Equity and impact of social prescribing in type 2 diabetes prevention:

cross-sectional and cohort study using national primary care data

Sara Calderón-Larrañaga, Bernardo Meza-Torres, Simon de Lusignan, Rohini Mathur, Sarah Finer and Daniel Stow

Abstract

Background

Social prescribing has expanded rapidly in English primary care since 2019 to support the prevention and management of long-term conditions. However, evidence on its equity of access and effectiveness for type 2 diabetes (T2D) prevention is limited.

Aim

To examine the reach, equity of access, and potential impact of social prescribing on T2D prevention among adults at high risk.

Design and setting

Observational study using routinely collected data from the Oxford-RCGP Research and Surveillance Centre, including >1800 general practices in England (January 2019 to November 2023).

Method

Cross-sectional analyses using multivariable logistic regression examined factors associated with social prescribing referral among adults at high risk of T2D. Cohort analyses estimated the association between social prescribing referral and incident T2D, adjusting for baseline covariates. Calendar-period–stratified Cox models were used to capture programme roll-out and COVID-19 changes. Exploratory time-since-index analyses tested if effects varied over time.

Results

Among 2 326 400 adults at high-risk of T2D, 271 582 (11.7%) developed T2D over a median 3.7 years (interquartile range [IQR] 1.44–4.83). Referrals to social prescribing increased 9.5-fold from 0.3% (*n* = 3897/1 479 172) in 2019–2020 to 2.5% (*n* = 47 883/1 917 187) in January–November 2023, and were more common among women (adjusted odds ratio (aOR) 1.42, 95% confidence interval [CI] = 1.40 to 1.43), those living in more deprived areas (aOR 1.89, 95% CI = 1.86 to 1.93), current smokers (aOR 1.71, 95% CI = 1.68 to 1.73), people with obesity (aOR 1.19, 95% CI = 1.17 to 1.21), depression/anxiety (aOR 2.52, 95% CI = 2.49 to 2.54), and multimorbidity (aOR 1.45, 95% CI = 1.43 to 1.47). By calendar year, social prescribing was associated with an increased risk of T2D in 2019 (adjusted hazard ratio [aHR] 1.67, 95% CI = 1.20 to 2.32) but became protective by 2023 (aHR 0.84, 95% CI = 0.79 to 0.89). By follow-up, social prescribing was associated with an increased risk of T2D within 0–2 years post-referral (aHR 1.09, 95% CI = 1.04 to 1.15) but was protective after ≥3 years (aHR 0.88, 95% CI = 0.80 to 0.97).

Conclusion

Social prescribing reached those with greater health and social need. The protective association against T2D emerged as services matured post-COVID-19 and with longer follow-up, potentially reflecting cumulative engagement, although activity data were unavailable.

Keywords

health equity; prevention; primary health care; social prescribing; type 2 diabetes.

Introduction

Social prescribing involves linking patients in primary care with services provided by the voluntary and community sector (VCS).[1] Activities are typically non-medicalised, provided locally (either in person or remotely), and have a wide remit (from lifestyle programmes to welfare advice and/or community engagement initiatives, depending on patients' needs and local availability).[2] In the UK, the link between primary care and the VCS is facilitated by a designated professional known as a link worker (or social prescriber), whose responsibilities may include signposting, needs assessment, ongoing support, and even codeveloping new community-based services where gaps exist.[3,4]

In July 2019, NHS England launched the national social prescribing link worker programme as part of the NHS Long Term Plan,[5] aiming to employ 1000

How this fits in

Social prescribing is widely promoted in UK primary care, but national evidence on its equity and effectiveness for type 2 diabetes prevention is limited. This study examined referral patterns and progression to type 2 diabetes among more than 2.3 million adults at high risk over a median 3.7 years of follow-up (IQR 1.44–4.83). Referrals increased 9.5-fold and were more common among people with greater health and social need, but lower among Asian groups and younger adults. Associations with type 2 diabetes shifted from higher risk during early implementation to lower risk by 2023 and after ≥3 years of follow-up.

link workers by the end of 2020/21. This was followed by a mandate that, by September 2022, every primary care network would provide social prescribing services to eligible adults, aged ≥18 years with an active registration at a general practice.[6] As a result, delivery of social prescribing expanded rapidly: between 2019 and 2023, an estimated 8.8–10.0 million consultations included a social prescribing discussion, of which 5.2–5.9 million led to referral; in 2023 alone, 1.1–1.4 million patients were referred.[7]

The service is expected to advance the prevention and management of long-term conditions, such as type 2 diabetes (T2D),[8,9] by encouraging healthier lifestyles, self-management, and personalised care.[10,11] However, despite growing interest and rapid scale-up, evidence on the effectiveness of social prescribing, particularly in the context of specific health conditions like T2D, remains limited.[8,12–14] Preliminary research suggests that uptake of social prescribing is higher among individuals at high risk of T2D who also experience greater social vulnerability, including people from minoritised ethnic backgrounds and those socioeconomically deprived.[15] This pattern suggests that social prescribing may be well positioned to deliver preventive interventions to populations with the greatest need. However, there has been no national-level evaluation of whether social prescribing is equitably reaching these groups, nor whether participation in social prescribing reduces clinical risk of developing T2D, to the authors' knowledge.

