



Impact of social prescribing intervention on people with type 2 diabetes mellitus in a primary healthcare context: a systematic literature review of effectiveness

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Abstract

Aim To identify social prescribing intervention for people with type 2 diabetes mellitus (T2DM) in the context of primary healthcare and evaluate their impact on improving health, behavior, and economic outcomes.

Subject and Methods Following the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines, a literature search was conducted in SCOPUS database (MEDLINE) and via EBSCO Host (CINHAL, MEDLINE, and Psychology, and Behavioral Sciences Collection). Review studies were included and excluded on the basis of defined criteria. A comprehensive quality appraisal was conducted by analyzing the risk of bias according to each study design. Narrative synthesis was performed by analyzing the social prescribing intervention, with the outcomes sorted into categories.

Results Eleven papers were selected with 19,202 participants describing nine social prescribing intervention domains with a positive contribution to health-related outcomes (improvement in quality of life, psychological and mental well-being, physical activity, and modestly reduced HbA1c), less evidence for health-related behavior outcomes (self-care management slow growth) and less evidence for health-related economic evaluation (small decline in care costs and primary care visits). Social prescribing intervention delivery in a face-to-face mode, performed for longer periods and involving fewer professionals in the referral and accompaniment of the person, demonstrated greater effectiveness. Quality methodology evaluation revealed concerns about the low quality of some studies and a high risk of bias.

Conclusion The analyzed studies suggest that social prescribing interventions can play an important role in producing related health, behavioral, and economic outcomes for people with T2DM. However, interventions targeted specifically at people with T2DM are needed to increase their robustness.

Keywords Social prescribing · T2DM · Effectiveness assessment · Primary care · Health promotion

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Background

Adherence to the recommended standards in diabetes care has improved worldwide in recent decades (ADA 2020). However, such improvements have not been enough to stop the rapid spread of type 2 diabetes mellitus (T2DM), which represents a strong challenge for health systems, people, and society (Stegbauer et al. 2020). Known as a chronic disease and often poorly managed, it is considered the main cause of retinopathy and blindness, nephropathy, and micro- and macrovascular complications (Cusick et al. 2005; WHO 2016). Its action translates into a heavy burden derived from the disease, associated complications, and the acquisition and integration of new self-care. This growing trend underscores the urgency for effective management strategies in primary healthcare settings, where the frontline of T2DM management and prevention takes place. Assumed as a priority by the World Health Organization (2016), it requires articulated interventions to prevent and reduce its prevalence.

Emerging from the recognized vital contribution that communities can make to health and well-being, community support through social prescribing intervention is being explored to expand options and resources beyond those traditionally provided in primary healthcare (Munford et al. 2020a; Centre for Reviews and Dissemination 2015). Social prescribing is considered a “holistic, person-centred and community-based approach to health and well-being, bridges the gap between clinical and nonclinical support and services.” (Muhl et al. 2023). It facilitates and improves communication between primary healthcare professionals and the target community. Through community development workers or health workers, most often referred to as linked workers, professionals who support people’s access to community resources, it is possible to establish a link between the two contexts (Kimberlee 2013; Kielly et al. 2020). The linked worker establishes a relationship with the person after they have been referred by the healthcare system, exploring their needs and directing them to the resources in the community that appears to be a viable response (Connolly et al. 2024). Social prescribing intervention allows healthcare professionals to refer people to nonclinical activities aimed at preventing and promoting self-management of long-term diseases, such as T2DM2 (Bickerdike et al. 2017; Calderón Larrañaga et al. 2021).

The first intervention in the field of social prescribing dates to the United Kingdom over the past few decades and is referred to as community referrals, such as voluntary or arts activities (Lejac 2021; Morse et al. 2022). The concept emerged in 2016, with the definition by the Social Prescribing Network and the subsequent introduction of

social prescribing into the national health system in England. The decade between 2012 and 2022 encompasses the formalization of the concept in 2016 and follows its quick evolution and integration into healthcare systems, both in the UK and internationally, with 20 countries currently involved (Morse et al. 2022; Muhl et al. 2023).

People’s lifestyles, such as low physical activity, smoking, and the intake of saturated fats and sugar, play a major role in the risk of and progression of T2DM and are also associated with low adherence to medication management, self-care behaviors, and recommendations made by health professionals (ADA 2020; Hamlin et al. 2016; Maddison et al. 2020). In addition, social determinants play a strong role in influencing behavioral changes in people with T2DM; when they come from disadvantaged socioeconomic backgrounds, they are more likely to have poorer self-management of the disease and an increased risk of associated complications. Social prescribing intervention, used as a stand-alone intervention or as a component of a complex intervention in a program, can reduce these deleterious effects of social determinants and encourage healthier behaviors and self-care (Calderón Larrañaga et al. 2021; Munford et al. 2020a; Wildman et al. 2019; Wildman and Wildman 2021). By bringing the person to the centre of care and acknowledging their needs, social prescribing is anchored in a multidimensional perspective (Husk et al. 2019) that enables people to change, adapt, and self-manage in the face of physical, emotional, and social challenges. Owing to its complexity (Saatci et al. 2010), it has been developed as a social prescribing program composed of a set of intervention components with structural intervention domains. Previous systematic literature reviews have been carried out more broadly to evaluate the effectiveness of social prescribing for producing outcomes related to health and well-being but not for specific diseases. In the literature, evidence analysis focusing only on T2DM, and social prescribing has been scarce; only one scoping review explored social prescribing for people with T2DM (Pilkington et al. 2017). Owing to the existence of a research gap in evaluating the effectiveness of social prescribing intervention for people with T2DM in the primary healthcare context, our focus was directed to the search for evidence. For a comprehensive understanding of the social prescribing intervention outcomes, they will also be analyzed by domains, such as a health intervention by the *International Classification of Health Intervention* (WHO 2021) and grounded in a conceptual framework the *Fundamentals of Care* (Kitson et al. 2013; Feo et al. 2018). This systematic literature review aimed to evaluate how the intervention of social prescribing can be effective on people with T2DM through the reporting of outcomes in three categories, health-related outcomes, health-related behaviors, and health-related economic evaluations.

Methods

Study design, data sources, and search strategy

A systematic literature review was conducted following the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page et al. 2021) in four electronic bibliographic databases, via EBSCO Host (CINHAL, MEDLINE and Psychology, and Behavioral Sciences Collection) and the SCOPUS database (MEDLINE). The selected search for published papers from January 2012 to December 2022 captures the field's dynamic and transformative phase. This decade encapsulates the rapid evolution and increasing adoption of social prescribing, making it a critical phase for examining its impact on people with T2DM in primary healthcare. Boolean operators were used to link descriptors according to the PICO model (patient/population, intervention, comparison, and outcomes) to search for specific words' synonyms or rejected results (Additional File 1). As social prescribing is a recent term and indexed descriptors are not yet available, the data search resorted to natural language. Truncation was used to integrate word variations and the singular and plural of each word. Covidence® software was used for independent analysis, and the research team was composed of three reviewers. Title and abstract analyses were carried out to exclude all duplicated papers. In the second stage, studies were identified for relevance to the theme under study through complete reading and were excluded if they met the established eligibility criteria. Subsequently, the reference lists of the selected studies were analyzed to locate new studies. The three reviewers carried out the final inclusion of the studies eligible for the systematic literature review.

Eligible and exclusion criteria

Our systematic literature review aimed to focus on the analysis, evaluation, and synthesis of the evidence produced by primary studies that seek to demonstrate the effectiveness of interventions in creating health, behavioral, and economic outcomes. Eligibility criteria included randomized controlled trials, non-randomized controlled trials, quasi-experimental trials, cohort studies, mixed methods studies, and observational studies. Owing to the recent concept of the social prescribing intervention and the fact that previous systematic reviews did not focus on the population under study, systematic literature reviews were not considered for our research. Gray literature was also excluded. Each study had to meet the following eligibility criteria: (i) person with T2DM aged 18 years or

older; (ii) intervention carried out under social prescribing programs, as part of a set of interventions; (iii) social prescribing intervention carried out in the primary healthcare setting; (iv) social prescribing intervention through the referral of health professionals from the primary healthcare setting to linked worker or non-clinical activities in the community.

Intervention categorization

Interventions were categorized using three different approaches: social prescribing domains, which facilitate understanding of the intervention of social prescribing in the production of results in the context of primary healthcare (Costa et al. 2021); the *International Classification of Health Intervention* (ICHI), which is used as a facilitating tool in the reporting and analysis of health-related interventions from different sectors of the system, including primary care and public health (WHO 2021); and the *Fundamentals of Care Framework*, as a conceptual framework, which provides support to health professionals and nurses in recognizing the needs of the person and taking into account the fundamental physical, psychosocial and relational needs, contemplated in the dimension of integration of care (Kitson et al. 2013; Feo et al. 2018).

Main outcomes

This systematic literature review was intended to analyze any outcomes produced by social prescribing programs and categorize them into three categories: health-related outcomes, health-related behaviors, and health-related economic evaluation. To determine the results, the following scales were used: the EQ5D5L and WHOQOL-BREF for quality of life, the New Zealand Physical Activity Questionnaire Short Form (NEPAQ-SF), International Physical Activity Questionnaire Short Form (IPAQ-SF-), and self-exercise reported for physical activity, the Warwick-Edinburgh Mental WellBeing Scale (WEMWBS) for psychological and mental well-being, the Qualify-Adjusted Life Years Scale (QUALYs) for quality of adjusted life years, the Hospital Anxiety and Depression Scale – Anxiety (HADS-A) for anxiety, the Hospital Anxiety and Depression Scale – Depression (HADS-D) for depression, the ICEop Capability Measure Adults (ICECAP-A) for capability measurement for adults, the Active Engagement in Life Score for Patient Engagement, and the Patient Activation Measure for self-management. During the follow-up period, the results of the intervention were evaluated on the basis of a temporal analysis from the beginning of implementation until the end of the study.

