may not be generalizable to people with schizophrenia, bipolar disorder or depression who have not had a hospital admission and whose condition is therefore perhaps less severe. This limitation is mitigated by the fact that the routine collection of hospital admission data in Scotland extend as far back as 1981. Since we ascertained depression using both general and psychiatric hospital data, there may have been selection bias in that people with less severe depression may have only been included because they were admitted to a general hospital for another health condition/reason. However, reassuringly we obtained similar results when we defined depression based on psychiatric hospital records only, suggesting that the depression group was similar in terms of severity, or that our findings equally apply to people with different severity of depression. Also, we did not account for the development or diagnosis of SMI following diabetes diagnosis. This is unlikely to have affected our findings on schizophrenia or bipolar disorder, since these conditions are typically diagnosed at a younger age than diabetes onset. However, the associations for depression, for

which there is a bidirectional association with diabetes, may be underestimated. Finally, although data was complete for most variables, we did have some missing values for three variables. However, when we repeated our first year analyses following multiple imputation of missing values, we obtained a very similar pattern of results.

There is little disparity in the receipt of routine diabetes care indicators by SMI status in Scotland, with high quality monitoring achieved in primary care. The degree to which the QOF contributed to this equality of monitoring is unclear and the effect of its discontinuation should be closely evaluated in future research. ~~However, t~~The lower proportions receiving retinopathy screening in people with SMI highlights a need for new initiatives to improve screening uptake, ~~in order~~ to help reduce retinopathy risk in this vulnerable group. Qualitative research is needed to identify barriers to uptake and inform these initiatives. People with SMI may need to be better supported to arrange and attend screening, and initiatives may need to improve diabetic retinopathy screening awareness. Moreover, future research should investigate the absolute risk of retinopathy in people with SMI and the effects of ~~reduction of~~lower uptake of retinopathy screening on eye complications. ~~with consideration given to the potential practical barriers, as well as other potentially important factors such as diabetic retinopathy screening awareness. Further qualitative research would help to identify barriers and inform such health service initiatives. Whilst it is reassuring that primary care-delivered diabetes monitoring did not differ by SMI status, the degree to which the QOF contributed to this equality of monitoring is unclear and the effect of its discontinuation should be closely evaluated.~~ It was beyond the scope of this study to examine levels of measured

indicators and whether successful management of these differ~~ed~~ by SMI status. ~~Although we found little difference in receipt of diabetes care in Scotland, it is important to establish whether successful management of these indicators differ by SMI status.~~ Few studies have examined this, with further research needed in this area.

In conclusion, reassuringly, in Scotland ~~(a universal healthcare setting),~~ delivery of annual routine processes of care for type 2 diabetes is largely similar, or better, among people with versus without a SMI ~~compared to those with no history of SMI identified from hospital records~~. However, although our findings are very positive for care delivered in general practice, people with SMI are less likely to receive retinopathy screening, which is delivered separately from primary care. New initiatives are needed to support improved retinopathy screening delivery in this vulnerable patient group.

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DECLARATIONS OF INTEREST

None

AUTHOR CONTRIBUTIONS

CAJ conceived the study, CAJ, KF, SHW, KL, DJS, SWM and CLMS obtained grant funding, all authors contributed to the study design, SHS and KF conducted the statistical analysis, all authors contributed to data interpretation, SHS and CAJ drafted the manuscript which all authors commented on. CAJ is the guarantor of this

work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

PRIOR PRESENTATION

Parts of this study were presented at the: European Diabetes Epidemiology Group Annual meeting in Luxembourg, 11-14 May 2019; Society for Social Medicine & Population Health 63rd Annual Scientific Meeting, Dublin, 4-6 September 2019; and the European Diabetes Epidemiology Group Annual meeting in Heraklio Crete, 2-5 April 2022.

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Table 1 Baseline characteristics* and receipt of diabetes care indicators among people with type 2 diabetes by history of severe mental illness