This study addresses these gaps by examining the reach, equity of access, and potential impact of social prescribing on T2D prevention. Specifically, it aims to:

- investigate the sociodemographic and clinical characteristics associated with social prescribing referral among individuals at high risk of T2D; and
- assess whether being referred to social prescribing is associated with a reduced risk of progressing to T2D in this high-risk population.

Method

Data source

This study used routinely collected, pseudoanonymised primary healthcare records data from the Social Prescribing Observatory, sourced from the Oxford-RCGP Research and Surveillance Centre (RSC).[16] The RSC comprises a network of 1790 general practices in England (28.7% of all English general practices),[17] serving 18 746 215 individuals, who are representative of the English population.[18]

Study population

The study cohort included adults ≥18 years at high risk of T2D between 1 January 2019 and 1 November 2023, either prevalent on 1 January 2019 or first identified during the study period. Time zero was defined as the later of: first meeting high-risk criteria or 1 January 2019; for individuals at high risk of T2D who received a social prescribing referral during the study period, time zero corresponded to the referral date. High risk was defined using established thresholds[19] as meeting ≥1 of the following within standard 5-year (or 30-year for gestational diabetes) look-back windows relative to each individual's index date:

- a QDiabetes®-2018[20] risk score ≥20;
- fasting blood glucose between 5.5 and 6.9 mmol/L;
- haemoglobin A1c (HbA1c) between 42 and 47 mmol/mol;
- a history of gestational diabetes;
- a diagnosis of non-diabetic hyperglycaemia and/or prediabetes; or
- a recorded referral to the NHS Diabetes Prevention Programme (NDPP) — a national behaviour-change programme for people identified as at high risk of T2D delivered at scale through (mostly private) independent providers.[21]

Follow-up continued until the earliest of: T2D diagnosis, death, deregistration from the GP practice, or 1 November 2023 (study end). Individuals with a prior diagnosis of diabetes or a history of social prescribing referral at time zero were excluded. Eligibility criteria, index and exit definitions are detailed in Supplementary Table S1.

Variable definitions

The study used Systematized Nomenclature of Medicine—Clinical Terms (SNOMED CT)[22] to identify study variables in the electronic health records (code lists and full variable definitions are provided in Supplementary Tables S2–S7). Referrals to social prescribing, documented by primary care teams, captured referral only; no data were available on subsequent participation or activity type. Incident T2D was defined as the earliest record of a diagnostic code. Ethnicity followed the Office for National Statistics five-category classification,[23] and deprivation used

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the Index of Multiple Deprivation (IMD)[24] quintiles derived from lower super output areas based on registered postcode. Age at index was derived from age provided on 1 January 2019 and analysed in prespecified age bands. Clinical covariates (body mass index [BMI], blood pressure, cholesterol) used the most recent record within 5 years before index, with extreme/implausible values excluded following thresholds applied in previous literature (BMI <15 or >50 kg/m^2;[25] total cholesterol <1.75 or >20 mmol/L).[26] Smoking status used the most recent available value. Depression and anxiety were coded separately and combined for analysis as any pre-index diagnosis of either condition. Multimorbidity used the modified Cambridge Multimorbidity Score (mCMMS; a 21-condition model validated for predicting mortality).[27]

Study design and analysis

Two separate analyses were conducted using the population of people at high risk of T2D as defined above:

- a cross-sectional study (predictive modelling) of sociodemographic and clinical factors associated with referral to social prescribing; and
- a prospective cohort study (causal modelling) of social prescribing referral and the risk of progression to T2D.

See study design diagram (Figure 1). For the cross-sectional study, baseline characteristics between the exposed (referred to social prescribing) and unexposed (no record of referred) groups were compared at their respective index dates. Multivariable logistic regression models were fitted to estimate odds ratios (ORs) (95% confidence intervals [CIs]) for referral to social prescribing across sociodemographic and clinical characteristics.

For the prospective cohort analysis, the study used Cox proportional hazards models to estimate hazard ratios (HRs) (95% CIs) for conversion to T2D following social prescribing referral, with time on study (years) as the timescale. Proportional hazards were assessed graphically (Aalen plots; Supplementary Figure S1) and formally via likelihood-ratio tests comparing models with and without a time-by-exposure interaction. For the formal test, follow-up time was divided into three intervals containing approximately equal numbers of T2D events. Testing revealed violation of the proportional hazards assumption for social prescribing referral status (likelihood ratio χ^2: 147.6; P<0.001), likely because of temporal changes in programme characteristics during initial roll-out and COVID-19. Calendar-period-stratified Cox models were therefore implemented as the primary approach, with separate strata for each calendar year from January 2019 onwards.

Covariates included sex, age at index, ethnicity, IMD, days from high-risk identification to index, BMI, baseline HbA1c, prior NDPP referral, total cholesterol, systolic and diastolic blood pressure, smoking status, depression/anxiety, and multimorbidity (mCMMS). For the predictive modelling (cross-sectional) analysis, these variables were included as candidate predictors based on clinical relevance and prior evidence.[15] For the causal modelling (prospective cohort) analysis, adjustment sets were defined *a priori*, guided by the hierarchical relationship of variables established in a conceptual framework,[28] previous assumptions on causality (determined using a direct acyclic graph [DAG]; see Supplementary Figure S2)[29] and assessment of collinearity among covariates. Analyses used complete-case methods; observations with missing values in any covariate were excluded. All analyses were conducted using Stata version 17.