Data extraction

After independently reading the full texts of the eligible studies, two reviewers selected the relevant data for extraction; in the event of disagreement, a third reviewer was involved. As a resource for the extraction process, standardized tables were created, consisting of the author's name, year of publication, country of origin, sample size, study design, provider, context, method and mode of delivery, frequency, duration, and content of the intervention, outcomes, and categorization of the social prescribing intervention (domains, ICHI categorization, and Fundamentals of Care Framework).

Data analysis

The heterogeneity of the studies in focus was calculated using the inconsistency index (I^2) (Higgins and Thompson 2002). Subsequently, owing to the methodological and clinical heterogeneity presented, a meta-analysis was carried out by subgrouping, grouping, and analyzing the studies that led to the same outcome. Values of $I^2 < 25\%$ were considered indicative of low heterogeneity, $I^2 > 50\%$ of moderate heterogeneity, and $I^2 > 75\%$ of high heterogeneity (Higgins et al. 2003). When the studies that produced the same outcome were grouped, a meta-analysis by subgroup was carried out if $I^2 < 25\%$. The effect sizes were analyzed according to Cohen's d-test, assuming a small effect ($d = 0.2$), a moderate effect ($d = 0.5$), and a large effect ($d = 0.8$) (Lakens 2013) and considering significant statistics with a p value < 0.05 .

Data synthesis

A synthesis of social prescribing programs was performed under the recommendations of the Synthesis without Meta-analysis (SWiM) reporting guidelines (Champbel et al. 2020) and reporting the effect sizes of the outcome that was allowed a meta-analysis by sub-group. Overall, the population, objectives, limitations, and recommendations were stated. The interventions were related to the provider, context, delivery mode and method, duration, frequency, content, outcome, social prescribing domain, categorization of ICHI, and dimension of care integration of the Fundamentals of Care Framework.

Study quality appraisal and data analysis

A quality appraisal was independently performed by two reviewers using standardized tools to assess the risk of bias, ensuring a comprehensive evaluation of potential biases. Discrepancies were resolved using a third reviewer. The

risk of bias was analyzed using the Cochrane Risk of Bias Rob 2 Assessment tool for randomized clinical trials and the ROBINS-I tool for nonrandomized intervention studies (Sterne et al. 2019); and the assessment tool developed by the NIH (National Heart Lung and Blood Institute) Study Quality Assessment Tools – NHLBI (2021) tool for mixed methods studies, cohort studies (retrospective and prospective), and observational studies (longitudinal, observational noncontrolled before and after study).

Results

The database searches identified 744 articles, of which 250 were duplicated and removed. After reading the title and abstract, 42 were selected and read in full; ten papers met the inclusion criteria. Subsequently, the bibliographical references of the ten papers were analyzed, and one article was identified and included in the review. A total of 11 papers met the inclusion criteria and were taken under the systematic review. The exclusion criteria were as follows: the wrong population, a person with another type of diabetes mellitus or of pediatric age; the wrong study design, a pilot study protocol; incorrect indication, not referring to social prescribing interventions; and incorrect setting, which took place in a hospital environment (Fig. 1).

Study and population characteristics

The eligible studies included two randomized controlled trials (Mercer et al. 2019; Williams et al. 2017), one nonrandomized controlled trial (Kiely et al. 2021), one mixed methods study with a matched control group (Cranes et al. 2017), three cohort studies (retrospective and prospective) (Hamlin et al. 2016; Wildman and Wildman 2021) and (Munford et al. 2020b) and four observational studies (Munford et al. 2020a; Pescheny et al. 2019; Poulos et al. 2019), and (Wakefield et al. 2022) (Table 1).

The studies were from five different countries: England (Carnes et al. 2017; Munford et al. 2020a, 2020b; Pescheny et al. 2019; Wakefield et al. 2022; Wildman and Wildman 2021), Scotland (Mercer et al. 2019), Ireland (Kiely et al. 2021), New Zealand (Hamlin et al. 2016; Williams et al. 2017), and Australia (Poulos et al. 2019). All the studies involved $n = 19,202$ participants with chronic disease, defined as a long-term disease in which T2DM was present (Table 1). In the cohort study by Wildman and Wildman (2021), with 8086 participants, and in the randomized controlled trial by Williams et al. (2017), with 138 participants, the focus was the person with T2DM. The mean age (SD) of the population was ± 58.5 years, but two of the papers, Munford et al. (2020b) and Poulos et al. (2019), focused on people older than 65 years. The female population was

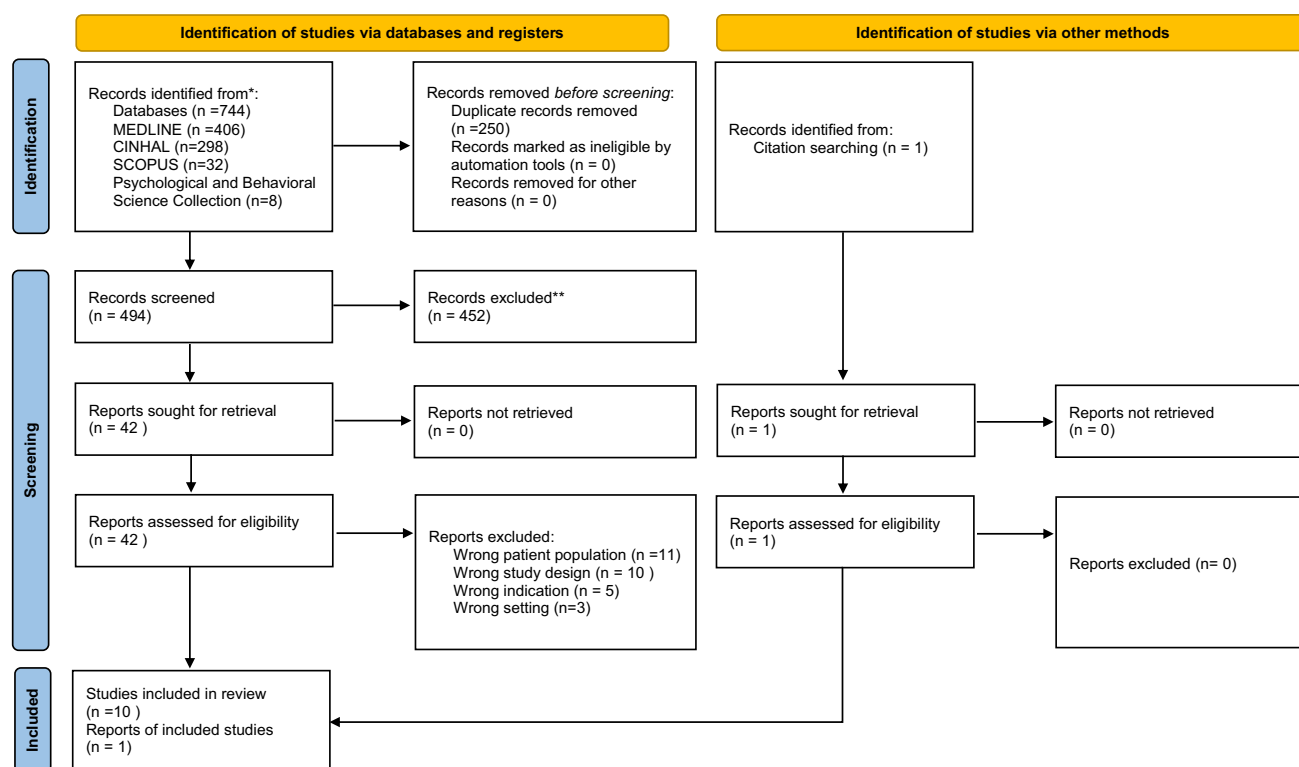


Fig. 1 Flow diagram of the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for report-

ing systematic reviews. *BMJ* 2021;372:n71. <https://doi.org/10.1136/bmj.n71>. For more information, visit: <http://www.prisma-statement.org/>

predominant, and five social prescribing programs have been developed in socioeconomically deprived areas (Carnes et al. 2017; Hamlin et al. 2016; Kiely et al. 2021; Wakefield et al. 2022; Wildman and Wildman 2021).

Social prescribing intervention

Provider and setting

Different approaches to social prescribing programs have been identified. Six studies involved three stages in the development of the programs (Kiely et al. 2021; Mercer et al. 2019; Munford et al. 2020a, 2020b; Wildman and Wildman 2021; and Pescheny et al. 2019) (Table 2). Each had two types of settings, primary care and community, with the first stage involving the recognition of the person's needs by healthcare professionals. The provider mainly identified in primary care was a general practitioner in ten studies (Carnes et al. 2017; Hamlin et al. 2016; Kiely et al. 2021; Munford et al. 2020a, 2020b; Pescheny et al. 2019; Poulos et al. 2019; Wakefield et al. 2022; Williams et al. 2017) and a practice nurse in five (Hamlin et al. 2016; Mercer et al. 2019; Poulos et al. 2019; Wakefield et al. 2022; Williams et al. 2017).

