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Systematic Review Or Meta-Analysis

Effectiveness of psychosocial interventions for the prevention and treatment of foot ulcers in people with diabetes: a systematic review

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Abstract

Aim To identify and synthesize the evidence for the effectiveness of psychosocial interventions to promote the healing, and/or reduce the occurrence of, foot ulceration in people with diabetes.

Methods In March 2019 we searched CENTRAL, Medline, Embase and PsycInfo for randomized controlled trials of interventions with psychosocial components for people with diabetes. The primary outcomes of this review were foot ulceration and healing. We assessed studies using the Cochrane risk-of-bias tool, the TIDieR checklist and GRADE. We conducted narrative synthesis and random-effects meta-analysis.

Results We included 31 randomized controlled trials (4511 participants), of which most (24 randomized controlled trials, 4093 participants) were prevention studies. Most interventions were educational with a modest psychosocial component. Ulceration and healing were not reported in most studies; secondary outcomes varied. Evidence was of low or very low quality because of high risks of bias and imprecision, and few studies reported adherence or fidelity. In groups where participants had prior ulceration, educational interventions had no clear effect on new ulceration (low-quality evidence). Two treatment studies, assessing continuous pharmacist support and an intervention to promote understanding of well-being, reported healing but their evidence was also of very low quality.

Conclusion Most psychosocial intervention randomized controlled trials assessing foot ulcer outcomes in people with diabetes were prevention studies, and most interventions were primarily educational. Ulcer healing and development were not well reported. There is a need for better understanding of psychological and behavioural influences on ulcer incidence, healing and recurrence in people with diabetes. Randomized controlled trials of theoretically informed interventions, which assess clinical outcomes, are urgently required. (PROSPERO registration: CRD42016052960).

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Introduction

Diabetes mellitus is an increasingly common condition that is expected to affect more than 578 million people globally by 2030 [1]. Success in treating diabetes has improved the life expectancy of those affected; however, increased prevalence, coupled with the extended time people live with diabetes, has led to increased numbers of diabetes-related complications, including foot ulceration (defined as a wound that extends through the full thickness of the skin below the level of the ankle, irrespective of duration) [2]. Foot ulceration is reported to affect 15–25% of people with diabetes at some time in their lives and people with both type 1 and type 2 diabetes are affected [3–5]. UK surveys estimate that approximately 1–4% of people with diabetes have foot ulcers at any given time [6,7]; a 2008 US prevalence estimate was 8% amongst people with diabetes receiving Medicare [8].

Foot ulcers in people with diabetes have a serious impact on health-related quality of life [9–11], and the cost of treatment for diabetic foot ulceration to the National Health Service (NHS) in England was estimated at £837m to £962m in 2014–2015 [12]. Economic impact is high in terms of personal costs

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What's new?

- Foot ulcers in people with diabetes are associated with high levels of morbidity, and have been linked to multiple psychosocial factors.
- Despite identifying 31 randomized controlled trials (4511 participants) we found only low-quality evidence for a range of psychosocial interventions; there were no clear effects on ulceration or ulcer healing. Reporting of key outcomes and intervention characteristics was limited.
- Our review highlights the lack of reliable evidence to inform clinical practice and the need for adequately powered, rigorously designed studies to assess theoretically informed psychosocial interventions for clinical outcomes such as ulcer incidence, recurrence, healing and ulcer-free time.

to patients and carers, including lost work time and productivity [13]. The long-term impact can be severe; up to 85% of foot-related amputations are preceded by ulceration [14,15], and people with diabetes have a 10–20-fold higher risk of non-traumatic lower limb amputation than those without diabetes [16,17]. Following amputation, risk of death in the next 5 years is high, >40% in one cohort study [18].

A meta-analysis of control groups from trials in which participants with diabetic foot ulceration received good wound care reported that 24% of ulcers healed completely by 12 weeks and 31% by 20 weeks [19]; however, the risk of re-ulceration can be up to 70% over 5 years [20–23].

Risk of ulceration and the time taken for an ulcer to heal are probably influenced by many factors along causal pathways with complex inter-relationships [24,25]. Adverse psychosocial factors may affect pathophysiological processes or impact on lifestyle factors such as smoking (thereby affecting tissue perfusion) or may influence the effectiveness of diabetes treatments and self-management behaviours, eventually leading to poorer foot outcomes [26–31]. Psychosocial interventions, which are intended to interrupt these pathways, may therefore depend on multiple mechanisms for any effects on ulcer development and healing. An intervention that primarily addresses depression may indirectly operate through an effect on foot care [32] and general self-care behaviours, and physical activity [30,33], as well as acting in a direct physiological way [30,34]. Direct and indirect effects may not be independent and it is important to consider the multicomponent nature of both treatments and their potential effects.

The aim of the present review was to identify and summarize the existing evidence for the effectiveness of psychosocial interventions that seek to promote the healing, and/or reduce the occurrence of, foot ulceration in people with diabetes.