Sensitivity and exploratory analyses

In the sensitivity analyses the robustness of the primary findings were tested by:

- modelling age at index as a continuous covariate with quadratic specification rather than categorical age groups; and
- applying alternative look-back windows for baseline BMI, blood pressure, and cholesterol (1-year versus 5-year windows).

In the exploratory analyses the Cox models were re-specified stratified by time-since-index (rather than calendar period) to investigate potential time-varying effects of social prescribing on incident T2D. To complement HRs, Poisson regression was also fitted with a log link to estimate rate ratios (RRs) per person-time.

Patient and public involvement

Patient and public involvement was central to the development and planned delivery of this research. Initial discussions with local East London community members, clinicians, service commissioners, and lay representatives informed the study design and funding application. Input was also obtained from local voluntary and community groups, the Queen Mary University of London–Barts Health Diabetes Lay Research Panel, and resources from Diabetes UK, including the James Lind Alliance T2D priority setting partnership.

Results

The study population flow diagram is presented in Figure 2. Between January 2019 and November 2023, a total of 2 326 400 people at high risk of T2D from 1839 general practices were enrolled. Baseline characteristics are shown in Table 1.

Association between baseline characteristics and social prescribing referral

Over the study period, 148 443 individuals were referred to social prescribing. Referral was more common among women (adjusted OR [aOR] 1.42, 95% CI = 1.40 to 1.43) and in older age groups (≥75 years versus 18–34 years [reference]: aOR 4.97, 95% CI = 4.83 to 5.12; increasing across age bands) (Table 2). A strong socioeconomic gradient was observed, where compared with the least deprived (IMD quantiles [Q]1), odds of referral were progressively higher in more deprived groups (Q2 aOR 1.09, 95% CI = 1.07 to 1.11; Q3 aOR 1.32, 95% CI = 1.30 to 1.35; Q4 aOR 1.56, 95% CI = 1.53 to 1.59; Q5 aOR 1.89 95% CI = 1.86 to 1.93). By ethnicity (versus White reference), Black (aOR 1.14, 95% CI = 1.11 to 1.16) and Mixed (aOR 1.11, 95% CI = 1.06 to 1.16]) groups had higher odds of referral, whereas Asian groups had slightly lower odds (aOR 0.94, 95% CI = 0.92 to 0.96). Clinically, referral was more likely among current smokers (aOR 1.71, 95% CI = 1.68 to 1.73), those with depression/anxiety (aOR 2.52, 95% CI = 2.49 to 2.54), obesity (BMI ≥30: aOR 1.19, 95% CI = 1.17 to 1.21), greater multimorbidity (mCMMS aOR 1.45, 95%

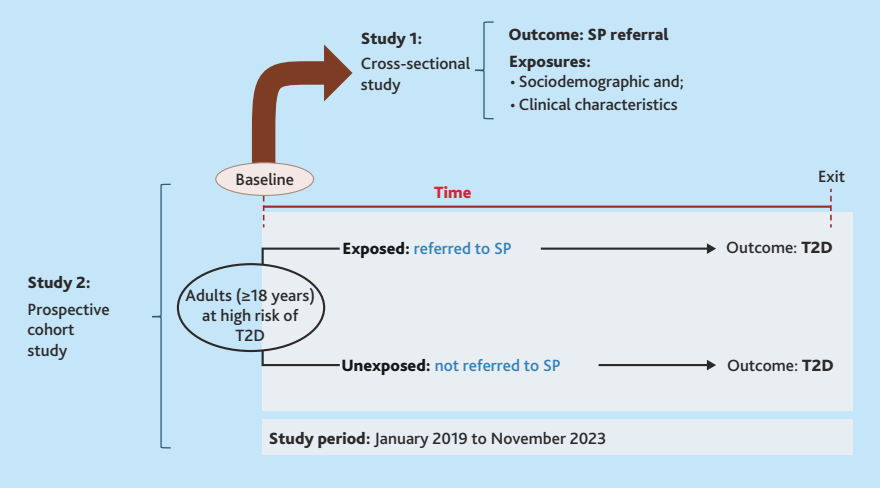

Figure 1. Study design diagram. SP = social prescribing. T2D = type 2 diabetes.

CI = 1.43 to 1.47), and a previous NDPP referral (aOR 3.68, 95% CI = 3.60 to 3.76).

Association between social prescribing referral and incident T2D

Over a median follow-up of 3.7 years (interquartile range [IQR] 1.44–4.83, 7 305 903 person-years), 271 582 (11.7% of *N* = 2 326 400) individuals developed T2D. Of these, 9779 (3.6%) had been referred to social prescribing and 261 803 (96.4%) had not. Referrals rose sharply from 3897 (0.3% of the population at risk; *n* = 1 479 172) during 2019–2020 to 47 883 (2.5% of the population at risk; *n* = 1 917 187) during January–November 2023 — a 9.5- fold increase (absolute +2.2 percentage points). Median follow-up was longer among those not referred to social prescribing (4.00 years, IQR 0.001–4.83) than among those referred (1.13 years, IQR 0.02–4.83). The interval from identification as high risk to the index date was also longer in the non-referred group (1551 days, IQR 705–2334) compared with the referred group (188 days, IQR 0–1112).