In the second stage, an articulation between primary healthcare and community organizations was referred to as performed by the linked worker (Kiely et al. 2021; Wakefield et al. 2022), also referred to as the social prescribing coordinator (Carnes et al. 2017), navigator (Pescheny et al. 2019), community health worker (Wildman and Wildman 2021), green prescriber facilitator (Williams et al. 2017), or community-link practitioner (Mercer et al. 2019), which normally occurs in the community. The third stage involved the development of social prescribing interventions in the community. Despite other reported approaches, healthcare professionals can refer directly to the community, such as network support sports (Williams et al. 2017) or professional arts (Poulos et al. 2019). Different approaches involved an intermediate stage, between stage 1 and stage 2, performed by the health coach (Wakefield et al. 2022) or trained volunteers to assist in the delivery of the service in the community by providing additional support (Carnes et al. 2017).

Delivery mode and method

The delivery methods were divided into individuals and groups and differed in the purpose of the activity in the community (Table 2). The social prescribing programs analyzed

Table 1 Principal characteristics of social prescribing studies

Author name	Study origin	Study design	Sample size	AIM	Limitations	Recommendations
Williams et al. 2017	New Zealand	Randomized controlled trial	138 with T2DM	Compare the uptake and effectiveness of two modes of Green Prescription delivery: face-to-face and telephone approach among both Maori and New Zealand Europeans	A small number were recruited overall. Revealed a high drop-out	The first interaction should be face-to-face to improve adherence to participation and potentially involve both face-to-face and telephone approaches. Improvements can occur with an increase in physical activity if programs last longer, along with and/or greater emphasis on food choices; and weekly or fortnightly support by the facilitator, rather than once a month
Mercer et al. 2019	Scotland, Glasgow	Quasi-experimental cluster RCT	900 adult patients for deprived areas with morbidity conditions (including T2DM)	Assess the effect of a primary care-based community-links practitioner (CLP) intervention on patients' quality of life and well-being	Being a quasi-experimental design, it was not possible to have a corresponding comparison group at baseline. The research team was not involved in the design of the intervention. Owing to limited funding, they were unable to extend the follow-up period any longer and were unable to access routine data on prescription and healthcare utilization	Future efforts aimed at increasing acceptance and engagement may improve overall results, although they revealed apparent improvements in participants who regularly viewed community-links practitioners. More research is needed before widespread implementation of this approach

Table 1 (continued)

Author name	Study origin	Study design	Sample size	AIM	Limitations	Recommendations
Kiely et al. 2021	Ireland	Pilot study non-controlled for a pragmatic RCT	12 participants with chronic conditions (including T2DM) in socially deprived areas	Test the effectiveness of primary care-based link workers providing social prescribing in improving health outcomes for people with multimorbidity who attend general practices in deprived areas in Ireland	The short timeline of 3-months for the pilot resulted in several limitations to the methods. There was a very limited number of participants and even fewer responded to interviews. The demographic findings cannot be taken to represent the population. Given the small sample size, statistical analyses of the patient-reported outcome measures were not possible	The use of consultative groups made it possible to include different views from health professionals and users, reflecting better adherence from general practitioners to participate in the definitive trial of the recruitment and intervention processes. More involvement from the public patient involvement panel before the pilot and afterward
Carnes et al. 2017	UK, London Borough of City and Hackney	Mixed-methods study, with a matched control group	486 (including T2DM)	Evaluate the SP intervention in Primary Care and its effect on well-being using the resources of Health Primary Care	Difficulties presented in response rates (14%), referring to the method (postal questionnaires), English not being the mother tongue, and the diversity of participants' literacy. Lack of access to data about the participants who participated in the activities, what the activities were, and their frequency. Qualitative data could not express results like qualitative data	More research is needed from the perspective of healthcare professionals. Further research is suggested to establish the right measurement tools and the appropriate timeline for data collection and cluster randomized controlled trials with a full health economic assessment that can provide more robust evidence for policymakers. More work is also needed to ensure the optimal delivery of social prescribing intervention to understand its potential effects

Table 1 (continued)

Author name	Study origin	Study design	Sample size	AIM	Limitations	Recommendations
Hamlin et al. 2016	New Zealand	Retrospective cohort comparative study	494	Quantify the effectiveness of a physical activity primary care intervention named the 'Green Prescription on changes in physical activity levels 2-3 years following the original prescription	The program was considered too generalist, without being adapted to different clinical conditions. Present a high drop-out rate, an uneven distribution of responses between the intervention groups, and the absence of a control group	Further research is needed to investigate changes to the Green Prescription program or similar primary care interventions that will enable the most benefit to all patients over the long term
Munford et al. 2020b	UK, Salford	Prospective cohort study	4377 older people long term	Improve outcomes for older people with long-term conditions and multimorbidity	A generalization of the data must be carried out with care, bearing in mind that the study was carried out in a single region, with a population of elderly people living in an area that was in the process of changing its services for the elderly. Also, have difficult to demonstrate which type of community assets were most beneficial	The results support the inclusion of social prescribing intervention and community assets as part of an integrated care model for the elderly
Wildman and Wildman 2021	UK, North East England	Cohort study	8086 patient with T2DM	To determine whether a UK National Health Service (NHS) CHW social prescribing program was associated with improved hemoglobin A1c (HbA1c) levels among patients with type 2 diabetes	Findings for racial and ethnic minority groups were limited by poor data recording and small group sizes. The effect sizes and differences reported were statistically small and may not have clinical significance	Suggests that individuals with less comorbidity (defined by intervention-qualifying comorbidities) may benefit more than individuals with 2 or more comorbidities. Suggests that social prescribing community health worker interventions addressing the wider social determinants of health may play a role in reducing the long-term public health burden of type 2 diabetes

Table 1 (continued)

Author name	Study origin	Study design	Sample size	AIM	Limitations	Recommendations
Pescheny et al. 2019	Luton, UK	Observational non-controlled before-and-after study	146 for a deprived area with a large ethnic minority population with chronic conditions (including T2DM)	Assess the change in energy expenditure levels of service users after participation in the Luton social prescribing program	Missing data, high loss of follow-up, and a short follow-up period. A lack of a control group made not possible to compare outcomes from those engaging with the service with those who did not, due to practical and resource issues	The results obtained from the social prescription intervention in increasing the physical activity levels of service users and promoting physical activity in inactive patient groups can serve as a basis for future research in this field, which could be useful for those responsible for contracting services and policymakers
Poulos et al. 2019	Sidney, Australia	Observational non-controlled before-and-after study	127 participants 65 years or older	Evaluate a large Art program targeting older people with diverse health and wellness needs	The program was carried out with a low number of participants, in two geographical areas with great cultural diversity and lower socioeconomic levels, and generalization to a wider population must be careful	Consider the inclusion in future research of measures to capture changes in chronic respiratory symptoms and functional ability. The results of the program may support the wider adoption of arts on prescription programs for older people
Munford et al. 2020a	UK, Salford	Longitudinal study	3686	The study's goal was to examine the effectiveness of community assets in improving QoL among older people living in the community	The study was carried out in just one city, with a population aged over 80, in a more disadvantaged socio-economic context and not observing the timing of events	Owing to the growing number of older adults in the future, health and social care services must continue to promote the well-being of their populations and maintain their functioning

Table 1 (continued)

Author name	Study origin	Study design	Sample size	AIM	Limitations	Recommendations
Wakefield et al. 2022	UK	Longitudinal study	630	Evaluation and investigation of the effects of Social Prescribing (SP) a pathway that addresses the healthcare needs through enhancing social connections	Difficulties in collecting data during the follow-up period, due to limited human and financial resources.	Further research is required to examine how social prescribing intervention can be adapted to the needs of specific groups (severe mental health/mobility). The social prescribing intervention must be seen as a social intervention, and its health-related results must be captured systematically

combined the two types, individually in the beginning and individually or in a group, according to community activities; only in one study were all activities in groups (Poulos et al. 2019). In terms of delivery mode, four studies reported face-to-face mode and by phone (Hamlin et al. 2016; Kiely et al. 2021; Mercer et al. 2019; Williams et al. 2017), two reported home visits (Mercer et al. 2019; Wildman and Wildman 2021), and four reported accompanying patient to community activities (Carnes et al. 2017; Kiely et al. 2021; Mercer et al. 2019; Wildman and Wildman 2021). Compared with phone mode, face-to-face mode had a small effect on HbA1c and body weight, with a greater effect (Table 3).

Duration and frequency

The interventions took place for a minimum of 6 weeks (Kiely et al. 2021) or for a maximum of 25 months (Wildman and Wildman 2021) (Table 2). Most of the studies did not detail the intervention duration or frequency. Only one study mentioned the number of sessions (Pescheny et al. 2019), and another study mentioned the number of courses, showing better results for participants who engaged in three or more courses (Poulos et al. 2019). Another three studies reported the appointment frequency with linked workers: six sessions (Carnes et al. 2017), one to five (Mercer et al. 2019), and one session face-to-face per month, with a duration of 15–60 min or four phone conversations per month (Williams et al. 2017). The studies revealed that there was a small to large effect of the linked worker intervention when three or more contacts were made during the program (Table 3).