	Schizophrenia (1,701)	**Bipolar disorder** (768)	**Depression** (5,211)	**No mental illness** (151,221)	**P-value¤**
Age at diabetes diagnosis, mean years (± SD)	51.3 (12.3)	56.7 (11.9)	57.7 (12.3)	59.8 (13.2)	<0.001
Female (%)	37.4	58.3	59.0	42.2	<0.001
Ethnicity (%)					<0.001
Mixed	2.3	2.7	2.0	2.3	
Other	3.2	1.7	2.2	5.2	
White	89.1	91.9	92.0	83.2	
Missing	5.5	3.6	3.8	9.3	
Deprivation† (%)					<0.001
5 (least deprived)	6.7	11.8	8.3	14.3	
4	10.3	15.4	12.7	18.3	
3	18.8	19.8	19.9	20.4	
2	26.3	22.7	25.3	22.9	
1 (most deprived)	37.9	30.3	33.8	23.9	
Missing	0.0	0.0	0.0	0.1	
Health board (%)					<0.001
Ayrshire & Arran	6.7	6.9	8.5	8.3	
Borders	1.6	2.5	2.2	2.3	
Dumfries & Galloway	3.5	3.4	3.5	3.2	
Fife	5.5	7.9	7.7	7.2	
Forth Valley	4.9	4.0	4.3	5.8	
Glasgow	29.5	21.4	22.7	21.1	
Grampian	8.1	10.2	8.9	10.0	
Highland	6.5	5.7	7.4	5.9	
Lanarkshire	10.6	14.1	12.3	13.5	
Lothian	13.9	13.4	12.6	13.2	
Orkney	0.4	0.5	0.6	0.4	
Shetland	0.4	0.4	0.4	0.4	
Tayside	8.1	9.0	8.4	8.3	
Western Isles	0.4	0.7	0.6	0.5	
Alcohol use disorder (%)	17.2	15.2	19.0	2.4	<0.001
CVD (%)	9.3	15.4	25.4	13.8	<0.001
Comorbidity‡ (%)					<0.001
0	81.5	74.1	65.4	83.3	
1-8	12.5	17.1	21.8	9.9	
<8	5.9	8.9	12.8	6.8	
Smoking (%)					<0.001
Never smoked	25.0	30.7	32.6	45.6	
Ex-smoker	22.0	29.6	30.8	34.5	
Current smoker	52.4	39.5	36.3	19.6	
Missing	0.5	0.3	0.2	0.3	
Receipt of care in first year (%)					
HbA1c	89.8	90.8	90.0	88.9	0.02
Cholesterol	85.7	86.3	83.4	81.6	<0.001

Urinary albumin	59.9	62.0	61.2	63.9	<0.001
Serum creatinine	88.7	91.8	89.6	86.4	<0.001
Blood pressure	89.8	90.6	91.2	90.3	0.15
Foot examination	65.4	68.6	66.5	66.7	0.44
Retinopathy screening	76.8	79.2	79.7	80.7	<0.001
Smoking review	83.8	82.8	84.4	81.3	<0.001
BMI review	87.0	87.6	85.9	86.1	0.39
All 9 indicators	34.9	36.2	35.8	38.5	<0.001
Mean follow-up, years (± SD)§	4.7 (2.5)	4.7 (2.5)	4.5 (2.5)	4.8 (2.5)	
Receipt of care during entire follow-up, mean prevalence (± SD)§					
HbA1c	0.86 (0.35)	0.87 (0.34)	0.86 (0.35)	0.85 (0.36)	
Retinopathy screening	0.70 (0.46)	0.71 (0.45)	0.69 (0.46)	0.76 (0.43)	

*Among the 158,901 people included in the first year analyses of receipt of care
ᵀ Differences between SMI groups were calculated by One-way ANOVA F-test for continuous variables, Pearson's Chi-Square test of independence for categorical variables with expected counts above 5 in all cells and Fisher's exact test of independence for categorical variables with expected counts in any cell below 5.
†Area-based deprivation, based on the Scottish Index of Multiple Deprivation
‡Defined using the Charlson comorbidity index
§Among 152,974 included in the longitudinal analyses
BMI = body mass index; CVD = cardiovascular disease; SD = standard deviation

FIGURE LEGENDS

Figure 1 Flow diagram showing the study population for the first year analysis and the longitudinal analysis

* Some persons were excluded for more than one reason

Figure 2 Adjusted odds ratios for receipt of diabetes care indicators during the first year post-diabetes diagnosis (first year analysis*) and during the whole follow-up (longitudinal analysis†), comparing people with a hospital record for schizophrenia, bipolar disorder, and depression versus no mental illness

*N=144,087; adjusted for sex, age, calendar year, area-based deprivation, ethnicity, health board, alcohol disorder, cardiovascular disease, comorbidities and smoking
†N=139,023; adjusted for sex, age, diabetes duration, calendar year, area-based deprivation, ethnicity, health board, alcohol disorder, cardiovascular disease, comorbidities and smoking
CI = confidence interval; OR = odds ratio