Referral to social prescribing was initially associated with an increased risk of T2D conversion but became protective over time (Figure 3). In 2019, the adjusted HR (aHR) was 1.67 (95% CI = 1.20 to 2.32), indicating higher conversion rates among those referred to social prescribing. However, this association reversed as the programme expanded: by 2023, the aHR had declined to 0.84 (95% CI = 0.79 to 0.89), demonstrating a protective effect of social prescribing referral (Table 3). This temporal shift coincided with programme roll-out and the easing of COVID-19 restrictions.

Sensitivity and exploratory analyses

The results of the sensitivity analyses are presented in Supplementary Tables S8–S9 and yielded results consistent with the primary analyses.

Two exploratory analyses were conducted to further examine the time-varying nature of the association. First, in the time-since-index model, the association varied over follow-up: the adjusted hazard ratio (aHR) was 1.09 (95% CI = 1.04 to 1.15) during years 0–2, then fell below 1 from year ≥3 (HR 0.88, 95% CI = 0.80 to 0.97) (Table 4). This time-varying pattern aligns with the calendar-period analysis results observed in the main analysis. Second, exploratory Poisson models estimating adjusted RR (aRRs; that is, ratios of average incidence rates per person-time, as opposed to HRs, which compare instantaneous hazards) indicated a lower rate of T2D among those referred to social prescribing (aRR 0.95, 95% CI = 0.92 to 0.99); Supplementary Table S9).

Discussion

Summary

In this national cohort including more than 2 million adults at high risk of T2D, social prescribing appeared to reach people with greater health and social need, including women, those living in more deprived areas, people with obesity, multimorbidity, mental health diagnosis, and current smokers. Referral was also more common among Black and mixed ethnic groups, but slightly lower among Asian groups and younger adults, indicating both strengths and gaps in equity of access (Table 2).

Referrals to social prescribing increased rapidly after NHS roll-out. During the initial implementation phase (2019–2020), when COVID-19 measures constrained services to remote delivery, referrals were associated with higher T2D risk (aHR 1.67, 95% CI = 1.20 to 2.32). With service expansion, maturation and a return to in-person care, the association reversed, becoming protective in 2022 (aHR 0.85, 95% CI = 0.79 to 0.91) and remaining so in 2023 (aHR 0.84, 95% CI = 0.79 to 0.89). Analyses by time-since-referral showed a similar shift: during the first 2 years post-referral, there was a modest increase in T2D risk (aHR 1.09, 95% CI = 1.04 to 1.15) but after ≥3 years of follow-up referrals became protective (aHR 0.88, 95% CI = 0.80 to 0.97). This temporal pattern may reflect cumulative engagement with services over time, although the current study lacked data on specific activity types and participation intensity. Overall, time-averaged analyses across the entire study period indicated a modest protective association (aRR 0.95, 95% CI = 0.92 to 0.99) between social prescribing referral and T2D incidence.

Strengths and limitations

This is, to the authors' knowledge, the first study to evaluate social prescribing in relation to incident T2D at national scale, using routinely collected real-world data from a large, broadly representative primary care network covering 2.3 million patients. The current study addresses a gap in the evidence base, which has primarily consisted of smaller-scale research and enables monitoring and evaluation of social prescribing referral patterns and effectiveness at scale. In the current study the authors prespecified covariates informed by a conceptual framework and DAG, used stratified Cox models to address non-proportional hazards, and undertook multiple sensitivity and exploratory analyses that supported the primary findings.

Table 1. Cohort characteristics

Characteristic	Total *N* (%) (*N* = 2 326 400, 100%)	Referred to social prescribing, *n* (%) (*N* = 148 443, 6.4%)	Not referred to social prescribing, *n* (%) (*N* = 2 177 957, 93.6)
Sex			
Male	1 206 350 (51.9)	64 274 (43.3)	1 142 076 (52.4)
Female	1 120 050 (48.1)	84 169 (56.7)	1 035 881 (47.6)
Age, years			
18–34	160 929 (6.9)	7458 (5.0)	153 471 (7.0)
35–44	243 798 (10.5)	12 635 (8.5)	231 163 (10.6)
45–54	415 346 (17.9)	22 592 (15.2)	392 754 (18.0)
55–64	586 175 (25.2)	36 000 (24.3)	550 175 (25.3)
65–74	780 635 (33.6)	46 398 (31.3)	734 237 (33.7)
≥75	139 517 (6.0)	23 360 (15.7)	116 157 (5.3)
Ethnicity			
White	1 788 248 (76.9)	117 696 (79.3)	1 670 552 (76.7)
Asian	253 309 (10.9)	14 057 (9.5)	239 252 (11.0)
Black	112 144 (4.8)	8203 (5.5)	103 941 (4.8)
Mixed	31 479 (1.4)	2121 (1.4)	29 358 (1.3)
Other	32 850 (1.4)	2066 (1.4)	30 784 (1.4)
Missing	108 370 (4.7)	4300 (2.9)	104 070 (4.8)
IMD			
Q1 (most affluent)	442 518 (19.0)	22 278 (15.0)	420 240 (19.3)
Q2	459 838 (19.8)	24 817 (16.7)	435 021 (20.0)
Q3	476 382 (20.5)	29 742 (20.0)	446 640 (20.5)
Q4	479 710 (20.6)	33 612 (22.6)	446 098 (20.5)
Q5 (most deprived)	467 908 (20.1)	37 990 (25.6)	429 918 (19.7)
Missing	44 (0.002)	4 (0.003)	40 (0.002)
Smoking status (latest pre-index)			
Active smoker	409 876 (17.6)	33 768 (22.7)	376 108 (17.3)
Ex-smoker	1 012 397 (43.5)	66 941 (45.1)	945 456 (43.4)
Non-smoker	894 017 (38.4)	47 500 (32.0)	846 517 (38.9)
Missing	10 110 (0.4)	234 (0.2)	9876 (0.5)
Depression or anxiety (latest pre-index)			
Yes	865 120 (37.2)	85 990 (57.9)	779 130 (35.8)
No	1 461 280 (62.8)	62 453 (42.1)	1 398 827 (64.2)
Obesity (5 years pre-index)			
Yes (BMI≥30)	791 960 (34.0)	62 422 (42.1)	729 538 (33.5)
No (BMI<30)	1 092 013 (46.9)	68 695 (46.3)	1 023 318 (47.0)
Missing	442 427 (19.0)	17 326 (11.7)	425 101 (19.5)
HbA1c, median (IQR) (5 years pre-index)	43 (42–44)	43 (42–44)	43 (42–44)
Days at high risk of T2D before time 0, median (IQR)	275 (0–1190)	1551 (705–2334)	188 [(0–1112)
Referred to NDPP (5 years pre-index)			
Yes	95 958 (4.1)	21 894 (14.7)	74 064 (3.4)
No	2 230 442 (95.9)	126 549 (85.3)	2 103 893 (96.6)
Diastolic BP (mmHg) (5 years pre-index)			
<80	1 027 179 (44.2)	72 996 (49.2)	954 183 (43.8)
80–89	838 336 (36.0)	52 217 (35.2)	786 119 (36.1)
≥90	330 339 (14.2)	19 548 (13.2)	310 791 (14.3)