Intervention content

Social prescribing intervention was developed in the community by carrying out different activities (Table 2). The most common interventions were physical activity (Carnes et al. 2017; Hamlin et al. 2016; Kiely et al. 2021; Munford et al. 2020a, 2020b; Pescheny et al. 2019; Poulos et al. 2019) (Wildman and Wildman 2021; Williams et al. 2017), involving 19 types of activities; walking was the most popular (Hamlin et al. 2016; Mercer et al. 2019; Pescheny et al. 2019; Williams et al. 2017). Social interaction activity was referred to in seven studies, with activities such as voluntary or charity (Carnes et al. 2017; Mercer et al. 2019; Munford et al. 2020a, 2020b; Poulos et al. 2019; Wakefield et al. 2022; Wildman and Wildman 2021). Personal development (Carnes et al. 2017; Hamlin et al. 2016; Mercer et al. 2019; Munford et al. 2020b; Pescheny et al. 2019; Wildman and Wildman 2021) and arts activities were developed in six programs, along with six different activities (Mercer et al. 2019; Munford et al. 2020a, 2020b; Pescheny et al. 2019; Poulos et al. 2019; Wildman and Wildman 2021). Self-management

Table 2 Principal Characteristics and Categorization of Social Prescribing Interventions

Author name	Provider	Setting	Delivery method	Delivery mode	Duration	Intensity	Content	Outcomes (measurement instruments)	SP domain	Categories	Integration of care dimension
Williams et al. 2017	General Practitioner Practice Nurse	Primary Health Care Community Organization (Sports Waikato)	One-to-One Group	Face-to-Face Phone Approach	6 months	Support: Face-to-Face 15-60min or phone call once per month	Nutrition (plan), physical activity (walking, swimming, weight training and also utilized common activities such as washing clothes, vacuuming, or gardening)	Height; Body weight; Waist circumference; Body mass index; Systolic and diastolic blood pressure; Heart rate; HbA1c; Blood lipids; New Zealand physical activity questionnaire short form (NZPAQSF)	Education Selfmanagement Social Support Physical Activity	Health-Related Behaviors Interventions on Activities and Participation Domain	Physical Physicosocial Relational
Mercer et al. 2019	General Practitioner Practice Nurse	Primary Health Care Community Organization	One-to-One Group	Face to Face Phone Approach Accompanying patients as they attend services or activities Home Visit	9 months	Seven types of Interventions/Support: 1-5 appointments with Community-Link worker	Physical Activities; walking groups Arts; Personal Development (welfare rights, bereavement support, debt management); Social Interaction (crafting clubs, lunch clubs, befriending schemes) Selfcare management	Quality of life Euro-QoL (EQ-5D-5L) Well-being (ICECAP-A) Hospital Anxiety and Depression Scale (HADS-A; HADS-D) Work and Social Adjustment Scale (WASAS) Self-reported exercise	Arts Physical Activity Social Interaction Activities Personal Development Selfcare Management	Health-Related Behaviors Interventions on Activities and Participation Domain	Physical Physicosocial Relational

Table 2 (continued)

Author name	Provider	Setting	Delivery method	Delivery mode	Duration	Intensity	Content	Outcomes (measurement instruments)	SP domain	Categories/Interventions	Integration of care dimension
Kiely et al. 2021	General Practitioner	Primary Health Care Community Organization	One-to-One Group	Face to Face Accompanying patients as they attend services or activities Phone Approach	6 weeks (November 2019–January 2020)		Social Support chronic disease self-management courses, addition services, and local exercise classes)	Quality of life Euro-QoL (EQ-5D-5L) Hospital Anxiety and Depression Scale (HADS-A; HADS-D) Activities of daily living (Frenchay Activity Index) Self-management (Patient Activation Measure) Multimorbidity Burden of Treatment Questionnaire Social Connectedness Scale	Social Interaction Activity Selfcare Management Physical Activity	Health-Related Behaviors Interventions on Activities and Participation Domain	Physical Physicosocial Relational
Carnes et al. 2017	General Practitioner	Primary Health Care Community Organization	One-to-One Group	Face to Face Accompanying patients as they attend services or activities	8 months (February 2014 – March 2015)	6 sessions	Exercise Classes: ping pong Cooking lunch club Library visits Religious groups	Psychological (HADS Anxiety Score; HADS Depression Score), Social Well-being (Well-being (past week); Active engagement in life score; General Health Score; Number of Annual GP appointment	Physical Activity Social Interaction Activities Cultural Activities Religious Activities Personal Development	Health-Related Behaviors Interventions on Activities and Participation domain	Physical Relational

Table 2 (continued)

Author name	Provider	Setting	Delivery method	Delivery mode	Duration	Intensity	Content	Outcomes (measurement instruments)	SP domain	Categories (ichi)	Integration of care dimension
Hamlin et al. 2016	General Practitioner Nurse	Primary Health Care Community Organization (Regional Sports Trust)	One-to-One Group	Face to Face Phone approach	3 Months (June – September 2015) Follow up 2–3 years	150 min per week or 30/min 5 days/week	Physical Activities: walking, Tai chi, Exercise Class, Gardening, Swimming, Golf, Home-work Educational Materials	International Physical Activity Questionnaire Short Form (IPAQ-SF); Medication; Body Mass, Energy Levels; Mobility; Pain; Strength/fitness; Relation; Over Hall Health; Breathing	Physical Activity Educational	Health-Related Behaviors Interventions on Activities and Participation Domain	Physical Physicosocial
Munford et al. 2020b	General Practitioner	Primary Health Care Community Organization	One-to-One Group	Face to Face	18 months		Group for elderly or older people (e.g. lunch club); Education, arts, music or singing group; Tea and Teach classes; Religious group or church organization; Charity, voluntary or community group; Social club; Sports club; gym, exercise, or dance group;	Quality of life Euro-QoL (5Q-5D-5L), Qualify-adjusted life years (QALYs) Health-care costs and Social Value	Arts Education Selfmanagement Physical Activity Religious Activity Social Interaction Activity Personal Development	Health-Related Behaviors Interventions on Activities and Participation Domain	Physical Physicosocial Relational
Wildman & Wildman, 2021	Primary Care Practitioner	Primary Health Care Community Organization	One-to-One Group	Face to Face Accompanying patients as they attend services or activities home visits	24 months		Education, Art, physical activity, social interaction, personal development, and Voluntary sector	HbA1c level, a marker of glycaemic control.	Arts Education Selfmanagement Physical Activity Social Interaction Activity Personal Development	Health-Related Behaviors Interventions on Activities and Participation Domain	Physical Physicosocial Relational

Table 2 (continued)

Author name	Provider	Setting	Delivery method	Delivery mode	Duration	Intensity	Content	Outcomes (measurement instruments)	SP domain	Categories iChi	Integration of care dimension
Pescheny et al. 2019	HealthCare Professional	Primary Health Care Community Organization	One-to-One Group	Face to Face	25 months (January 2016 – February 2018)	12 sessions and an exit interview with Navigator	Physical activity (walking, vigorous physical activity, yoga, aerobics, gardening), Arts, Personal Development (relaxation courses, Stress management, debt, housing, and employment), Social activities (lunch club)	International Physical Activity Questionnaire (IPAQ): Energy expenditure measured as metabolic equivalent (MET) minutes per week	Art Education Self management Physical Activity Social Interaction Activities Personal Development	Health-Related Behaviors Interventions on Activities and Participation Domain	Physical Physicosocial Relational
Poulos et al. 2019	Health Practitioner Professional	Primary Health Care Community Organization	One-to-one Group with an art professional	Face to Face	8–10 week	Choose 3 courses at some time	Visual arts, photography, dance and movement, drama, singing, or music. Encourage Physical activities.	Levels of creative Warwick-Edinburgh Mental Well-being Scale (WEMWBS) Frailty	Art Physical Activity	Health-Related Behaviors Interventions on Activities and Participation Domain	Physical Physicosocial Relational

Table 2 (continued)

Author name	Provider	Setting	Delivery method	Delivery mode	Duration	Intensity	Content	Outcomes (measurement instruments)	SP domain	Categories	Integration of care dimension
Munford et al. 2020a	General Practitioner	Primary Health Care Community Organization	One-to-One Group	Face to Face	12 months intervention		Group for elderly or older people (e.g. lunch club) Education, arts, music or singing group (including evening classes) Religious group or church organization Charity, voluntary or community group Social club Sports club, gym, exercise, or dance group; Tea and Teach classes	Quality of life (WHOQOL-BREF short-form)	Arts Education Self management Physical Activity Religious Activity Social Interaction Activity Personal Development	Health-Related Behaviors Interventions on Activities and Participation Domain	Physical Physicosocial Relational
Wakefield et al. 2022	General Practitioner Practice Nurse	Primary Health Care Community Organization	One-to-One Group	Face to Face	24 months		Social Support: social group memberships (e.g. family, community, hobby groups); Health Coach: self-care management.	Loneliness ULS-8; Quality of life Euro-QoL (5Q-5D-5L);	Social Interaction Activities SelfCare Management	Health-Related Behaviors Interventions on Activities and Participation Domain	Physical Relational

NR not reported, *HADS-A* Hospital Anxiety and Depression Scale – Anxiety, *HADS-D* Hospital Anxiety and Depression Scale – Depression, *ULS-8* Loneliness, *E5Q-5D-5L* Quality of Life Euro-QoL 5-Dimensions, *WHOQOL-BREF short-form* Quality of life, *WEMWBS* Warwick-Edinburgh Mental Well-being Scale, *NZPAQSF* New Zealand Physical Activity Questionnaire Short Form, *ICECAP-A* ICEop Capability Measure Adults, *IPAQ-SF* International Physical Activity Questionnaire Short Form, *QALYs* Quality-adjusted life years, *WASAS* Work and Social Adjustment Scale