...continued

Table 1. continued.

Characteristic	Total *N* (%) (*N* = 2 326 400, 100%)	Referred to social prescribing, *n* (%) (*N* = 148 443, 6.4%)	Not referred to social prescribing, *n* (%) (*N* = 2 177 957, 93.6)
Missing	130 546 (5.6)	3682 (2.5)	126 864 (5.8)
Systolic BP (mmHg) (5 years pre-index)			
<120	384 113 (16.5)	28 362 (19.1)	355 751 (16.3)
120–139	1 121 197 (48.2)	76 532 (51.6)	1 044 665 (48.0)
140–160	553 685 (23.8)	32 254 (21.7)	521 431 (23.9)
≥160	136 859 (5.9)	7613 (5.1)	129 246 (5.9)
Missing	130 546 (5.6)	3682 (2.5)	126 864 (5.8)
Cholesterol (mmol/L) (5 years pre-index)			
<5	910 709 (39.2)	69 806 (47.0)	840 903 (38.6)
5–6.4	857 861 (36.9)	50 050 (33.7)	807 811 (37.1)
≥6.5	251 870 (10.8)	13 808 (9.3)	238 062 (10.9)
Missing	305 960 (13.2)	14 779 (10.0)	291 181 (13.4)
mCMMS median (IQR) (5 years pre-index)	0.45 (0.32–0.93)	0.69 (0.32–1.12)	0.45 (0.32–0.88)

BP = blood pressure. HbA1c = haemoglobin A1c. IQR = interquartile range. mCMMS = modified Cambridge Multimorbidity Score. NDPP = NHS Diabetes Prevention Programme. Q = quantiles. T2D = type 2 diabetes.

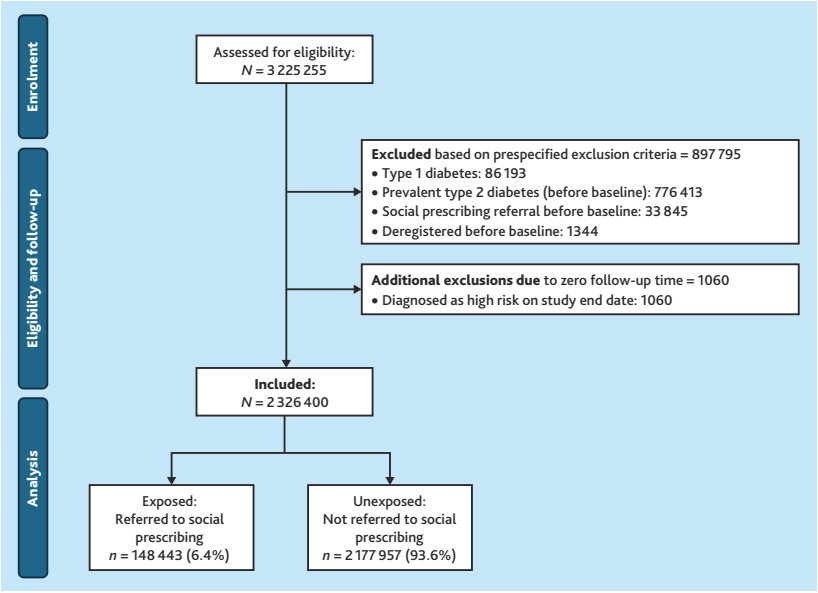

Figure 2. Study population flow diagram.