Table 3 Health-related, behavior economics evaluation outcomes of the social prescribing intervention

	Outcomes	Author name	Results
Health-related outcomes	HbA1C	Williams et al. 2017	HbA1c concentration fell by 3.1 mmol/mol across the 64 participants with data. This effect was dominated by a lowered HbA1c in patients with poorer glucose regulation at baseline, i.e., HbA1c >9.5% (80 mmol/mol). A small effect size was reported, with a greater impact with the face-to-face mode $d = 0.2$ [95 CI% -0.205, 0.597] $p = 0.338$ than with the telephone mode $d = 0.05$ [95 CI% -0.384, 0.493] $p = 0.808$
		Wildman and Wildman 2021	The referral group experienced an HbA1c reduction of -0.10 percentage points (95% CI, -0.17 to -0.03 percentage points) compared with the control group. The association increased over time after 3 years: the estimated association was -0.14 percentage points [95% CI, -0.24, -0.03 percentage points], in White patients compared with non-White patients (-0.15 percentage points [95% CI, -0.26, -0.04 percentage points], those with fewer additional comorbidities (-0.16 percentage points [95% CI, -0.29 to 0.04 percentage points], and those living in the most socio-economically deprived areas (-0.19 percentage points [95% CI, -0.32 to 0.07 percentage points])
	Waist circumference	Williams et al. 2017	After 6 months of intervention, there were small reductions in waist circumference. The small effect size was revealed greater with the telephone mode $d = 0.22$ [95 CI% -0.204, 0.638] $p = 0.312$ than with the face-to-face $d = 0.20$ [95 CI% -0.219, 0.622] $p = 0.348$
	Body weight	Williams et al. 2017	The small effect was slightly, but insignificantly, greater with the face-to-face $d = 0.08$ [95 CI% -0.320, 0.481] $p = 0.694$ than with the telephone approach $d = 0.06$ [95 CI% -0.361, 0.478] $p = 0.784$
		Hamlin et al. 2016	Participants revealed a small decrease compared to the non-adherence group, with a small effect of $d = 0.03$ [95 CI% -0.303, 0.363] $p = 0.861$
	Total cholesterol	Williams et al. 2017	Reported a small reduction in total plasma cholesterol concentration with a better impact with the phone mode $d = 0.48$ [95 CI% -0.205, 0.597] $p = 0.027$ than the face-to-face mode $d = 0.30$ [95 CI% -0.135, 0.780] $p = 0.183$

Table 3 (continued)

Outcomes	Author name	Results
Physical activity	Williams et al. 2017	NZPAQSF data revealed that overall, at baseline the individual's total time spent in physical activity was extremely low. 90% of participants did not undertake the recommended 30 min per day of brisk walking on five or more days per week. Green Prescription Program increased levels of physical activity (especially from nothing to some brisk walking), but overall, there was no statistically significant change in time spent walking following the treatment
	Pescheney et al. 2019	Energy expenditure from all levels of physical activities increased post-intervention (walking 41.7% [95%PPI 40.31%, 43.11%]; moderate 5.0% (95%PPI 2.94%, 7.09%); vigorous 107.3% (95%PPI 98.19%, 116.20%) and total 56.3% (95%PPI 54.77%, 57.69%)
	Mercer et al. 2019	Improvement in exercise reported by comparing participants who personally consulted the community-links practitioner more times (3 or more) $d = 0.34$ [95% CI 0.07, 0.61] $p = 0.013$ than those who consulted them once $d = 0.12$ [95% CI -0.16, 0.40] $p = 0.403$
	Hamlin et al. 2016	Participants who completed the program reported an additional 64 min [95%CI 16, 110] of total physical activity per week compared to the group who had dropped out
Quality of life	Mercer et al. 2019	Improvement in quality of life by comparing participants who personally consulted: community-links practitioner more times (3 or more) $d = 0.07$ [95% CI 0.02, 0.13] $p = 0.011$ than those who consulted them once $d = 0.01$ [95%CI -0.05, 0.07] $p = 0.755$
	Kiely et al. 2021	Small improvement, with a small effect $d = 0.03$ [95% CI -0.84, 0.89] with no statistical significance $p = 0.949$
	Munford et al. 2020a	Environmental quality of life: small to moderate effect size $d = .45$ [95% CI 0.39, 0.52] $p < 0.000$, than small effect in physical quality of life $d = 0.35$ [95% CI 0.28, 0.42] $p < 0.000$, psychological quality of life $d = 0.32$ [95% CI 0.25, 0.39] $p < 0.000$ and social quality of life $d = 0.22$ [95% CI 0.15 to 0.29] $p < 0.000$

Table 3 (continued)

Outcomes	Author name	Results
Quality of adjusted life	Munford et al. 2020b	Improving along 6, 12, and 18 months. After 18 months the estimated effect size was $d = 0.36$ [95% CI 0.28, 0.44] $p < 0.000$
	Wakefield et al. 2022	Increase significantly between T0 (baseline) and T1 (4 months of follow-up) $F(1177) = 4.26, p = 0.04$
	Williams et al. 2017	Showed an associated reduction in weight, waist circumference, and total cholesterol with improvements in quality of life
	Munford et al. 2020b	Starting to participate in community assets was associated with a $d = 0.02$ [95% CI 0.002, 0.032] gain in QALYs after 6 months, $d = 0.03$ [95% CI 0.005, 0.054] after 12 months, and $d = 0.06$ [95% CI 0.017, 0.094] after 18 months. Stopping participation was associated with a small impact of $d = 0.10$, (-0.102 [95% CI $-0.173, -0.031$]) in QALYs
Anxiety	Carnes et al. 2017	Reported a small effect size reported -0.13 [95% CI $-0.657, 0.176$] $p = 0.409, d = 0.13$
	Mercer et al. 2019	Reduction in anxiety by comparing participants who personally consulted the community-links practitioner more times (3 or more) $d = 1.38, (-1.38$ [95% CI $-2.34, -0.42$] $p = 0.005$ than those who consulted them once, $d = 0.77, -0.77$ [95% CI $-1.82, 0.28$] $p = 0.150$
	Kiely et al. 2021	Reported a better result after 3 months, representing a small effect, $d = 0.22$ (-0.22 [95% CI $-1.090, 0.652$] $p = 0.623$)
Depression	Carnes et al. 2017	Did not reveal a statistically significant difference, with a small effect size reported $d = 0.13$ (-0.13 [95% CI $-0.413, 0.176$] $p = 0.409$)
	Mercer et al. 2019	Reduction in depression by comparing participants who personally consulted the community-links practitioner more times (3 or more), with a large impact $d = 1.28$ (-1.28 [95% CI $-2.21, -0.35$] $p = 0.007$, than those who consulted them once, with a moderate impact $d = 0.5$ (-0.50 [95% CI $-1.47, 0.47$] $p = 0.314$)
	Kiely et al. 2021	Reported a better result after 3 months, representing a very small effect $d = 0.04$ (-0.04 [95% CI $-0.909, 0.829$] $p = 0.928$)
Well-being	Carnes et al. 2017	With a small effect size reported $d = 0.09$ [95% CI $-0.57, 0.39$] with no statistically significant

Table 3 (continued)

	Outcomes	Author name	Results
	Psychological and mental well-being	Poulos et al. 2019	The mean increase was 6.86 [95% CI 5.33–8.38] points on a paired samples t test ($t = 8.91$, $df = 104$, $p < 0.001$). There was a statistically significant increase in scores for participants who attended one or two courses, with 71.7% having an increase of three points or more. The effect size measure effects demonstrated a moderate to large effect of $d = 0.79$ [95% CI 0.52; 1.06] $p < 0.000$
Health-related behavior outcomes	Self-management	Carnes et al. 2017	Did not reveal a statistically significant difference, with a very small effect size reported $d = 0.02$ [95% CI -0.96 , 1.00]
	Patient activation measure	Kiely et al. 2021	Presented the baseline results, but the follow-up data not reported
Health-related economics evaluation	Capability measures adult	Mercer et al. 2019	Demonstrated no difference in ICECAP-A by comparing participants who personally consulted the community-links practitioner more times (3 or more) $d = 0.002$ [95% CI -0.04 , 0.04] $p = 0.909$ than those who consulted them once $d = 0.004$ [95% CI -0.04 , 0.05] $p = 0.841$
	Health care costs	Munford et al. 2020b	Cumulative effects on care costs were negative in each period: £ -96 (95% CI £ -512 to £321) at 6 months; £ -283 (95% CI £ -926 to £359) at 12 months; and £ -453 (95% CI £ -1366 to £461) at 18 months. The net benefit of starting to participate was £1956 (95% CI £209 to £3703) per participant at 18 months. Stopping participation was associated with a higher cost after 18 months £1335.33 (95% CI £112.85 to £2557.81)
	Number of visits to general practitioners	Carnes et al. 2017	The general practitioner consultation rate was significantly higher than in the control group before and after referral. In the median value of the consultation, the rate observed a drop in the median of the referral group, from ($M = 8.3$ (5.8–12.1) to ($M = 7.3$ (4.7–10.7)

NZPAQSF New Zealand Physical Activity Questionnaire Short Form; *QUALYS* Qualify-adjusted life years; *ICECAP-A* ICEpop CAPability measure for Adults); *MET* metabolic equivalent; Care costs calculated in British pound Sterling (£); Mean the effect size of asset participation as assessed by the difference in the standardized means, negative values result from the median of the intervention group being lower than the control group (when the effect size is negative, for the Cohen's d assessment it was considered positive); 95% confidence interval, % *PPI* posterior probability interval

education intervention was presented in five studies (Munford et al. 2020a, 2020b; Pescheny et al. 2019; Wildman and Wildman 2021; Williams et al. 2017), and self-care

management was presented in three (Carnes et al. 2017; Mercer et al. 2019; Wakefield et al. 2022). Other interventions, such as social support (Kiely et al. 2021; Wakefield

et al. 2022), religious support (Carnes et al. 2017; Munford et al. 2020a; Pescheny et al. 2019), and cultural activity (Carnes et al. 2017; Munford et al. 2020a, 2020b), were also observed (Table 2).