However, several limitations should be acknowledged. First, as an observational study using routinely collected healthcare data, there is the potential for residual confounding (for example, by clinical judgement, health-seeking behaviour, or unmeasured social and clinical factors). Notably, data on prescribing beyond social prescribing were not available. Some residual confounding by prior or existing pharmaceutical intervention (such as, with antidiabetic drugs like metformin) cannot be completely excluded. However, pharmacological intervention is not routinely recommended for people without diagnosed diabetes in UK practice, and uptake of metformin in prediabetes appears low.[30] In comparable analyses, exclusion of individuals receiving metformin has not materially altered effect estimates,[30] suggesting that any resulting bias may be limited. In common with other studies using electronic health record data,[31] other potentially important confounders, such as patterns of healthcare utilisation and some individual health behaviours could not be captured. Smoking status was included in the adjusted analyses and is relatively well recorded in electronic health records,[32] but other individual-level behaviours, such as alcohol[33] and exercise,[34] that may have influenced referral decisions and subsequent T2D risk, are not reliably available in routinely recorded electronic health record data.

Second, defining time zero at referral for the exposed group (with exposure modelled as fixed) makes comparisons susceptible to guarantee-time bias.[35] Although adjusting for time since high-risk identification and stratifying by calendar period may mitigate related time effects, this approach does not fully remove bias arising from the event-free period before referral occurred. The resulting bias may have inflated the apparent risk among referred individuals in the earlier follow-up period, as those in the exposed group had to remain event-free until referral in order to be classified as exposed. More generally, the observed associations should be interpreted as estimates derived from a pragmatic fixed-exposure

Table 2. Factors associated with referral to social prescribing

Characteristic	OR (95% CI)	*P*-value	aOR (95% CI)	*P*-value
Sex[a]				
Male	Reference		Reference	
Female	1.44 (1.43 to 1.46)	<0.001	1.42 (1.40 to 1.43)	<0.001
Age[a]				
18–34	Reference		Reference	
35–44	1.13 (1.09 to 1.16)	<0.001	1.20 (1.17 to 1.24)	<0.001
45–54	1.18 (1.15 to 1.22)	<0.001	1.32 (1.28 to 1.36)	<0.001
55–64	1.35 (1.31 to 1.38)	<0.001	1.57 (1.52 to 1.61)	<0.001
65–74	1.30 (1.27 to 1.33)	<0.001	1.58 (1.54 to 1.62)	<0.001
≥75	4.14 (4.03 to 4.25)	<0.001	4.97 (4.83 to 5.12)	<0.001
Ethnicity[a]				
White	Reference		Reference	
Asian	0.83 (0.82 to 0.85)	<0.001	0.94 (0.92 to 0.96)	<0.001
Black	1.12 (1.09 to 1.15)	<0.001	1.14 (1.11 to 1.16)	<0.001
Mixed	1.03 (0.98 to 1.07)	0.268	1.11 (1.06 to 1.16)	<0.001
Other	0.95 (0.91 to 0.99)	0.034	1.00 (0.96 to 1.05)	0.958
IMD[a]				
Q1 (most affluent)	Reference		Reference	
Q2	1.08 (1.06 to 1.10)	<0.001	1.09 (1.07 to 1.11)	<0.001
Q3	1.26 (1.23 to 1.28)	<0.001	1.32 (1.30 to 1.35)	<0.001
Q4	1.42 (1.30 to 1.45)	<0.001	1.56 (1.53 to 1.59)	<0.001
Q5 (most deprived)	1.67 (1.64 to 1.70)	<0.001	1.89 (1.86 to 1.93)	<0.001
Smoking status[a] **(latest pre-index)**				
Non-smoker	Reference		Reference	
Active smoker	1.60 (1.58 to 1.62)	<0.001	1.71 (1.68 to 1.73)	<0.001
Ex-smoker	1.26 (1.25 to 1.28)	<0.001	1.25 (1.23 to 1.26)	<0.001
Depression or anxiety[a] **(latest pre-index)**				
No	Reference		Reference	
Yes	2.48 (2.45 to 2.50)	<0.001	2.52 (2.49 to 2.54)	<0.001
Obesity[b] **(5 years pre-index)**				
No (BMI<30)	Reference		Reference	
Yes (BMI≥30)	1.28 (1.26 to 1.29)	<0.001	1.19 (1.17 to 1.21)	<0.001
HbA1c[b] **(5 years pre-index)**	1.03 (1.02 to 1.04)	<0.001	0.95 (0.94 to 0.96)	<0.001
Days at high risk of T2D before time 0[b]	1.01 (1.01 to 1.01)	<0.001	1.01 (1.01 to 1.01)	<0.001
Referred to NDPP[b] **(5 years pre-index)**				
No	Reference		Reference	
Yes	4.91 (4.84 to 4.99)	<0.001	3.68 (3.60 to 3.76)	<0.001
Diastolic BP (mmHg)[b] **(5 years pre-index)**				
<80	Reference		Reference	
80–89	0.87 (0.86 to 0.89)	<0.001	0.97 (0.96 to 0.99)	0.001
≥90	0.82 (0.81 to 0.84)	<0.001	1.18 (1.15 to 1.21)	<0.001
Systolic BP (mmHg)[b] **(5 years pre-index)**				
<120	Reference			
120–139	0.92 (0.91 to 0.93)	<0.001	0.88 (0.96 to 0.90)	<0.001
140–160	0.78 (0.76 to 0.79)	<0.001	0.76 (0.74 to 0.78)	<0.001
≥160	0.74 (0.72 to 0.76)	<0.001	0.97 (0.93 to 1.01)	0.99

...continued

Table 2. continued.