Social prescribing intervention categorization

Heterogeneous interventions were identified and assembled in seven of the nine social prescribing domains mentioned by Costa et al. (2021). Of the seven social prescribing domains, self-care education was divided into two distinct fields—self-care management and self-management education—and a new domain—social support—was included. The nine domains assigned were physical activity, art activities, social interaction, personal development, self-management education, self-care management, social support, and cultural and religious activities (Table 2). After categorization by domain, each domain was allocated according to the ICHI into two categories: *interventions on health-related behaviors*, which involve interventions related to accessing, promoting, and modifying behavior associated with a particular health condition; and *interventions on activities and participation domains* related to learning, applying knowledge, self-care, interpersonal interactions and relationships, and community, social and civic life (WHO 2021). The social prescribing domains of social interaction, art activities, social support, and cultural and religious activities were allocated to the *intervention on activities and participation domains*. The physical activity, personal development, self-care management, and self-management education domains were categorized as *interventions for health-related behavior*. Considering that physical, psychosocial, and relational needs are fundamental pillars of T2DM, the intervention of social prescribing was categorized according to the Integration of the Care dimension of *Fundamentals of Care Framework: Physical*: physical activities and self-care management; *Psychosocial*: self-management education, social support, and arts activities; and *Relational*: social interaction, personal development, and cultural and religious activities.

Social prescribing intervention outcomes

The impact of the social prescribing intervention resulted in different outcomes, which were grouped into three categories: health-related outcomes, health-related behavior outcomes, and health-related economics evaluation. The outcome was evaluated using questionnaires administered at the beginning of the intervention and during the follow-up period (between 6, 8, 12, 18, 24–36, and 96 months) (Table 2). Owing to methodological and clinical heterogeneity, with $I^2 = 97\%$, it was not possible to carry out a meta-analysis. A subsequent subgroup meta-analysis was carried

out for the following outcomes: anxiety, depression, HbA1c, and body weight, with an $I^2 = 0\%$.

Health-related outcomes

The *health-related outcomes* considered were social, psychological, and mental well-being; anxiety; quality of life; quality-adjusted life years; physical activity; HbA1c; total cholesterol; waist circumference; and weight. Regarding quality of life, quantitative and qualitative data from six social prescribing programs revealed an increase in quality of life, with a small effect size (Kiely et al. 2021; Mercer et al. 2019; Munford et al. 2020a, 2020b; Wakefield et al. 2022; Williams et al. 2017) (Table 3). An improvement in quality of life was associated with a greater number of contacts with the linked worker, three or more contacts with a very small effect ($d = 0.07$ [95% CI 0.02, 0.13] $p < 0.011$), a length of the follow-up period with a small effect ($d = 0.36$ [95% CI 0.28, 0.44]) and an environmental domain with a small to moderate effect size ($d = 0.45$ [95% CI 0.39, 0.52] $p < 0.000$).

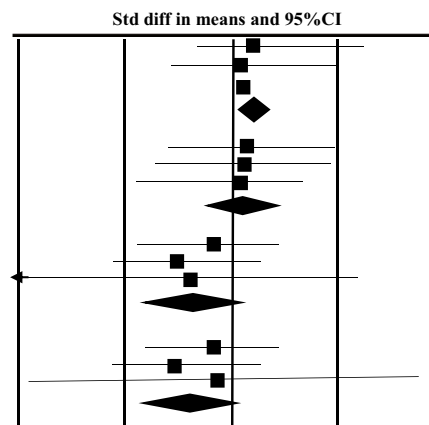
Psychological or mental well-being was referred to in three studies in which positive feelings were reported (Poulos et al. 2019; Wakefield et al. 2022; Williams et al. 2017), with a moderate effect size (Poulos et al. 2019), and social well-being was associated with a decline in social isolation (Poulos et al. 2019). Anxiety and depression were reported in three studies (Carnes et al. 2017, Kiely et al. 2021, Mercer et al. 2019), with an $I^2 = 0\%$. On the basis of the homogeneity displayed, a subgroup meta-analysis of anxiety and depression outcomes was conducted and revealed small effect sizes ($d = 0.19$ [95% CI 0.0145, 0.044] $p = 0.006$ and $d = 0.17$ [95% CI 0.403, 0.057] $p = 0.114$) for both outcomes. When the levels of anxiety and depression were compared with the number of times (three or more times) the person consulted the linked worker, they revealed an increase in the effect on the results (Table 3).

Four studies showed that there is a growth in physical activity levels and a decrease in a sedentary lifestyle (Hamlin et al. 2016; Mercer et al. 2019; Pescheny et al. 2019; Williams et al. 2017). Age and work status were reported to have a negative effect on physical activity (Pescheny et al. 2019) and consulting a linked worker three or more times had a small effect on physical activity ($d = 0.34$ [95% CI 0.07, 0.61], $p = 0.013$) (Mercer et al. 2019).

In terms of HbA1c, there was a modest reduction, with a very small effect size reflected by the subgroup meta-analysis $d = 0.07$ [95% CI 0.021, 0.109], $p = 0.004$ (Wildman and Wildman 2021; Williams et al. 2017) (Table 4). A slight increase in the impact can be observed when analyzing the face-to-face mode, but with no statistical significance (Williams et al. 2017). The same effect can be seen in the decrease in body weight (Williams et al. 2017). Waist

Table 4 Effects size of health-related outcomes

Study Name	Outcome	Std diff in means	Standard error	Lower limit	Upper Limit	p-Value
Williams et al, 2017	HbA1C	0.20	0.042	-0.205	0.597	0.338
Face to Face		0.05	0.050	-0.384	0.493	0.808
Telephone		0.06	0.023	0.019	0.108	0.005
Pooled		0.07	0.023	0.021	0.109	0.004
Williams et al, 2017	Body Weight	0.08	0.20	-0.320	0.481	0.694
Face to Face		0.06	0.21	-0.361	0.478	0.784
Telephone		0.03	0.17	-0.303	0.363	0.861
Pooled		0.05	0.11	-0.166	0.271	0.636
Carnes et al, 2017	Anxiety	-0.13	0.16	-0.431	0.176	0.409
Mercer et al, 2019		-0.27	0.20	-0.657	0.113	0.166
Kiely et al, 2021		-0.22	0.44	-1.090	0.652	0.623
Pooled		-0.19	0.12	-0.415	0.044	0.114
Carnes et al, 2017	Depression	-0.13	0.16	-0.413	0.176	0.409
Mercer et al, 2019		-0.27	0.20	-0.657	0.113	0.166
Kiely et al, 2021		-0.04	0.44	-0.909	0.829	0.928
Pooled		-0.17	0.12	-0.403	0.057	0.140



Standardized difference means; 95% confidence interval

circumference and total cholesterol have also been reported to have a small effect, but the phone approach had a greater effect on decreasing total cholesterol (Table 3). A gain in years of life was revealed throughout a longer follow-up period, and a stop in community asset participation revealed a decrease in quality-adjusted life years with a small impact (Munford et al. 2020b).

Health-related behavior outcomes

Health-related behaviors were categorized as follows: self-management (patient measure activation) and patient engagement (active engagement in life score). Self-management was reported in two studies, with suggested improvements in self-care and condition management (Kiely et al. 2021; Wildman and Wildman 2021). Related active engagement in life scores revealed better engagement through linked worker intervention, intending to facilitate the understanding of needs, and coaching lifestyle interventions that promote self-management of life skills and health conditions, with no reported statistical significance (Carnes et al. 2017) (Table 3). Other studies have shown personal growth and empowerment (Pescheny et al. 2019), with an

increase in self-confidence and self-determination (Poulos et al. 2019).

Health-related economics evaluation

For *health-related economics*, evaluations were assigned according to capability measures for adults (ICECAP-A), number of visits to general practitioners, and healthcare costs. The adult capability measure did not show an effect size when related to the number of views of the linked worker. Healthcare costs continued to rise throughout the follow-up period. Discontinuing participation in the program was found to have a small impact on costs after 18 months of follow-up (Munford et al. 2020b) (Table 4). A decrease in the number of visits to the general practitioner was identified when comparing the data of the control group before the start and after the course of the intervention (Carnes et al. 2017).

Quality appraisal

All eligible studies were critically analyzed using methodological assessment tools. The risk of bias was determined

Fig. 2 Risk of bias assessment of randomized controlled trials, *Cochrane Risk of Bias Assessment Tool* (RoB 2)

	Mercer et al, 2019	Williams et al, 2017
Arising from randomized process	+	+
Deviations from the intended interventions	+	+
Missing outcome data	!	!
Measurement of the outcome	+	+
Selection of the reported result	+	+
Overall	!	!