Characteristic	OR (95% CI)	*P*-value	aOR (95% CI)	*P*-value
Cholesterol (mmol/L)[b] (5 years pre-index)				
<5	Reference		Reference	
5–6.4	0.75 (0.74 to 0.76)	<0.001	0.92 (0.91 to 0.94)	<0.001
≥6.5	0.70 (0.69 to 0.71)	<0.001	0.97 (0.94 to 0.99)	0.016
mCMMS[a] (5 years pre-index)	1.48 (1.46 to 1.50)	<0.001	1.45 (1.43 to 1.47)	<0.001

[a]Adjusted for covariates in level 1: sex, age band, ethnicity, IMD.
[b]Adjusted for covariates in level 1 plus obesity, HbA1c_baseline, days at risk of T2D, NDPP_baseline, diastolic BP, systolic BP, Cholesterol. aOR = adjusted odds ratio. BP = blood pressure. CI = confidence interval. HbA1c = haemoglobin A1c. IMD = Index of Multiple Deprivation. IQR = interquartile range. mCMMS = modified Cambridge Multimorbidity Score. NDPP = NHS Diabetes Prevention Programme. OR = odds ratio. Q = quantiles. T2D = type 2 diabetes.

Table 3. Adjusted hazard ratios (aHRs) for risk of type 2 diabetes (T2D) following referral to social prescribing by calendar year

Calendar_time	HR[a] (95% CI)	*P*-value	Social prescribing referrals, *n* (% of total referrals; *N* = 148 443)	Events (T2D)	Population at risk, *n*	Person-years at risk, *n*	T2D incidence rate per 1000 person-years (95% CI)
Year 1 (January 2019 to January 2020)	1.67 (1.20 to 2.32)	0.003	3897 (2.6)	48 436	1 479 172	1 326 857	36.50 (36.18 to 36.83)
Year 2 (January 2020 to January 2021)	1.05 (0.90 to 1.22)	0.546	22 100 (14.9)	40 481	1 544 013	1 430 995	28.29 (28.01 to 28.57)
Year 3 (January 2021 to January 2022)	0.98 (0.90 to 1.07)	0.661	29 552 (19.9)	57 027	1 650 533	1 495 246	38.14 (37.83 to 38.45)
Year 4 (January 2022 to January 2023)	0.85 (0.79 to 0.91)	<0.001	45 011 (30.3)	64 621	1 796 061	1 601 365	40.35 (40.04 to 40.67)
Year 5 (January 2023 to November 2023)	0.84 (0.79 to 0.89)	<0.001	47 883 (32.3)	61 017	1 917 187	1 451 438	42.04 (41.71 to 42.37)

[a]Adjusted for sex, age band, ethnicity, Index of Multiple Deprivation (IMD), days from high-risk identification to index, BMI, baseline HbA1c, prior NHS Diabetes Prevention Programme (NDPP) referral, total cholesterol, systolic and diastolic blood pressure, smoking status, depression/anxiety, and multimorbidity (modified Cambridge Multimorbidity Score [mCMMS]) . CI = confidence interval.

Table 4. Adjusted hazard ratios (aHRs) for risk of type 2 diabetes (T2D) following referral to social prescribing by follow-up period

Time since social prescribing referral	HR[a] (95% CI)	*P*-value	Events (T2D)	Person-years at risk, *n*	T2D incidence rate per 1,000 person-years (95% CI)
0–2 years	1.09 (1.04 to 1.15)	<0.001	118 007	3 845 398	30.69 (30.51 to 30.86)
3–4.8 years	0.88 (0.80 to 0.97)	0.01	153 575	3 460 504	44.38 (44.16 to 44.60)

[a]Adjusted for sex, age band, ethnicity, Index of Multiple Deprivation (IMD), days from high-risk identification to index, BMI, baseline HbA1c, prior NHS Diabetes Prevention Programme (NDPP) referral, total cholesterol, systolic and diastolic blood pressure, smoking status, depression/anxiety, and multimorbidity (modified Cambridge Multimorbidity Score [mCMMS]) . CI = confidence interval.

design rather than as causal effects, and the potentially protective associations observed at later follow-up should therefore be interpreted cautiously.

Third, exposure was defined by referral codes, with no information on dose, modality (face-to-face versus remote), and the content and quality of community activities. Similar to medication prescribing data in primary care records from England and Wales,[36] referral was recorded but 'what was dispensed', including subsequent engagement or attendance, could not be determined. The resulting lack of detail prevents assessment of