+ Low risk ! Some concerns - High risk

Table 5 Risk of bias assessment of non-randomized controlled trials, *Cochrane Risk of Bias Assessment Tool (ROBINS-I)*

	Kiely et al. 2021
Bias due to confounding	Serious
Bias in selection of participants into the study	Serious
Bias in classification of interventions	Serious
Bias due to deviations from intended interventions	Low
Bias due to missing data	Serious
Bias in measurement of outcomes	Serious
Bias in selection of the reported result	Moderate
Overall bias	Serious

according to the study design: randomized controlled trial (Fig. 2), nonrandomized controlled trial (Table 5), mixed methods study (Table 6), cohort study (retrospective and prospective) (Table 7), and observational study (longitudinal, observational noncontrolled before and after study) (Table 8).

Analysis of the included studies revealed significant concerns regarding their methodologies. A quality appraisal using a risk of bias assessment indicated a “high” level of bias in these studies. Several issues arose, including a considerable drop-out of participants from the initial phases to the follow-up periods in most of the studies (Carnes et al. 2017; Kiely et al. 2021; Hamlin et al. 2016; Munford et al. 2020a, 2020b; Pescheny et al. 2019; Wakefield et al. 2022;

Wildman and Wildman 2021). Furthermore, four studies reported a reduced number of participants (Kiely et al. 2021; Munford et al. 2020a; Pescheny et al. 2019; Poulos et al. 2019), potentially compromising the representativeness of the sample and thereby affecting the generalizability of the findings.

In addition, the analysis highlighted another significant concern, missing data, which impeded the coherence of the studies. Specifically, comprehensive information related to the clear description of various interventions and outcome measures was lacking, diminishing the overall clarity and coherence of the research findings.

Discussion

The analysis of 11 papers in this systematic literature review sought to identify social prescribing interventions for people with T2DM and analyze their impact on producing health, behavioral, and economic outcomes. Nine domains of social prescribing intervention were assigned in the production of outcomes. Social prescribing intervention carried out face-to-face, over longer periods, and with regular contact with the linked worker, showed the greatest impact. The effect of the social prescribing intervention on health-related outcomes was more noticeable than on behavioral or economic outcomes, such as improved quality of life, well-being, reduced anxiety and depression, increased physical

Table 6 Risk of bias assessment of mixed method study, (adapted from an assessment tool developed by the US National Heart, Lung, and Blood Institute)

	Carnes et al. 2017
1. Study described as randomized, a randomized trial, a randomized clinical trial, or an RCT?	No
2. Method of randomization adequate (i.e., use of randomly generated assignment)?	No
3. Treatment allocation concealed (so that assignments could not be predicted)?	No
4. Study participants and providers blinded to treatment group assignment?	No
5. People assessing the outcomes blinded to the participants' group assignments?	No
6. Groups similar at baseline on important characteristics that could affect outcomes (e.g., demographics, risk factors, comorbid conditions)?	No
7. Overall drop-out rate from the study at endpoint 20% or lower of the number allocated to treatment?	No
8. Differential drop-out rate (between treatment groups) at endpoint 15% points or lower?	No
9. Was there high adherence to the intervention protocols for each treatment group?	No
10. Other interventions avoided or similar in the groups (e.g., similar background treatments)?	Yes
11. Outcomes assessed using valid and reliable measures, implemented consistently across all study participants?	Yes
12. Authors report that the sample size was sufficiently large to be able to detect a difference in the main outcome between groups with at least 80% power?	No
13. Outcomes reported, or subgroups analyzed prespecified (i.e., identified before analyses were conducted)?	NR*
14. All randomized participants analyzed in the group to which they were originally assigned, i.e., did they use an intention-to-treat analysis?	No
Quality rating	Poor

*NR, not reported

Table 7 Risk of bias assessment of cohort study (adapt from an assessment tool developed by the US National Heart, Lung, and Blood Institute)

	Hamlin et al. 2016	Munford et al. 2020b	Wildman and Wildman 2021
1. Research question or objective in this paper clearly stated?	Yes	Yes	Yes
2. Study population clearly specified and defined?	Yes	Yes	Yes
3. Participation rate of eligible persons at least 50%?	Yes	Yes	Yes
4.1 All subjects selected or recruited from the same/similar populations?	Yes	Yes	Yes
4.2. Inclusion/exclusion criteria prespecified and applied uniformly to all participants?	NR*	NR*	NR*
5. Sample size justification, power description, or variance and effect estimates provided?	Yes	Yes	Yes
6. Analyses were the exposure(s) of interest measured prior to the outcome(s) being measured?	Yes	Yes	Yes
7. Timeframe sufficient to see an association between exposure and outcome?	Yes	Yes	Yes
8. Study examined different levels of the exposure as related to the outcome?	Yes	Yes	Yes
9. Exposure measures clearly defined, valid, reliable, and implemented consistently across all study participants?	Yes	Yes	Yes
10. Exposure(s) assessed more than once over time?	No	Yes	Yes
11. Outcome measures, clearly defined, valid, reliable, and implemented consistently across all study participants?	Yes	Yes	Yes
12. Outcome assessors blinded to the exposure status of participants?	NR*	Yes	No
13. Loss to follow-up after baseline 20% or less?	No	No	NR*
14. Key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?	NR*	Yes	Yes

*NR not reported

Table 8 Risk of bias assessment of observational studies (longitudinal, observational non-controlled before and after study) (adapt from an assessment tool developed by the US National Heart, Lung, and Blood Institute)

	Munford et al. 2020a	Pescheny et al. 2019	Poulos et al. 2019	Wakefield et al. 2022
1. Study question or objective clearly stated?	Yes	Yes	Yes	Yes
2. Eligibility/selection criteria for study population specified and clearly described?	Yes	NR*	Yes	Yes
3. Participants are representative of those who would be eligible for test/service/intervention in the general or clinical population of interest?	Yes	No	No	Yes
4. All eligible participants that met the prespecified entry criteria enrolled?	NR*	NR*	NR*	NR*
5. Sample size sufficiently large to provide confidence in the findings?	Yes	Yes	No	Yes
6. Test/service/intervention clearly described and delivered consistently across the study population?	No	No	No	No
7. Outcome measures prespecified, clearly defined, valid, reliable, and assessed consistently across all study participants?	Yes	Yes	Yes	Yes
8. People assessing the outcomes blinded to the participants' exposures/interventions?	Yes	No	No	Yes
9. Loss to follow-up after baseline 20% or less? Were those lost to follow-up accounted for in the analysis?	No	NR*	No	No
10. Statistical methods examine changes in outcome measures from before to after intervention? Were statistical tests done that provided values for the pre-to-post changes?	Yes	Yes	Yes	Yes
11. Outcome measures of interest taken multiple times before intervention and multiple times after intervention?	No	No	No	Yes
12. Intervention was conducted at a group level, did the statistical analysis take into account the use of individual-level data to determine effects at the group level?	NA*	NA*	NA*	NA*

*NR - not reported; NA - not applicable

activity, reduced HbA1c levels, weight, and abdominal circumference. Similar to the difficulties mentioned in another study (Carnes et al. 2017), during the analysis and narrative synthesis of the data from the papers under review, it was observed that the qualitative data was sometimes able to better translate the impact of the social prescription intervention than the quantitative data (Carnes et al. 2017). This difficulty can be attributed to the heterogeneity of the social prescribing intervention and the instruments used to measure the results (Carnes et al. 2017; Sonke et al. 2023; Thomas et al. 2021).

Main findings social sociodemographic and socioeconomic characteristics

Individual characteristics of each participant, such as problems related to mobility concerns (poor balance), fear of failure, limitations in walking distance and inability to stand for long periods, poor vision, and hearing (Poulos et al. 2019), and older age (Munford et al. 2020a, 2020b), were related to social prescribing program dropout and negative results in physical activities (Pescheny et al. 2019). The group of working people was identified as those who found it most difficult to practice physically (Munford et al. 2020b), and the time when the interventions were carried out, after or before work, or on weekends was mentioned as a facilitating factor (Munford et al. 2020b). The socioeconomic deprivation context emphasizes limited access to resources, such as appropriate diet, medication, and exercise opportunities, while reducing self-efficacy by creating barriers to self-care management (Carnes et al. 2017; Hamlin et al. 2016; Kiely et al. 2021; Wakefield et al. 2022; Wildman and Wildman 2021).

Main findings in social prescribing intervention

Different approaches were identified, beginning with primary healthcare and continuing activities in the community. Some of them revealed many clinical and nonclinical professionals involved in programs, with people reporting difficulty distinguishing the role of each (Carnes et al. 2017). As identified in five studies (Mercer et al. 2019; Hamlin et al. 2016; Poulos et al. 2019; Wakefield et al. 2022; Williams et al. 2017), nurses are recognized as health professionals who are becoming increasingly involved in social prescribing and assume an important role in social prescribing programs (McKenzie et al. 2021). They are considered health professionals with the ability to assess a person's needs and identify psychosocial problems with an impact on self-care and diabetes mellitus control more easily (Donohue-Porter 2012; Kenkre and Howarth 2018; Nikitara et al. 2019). It plays a major role in social prescribing, supporting people in

achieving desired goals (Kenkre and Howarth 2018; Nikitara et al. 2019).

The face-to-face approach had an impact on people's knowledge of needs from the first visit, with a higher rate of adherence to the program and a greater reduction in HbA1c compared to the telephone-based approach (Williams et al. 2017). Longer programs have shown better results (Mercer et al. 2019; Kiely et al. 2021; Williams et al. 2017), and those who consulted linked workers more often had a better quality of life and improvements in anxiety, depression, and self-reported exercise (Carnes et al. 2017; Mercer et al. 2019).

Heterogeneous interventions were identified and assembled in nine social prescribing domains that can be developed in the community to support behavioral change by connecting patients with their activities and providing interpersonal support and motivation (Munford et al. 2020a). The following social prescribing program involves the three fundamental needs of the Fundamentals of Care Framework (Williams et al. 2017), and others direct their intervention to specific needs dimensions. Physical engagement can have a positive impact on self-care, condition management (Kiely et al. 2021; Wildman and Wildman 2021), and decreasing HbA1c (Wildman and Wildman 2021; Williams et al. 2017). The potential for growth and integrated physical activity in inactive persons has been demonstrated, with significant results in weight management, waist circumference reduction, and glycemic control (Pescheny et al. 2019; Williams et al. 2017). Self-care management intervention improves the patient's condition through information and education and empowers the person to manage their illness (Bhuyan 2004). In the psychosocial dimension, art activities lead to a rise in physical levels, a sense of purpose and direction, personal growth, empowerment, and interaction, and the establishment of a relationship with others, which contributes to psychological and mental well-being (Poulos et al. 2019). Social support intervention contributes to the self-management of T2DM and clinical outcomes (Garizábal-Dávila et al. 2021; van Dam et al. 2005). Self-management education is considered a significant contributor to new learning, knowledge, and skills that promote long-term and positive health outcomes (Haas et al. 2013). In a qualitative follow-up study, individuals reported confidence and an improved ability to self-manage their disease condition (Wildman et al. 2019). In the relational dimension, social interaction creates an opportunity to engage patients in open decision-making through community assets, which leads to a better quality of life and personal relationships that allow the person to feel more integrated into their community (Munford et al. 2020a; Wakefield et al. 2022). Personal development involves the person in a dynamic process, engaging in their own life with an increase in self-esteem and a sense of purpose (Yardley et al. 2015).

Most of the programs encompass several domains of social prescribing, with no discernible variation in the development of the intervention or the associated outcomes. The lack of an evaluation of individual results according to each intervention, and the results are seen as an outcome of the entire program, poses challenges in identifying the effectiveness of the individuality of each intervention.

Main finding outcomes

HbA1c recognized as a marker of glycemic control and as an important indicator for metabolic control and diabetes management (ADA 2020; Genis-Mendoza et al. 2022; Wildman and Wildman 2021) was reported in two studies, with a slight decrease and a small effect (Wildman and Wildman 2021; Williams et al. 2017). Obesity and the accumulation of visceral fat with increased abdominal circumference are related to increased cardiovascular risk and the development of non-communicable diseases such as T2DM (Powell-Wiley et al. 2021; Rothberg et al. 2017). Considering the predictors of worsening metabolic control in T2DM patients and/or the occurrence of associated complications. Previous studies in recent decades have shown that reducing weight and abdominal circumference is associated with improvements in T2DM control, with reductions in blood glucose, cholesterol levels, and blood pressure (Genis-Mendoza et al. 2022; Rothberg et al. 2017). The social prescribing intervention in this systematic review showed a small effect on reducing weight and abdominal circumference.

Quality of life, as a health-related outcome, was one of the outcomes that was the focus of interest in most social prescribing programs and the one that showed results in different studies (Mercer et al. 2019; Kiely et al. 2021; Munford et al. 2020a, 2020b; Wakefield et al. 2022; Williams et al. 2017). Quality of life was analyzed in four domains (Munford et al. 2020a). Environment quality of life: a person feels more physically safe and secure, has a positive perception of their physical environment, and has positive feelings. Psychological quality of life includes more self-esteem, better body image, and better appearance. Physical quality of life includes more energy, better sleep, greater mobility, less pain and discomfort, and social quality of life, as well as better personal relationships and fewer negative feelings (Munford et al. 2020a). The greatest improvement in quality of life was revealed in the environmental domain, followed by the psychological, physical, and social domains (Munford et al. 2020a). A positive effect and statistically significant quality of life were revealed with community asset participation, and its discontinuation led to a decrease in quality of life and quality-adjusted life years (Munford et al. 2020b). The number of group members was also described as a positive predictor of quality of life over time (Wakefield et al. 2022).

Psychological well-being is associated with health behaviors, such as greater physical activity, a healthy diet, better glucose levels, and lower levels of HbA1c (Yi et al. 2008; Boehm et al. 2015; Huffman et al. 2015). Social prescribing interventions have been reported to have a moderate impact on mental health in terms of self-confidence, self-determination, personal achievement, and growth (Poulos et al. 2019; Wakefield et al. 2022), which allows people with T2DM to better manage and control their disease. Social well-being has also increased with a reported sense of purpose and direction, finding a new interest, and feeling motivated and optimistic for a new stage in one's life (Poulos et al. 2019; Wakefield et al. 2022). Lonely people tend to receive routine primary healthcare and may use this care as a source of much-needed social connections (Poulos et al. 2019). Social prescribing programs can promote a rich social environment that allows people to feel more integrated into their communities, establish connections, and establish relationships with others (Poulos et al. 2019; Wakefield et al. 2022), as well as with a sense of community belonging (Kiely et al. 2021; Wakefield et al. 2022). It is recognized as having the potential to promote behavioral change and support people in accessing and developing activities in the community that promote engagement in one's self-condition and improvements in self-management (Hamlin et al. 2016; Kiely et al. 2021; Wildman and Wildman 2021). Depressive symptoms and anxiety are frequently identified in people with T2DM and are related to poorer glycemic control, reduced quality of life, increased complications, and a greater mortality rate. The data analyzed from the subgroup meta-analysis of these outcomes suggest that intervention of social prescribing can play an important role in reducing these symptoms. Health literacy was not an outcome evaluated in any paper. However, Wildman and Wildman (2021) and Williams et al. (2017) highlight the importance of improving health literacy by understanding individuals in their communities to improve communication. They reflect the importance of developing holistic interventions, involving education, self-care, and behavior change support to empower the person with individual knowledge and skills (Wildman and Wildman 2021; Williams et al. 2017); however, they do not analyze this data. Regarding costs, the studies analyzed are not unanimously revealing through the analyses of quantitative data an increase in general practitioner visits, but qualitative data revealed a reduction in rates for the baseline to follow-up period (Carnes et al. 2017). Supported by a recent study, there is a lack of economic evaluation of social prescribing and more research is needed to evaluate the economic impact (Kiely et al. 2022). Another study throughout the follow-up period showed a reduction in the total costs of healthcare and that stopping community activity participation led to a large significant increase in healthcare costs (Munford et al. 2020b).

Strengths and limitations of the review

This systematic literature review employed a rigorous and quality methodology, meticulously analyzing the risk of data bias based on each study's design. This study provides a comprehensive summary of the diverse domains of social prescribing interventions in primary healthcare for T2DM patients, detailing their potential impacts on health, behavior, and economic costs. Additionally, this review synthesizes key evidence-based barriers, such as individual characteristics, comorbidities, and socioeconomic contexts, that influence the feasibility, adherence, and acceptance of future interventions.

However, the review also acknowledges several limitations: a limited number of studies exclusively focused on T2DM patients; a lack of clear information about the measured outcomes and their specific interventions; higher drop-out rates due to engagement difficulties; a high risk of bias in quality appraisal; and a scarcity of studies analyzing the economic cost-effectiveness of social prescribing interventions. These limitations underscore the need for more targeted research in these areas, particularly to enhance the understanding of the economic impacts of social prescribing and to improve engagement strategies in T2DM management.

Conclusion

This systematic review of the literature allows us to look at social prescribing and its effectiveness in achieving outcomes that respond to better management and self-care of diabetes and prevent future complications. This systematic review highlights social prescribing as a health intervention in different domains. Owing to their heterogeneity, the understanding and integration of these domains in the design of future social prescribing interventions are considered fundamental to achieving results-oriented objectives. With a suggested reduction in the number of general practitioner visits and lower expenditure on health resources in the long term, social prescribing could be a possible sustainable approach in health systems with an impact on a person's quality of life and well-being. However, there remains a need to develop studies that improve the evidence supporting the results of economic evaluation and that support the effectiveness of social prescribing interventions.

Implication for practice and research

For further studies to promote better personal engagement in program participation and monitoring during the process, it is important to consider the barriers and limitations of sociodemographic and socioeconomic characteristics that can be imposed. It is considered important to delve deeper

into the complexity of social prescribing interventions and their effects on people's behavior, well-being, and quality of life, as these actions will allow for a better translation of the quality of the evidence and an understanding of the individual contributions of each intervention. Social prescribing programs developed in socioeconomic areas are necessary to create equal opportunities for T2DM patients and thus promote equity in healthcare. On the basis of the findings of this systematic literature review, we propose to contribute to the importance of examining social prescribing interventions as a connection between community and primary healthcare, which may play a crucial role in controlling the complications associated with T2DM and its evolution in the future.

Abbreviations *HbA1C*: hemoglobin A1C; *ICHI*: International Classification of Health Intervention; *T2DM*: type 2 diabetes mellitus

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Authors' contribution DO, AC, and AH were involved in the study design and literature review conception. AC and AH supervised the search strategy, extracted the data, and assessed the quality of the evidence. DO contributed to the previous draft manuscript and narrative analysis synthesis. DO, AC, AH, and PN performed a critical study review and participated in the final manuscript. All the authors read and accepted the review for submission.

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Declarations

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