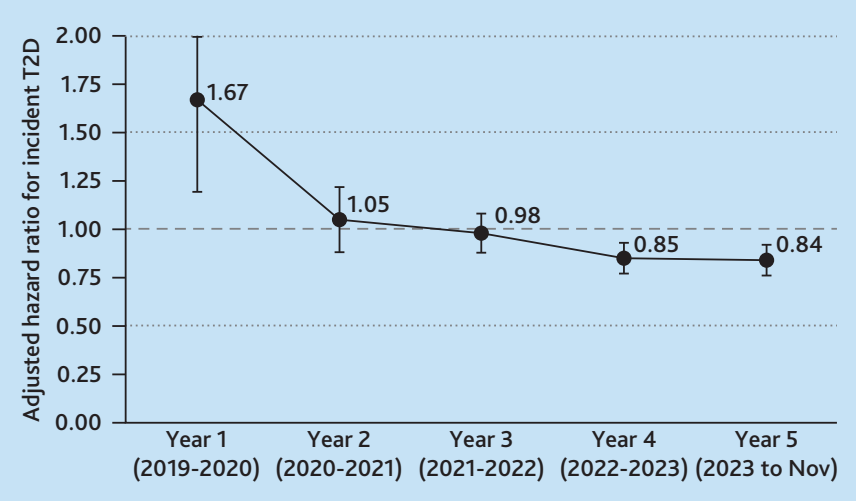

Figure 3. Adjusted hazard ratios (with 95% confidence intervals) for incident type 2 diabetes (T2D) over calendar period (stratified Cox models).

potential variation in effects across social prescribing models and reflects a broader limitation in how social prescribing is recorded in routinely collected healthcare data. Reliance on referral-level estimates may also have attenuated any true effect, underestimating the impact of social prescribing, as some referred individuals may not have engaged with social prescribing or may have received less effective or lower intensity forms of support. However, from a public health and policy perspective, this approach provides a pragmatic estimate of the impact under real-world implementation conditions, where non-uptake, attrition, and variation in delivery are part of routine service roll-out. Finally, missing data were highest for BMI and modest for other clinical variables and ethnicity, which may have affected the observed distributions, although the proportion missing was lower than that reported in previous electronic health record studies.[37]

Comparison with existing literature

The study's equity findings align with social prescribing's aim to support people with greater psychosocial need. In contrast to the social gradients reported for the NDPP,[38–40] social prescribing referrals in the current cohort were higher among socioeconomically deprived groups, suggesting social prescribing may complement NDPP by engaging populations less likely to take up or benefit from standard lifestyle programmes. Despite evidence showing geographic inequalities in the provision of social prescribing link workers — with staffing not consistently aligned to local deprivation and long-term condition burden[41] — where referrals do occur, they disproportionately reach socioeconomically deprived patients. This pattern likely reflects the embedding of social prescribing within primary care and local community networks, as well as its more holistic offer beyond narrow lifestyle advice, including referral to physical activity programmes, social and cultural groups, and support with welfare, housing, or employment.[15] However, lower referral among Asian groups and younger adults, who have elevated T2D risk and greater potential lifetime benefit from prevention,[42,43] indicates an equity gap that warrants further attention. Evidence of higher social prescribing refusal rates among White and older patients[44] suggests that Asian and younger patients may instead be less likely to be offered the service in the first place.

The time-varying association with incident T2D is consistent with an implementation narrative.[45] Early roll-out coincided with the COVID-19 pandemic lockdown, when health services were disrupted and delivered largely remotely. Over time, experience with social prescribing accumulated and in-person care resumed, creating opportunities to refine delivery through learning and adaptation to local needs. Temporal changes in referral patterns and case mix may also have contributed, although the current study's cross-sectional findings suggest referrals remained concentrated among people with greater health and social need overall, and most referrals occurred after wider programme expansion. The emerging protective association with longer follow-up is encouraging given that behaviour maintenance is a central challenge in T2D prevention.[46] It is also consistent with reports of gradual improvements in glycaemic and wellbeing outcomes among people with established T2D engaged with social prescribing-type interventions.[8] Mechanistically, social prescribing's potential to reduce psychological distress,[47–49] enhance social support,[50,51] and facilitate access to financial/welfare advice[52] may improve the conditions necessary for more sustained behaviour change, with downstream effects on diabetes risk.

Implications for research and practice

The study findings suggest that social prescribing can extend the reach of preventive efforts to those with complex social needs and could be integrated with NDPP (for example, dual referral pathways, coordinated follow-up, and bidirectional feedback between link workers and NDPP providers). Services should monitor equity routinely and co-design culturally tailored offers to improve reach among Asian communities and younger adults. Emphasis on sustained, relationship-based support and community-embedded, face-to-face options — where feasible — may enhance effectiveness.

Further research priorities include:

- unpacking which social prescribing components (content, intensity, modality, duration, link-worker practices) drive benefit;
- measuring engagement and adherence beyond referral;
- linking to prescribing and NDPP attendance data; and
- using time-aware and quasi-experimental designs to reduce confounding — such as, time-varying exposure models, landmark designs, target-trial emulation.

Longer follow-up will be important to confirm durability of effects and to assess cost-effectiveness. Overall, the study indicates that social prescribing may have a role in a more holistic, equitable approach to individual-level T2D prevention, complementing condition-specific programmes within primary care.

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Ethical approval

Ethical approval was granted by the Medical Sciences Interdivisional Research Ethics Committee (MS IDREC), University of Oxford (Reference: R88347/RE001).

Data availability

The Oxford–RCGP RSC dataset can be accessed by researchers; approval is on a project-by-project basis (https://orchid.phc.ox.ac.uk/index.php/rcgp-rsc). Ethical approval by an NHS Research Ethics Committee/other appropriate approval is needed before any data release. Researchers wishing to directly analyse patient-level pseudonymised data will be required to complete information governance training and work on the data from the secure servers at the University of Oxford. Patient-level data cannot be taken out of the secure network.

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Competing interests

The authors have declared no competing interests.

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