Methods

The full methods are reported in the protocol [35].

We included randomized controlled trials (RCTs) involving participants with type 1 or type 2 diabetes with or without active foot ulceration if they assessed any individual or group psychological, behavioural or social intervention alone or in combination (e.g. cognitive behavioural therapy, motivational interviewing, counselling, psychological therapy, social support, mindfulness). We included cluster-randomized trials (where groups of participants were randomly allocated at the group level, e.g. attendees at a particular clinic), but excluded quasi-randomized studies (i.e. where allocation was based on a non-random method such as alternation). We included studies of exercise or educational interventions, provided the intervention was more than printed materials and had a psychosocial component. We considered any comparator to be eligible, including alternative interventions, usual care and no treatment.

Primary outcomes were complete healing and ulceration. Secondary foot-related outcomes were rate of wound healing, amputation, standardized diabetic foot ulceration risk assessments, foot-care knowledge or behaviours, and foot-related adverse events. Studies had to report a foot-related outcome to be included. We also assessed: mortality; non-foot-ulcer-related adverse events; general and diabetes-related health behaviours and indicators; social activity/participation; psychological outcomes (e.g. depression, anxiety and stress); and health-related quality of life, reported using validated scales or disease-specific questionnaires.

We searched the Cochrane Central Register of Controlled Trials (CENTRAL); Ovid MEDLINE (from 1946); Ovid EMBASE (from 1974) and PsycINFO (from 1967) without restrictions in March 2019 (see Appendix S1). We searched bibliographies of included studies, systematic reviews, guidance or health technology assessments In addition, three clinical trial registries were searched for ongoing and completed studies (ClinicalTrials.gov, the WHO International Clinical Trials Registry and the EU Clinical Trials Register).

Two researchers independently screened records at each stage. Studies that were considered to be potentially eligible on the basis of title and abstract were obtained as full papers; studies which were clearly not an RCT, were not an evaluation of a potentially relevant intervention or did not include a diabetes population were not further evaluated. One researcher extracted data and a second researcher checked. Where necessary, we attempted to contact authors or obtained translations. We assessed risk of bias using the Cochrane tool [36,37], and completeness of intervention reporting using the Template for Intervention Description and Replication (TIDieR) checklist [38]. We performed GRADE (Grading of Recommendations Assessment, Development and Evaluation) assessment for each comparison and outcome [39]; this classifies evidence as high, moderate, low or very low quality, which relates directly to the uncertainty with which decision makers should regard evidence [40].

Studies were combined using narrative synthesis according to intervention type and population targeted. Where clinically appropriate, we pooled data in random-effects meta-analyses. Where possible we reported or calculated hazard ratios (HRs) [41–43] or risk ratios (RRs). For continuous outcomes we used mean differences. In each case we calculated 95% CIs. Heterogeneity was assessed using I^2 statistics and visual inspection. We were unable to conduct a planned funnel plot analysis because of an insufficient number of studies.

Results

We included 31 studies (35 records) that enrolled 4511 people [references S1–S31]. We also identified 11 ongoing studies [S32–S42].

We screened 9832 records [2940 from database searches, 5408 identified for a companion review (Westby *et al.*, submitted for publication, 2020) or prior scoping work, and 1485 from trial registers and references; Fig. 1]. A list of 127 excluded full-text studies is available on request.

Characteristics of studies

Twenty-four studies assessed interventions for preventing ulceration (4451 participants) [S1–S3,S5,S7–S12,S14–S18, S20–S22,S25–S27,S29–S31]. Seven studies assessed interventions for treating ulceration in people with existing diabetic foot ulcers (418 participants) [S4,S6,S13,S19,S23,S24,S28].

Sixteen studies had inclusion criteria which either specified only an absence of risk factors or did not specify risk level [S1,S2,S5,S8–S10,S12,S15–S18,S25,S26,S29–S31]. Four studies enrolled only participants with previous ulceration [S7,S11,S21,S27] and four enrolled both people with and without prior ulceration [S3,S14,S20,S22].

Sample sizes ranged from 13 to 530 (Table S1). Two studies were cluster-randomized trials [S29,S31]. Most participants had type 2 diabetes (often 100%), and mean ages ranged from 44 to 70 years. Overall 48% of participants were male, but this proportion was higher in people with current or prior ulceration. Studies were conducted across 15 high- and middle-income countries. Only one prevention study enrolled outpatients [S17]; most treatment studies enrolled inpatients [S4,S6,S19,S23,S28]. Most studies enrolled participants who reflected the clinical population from which they were drawn; exclusion criteria tended to be restricted to ensuring the linguistic and cognitive ability to understand the intervention.

Interventions were diverse but with some common approaches. Many involved some element of foot care education [S1–S5,S7,S8,S10–S12,S14–S18,S20,S22,S23,S25, S26,S28–S30]. A strong educational focus was particularly a feature of prevention studies. Psychological approaches were

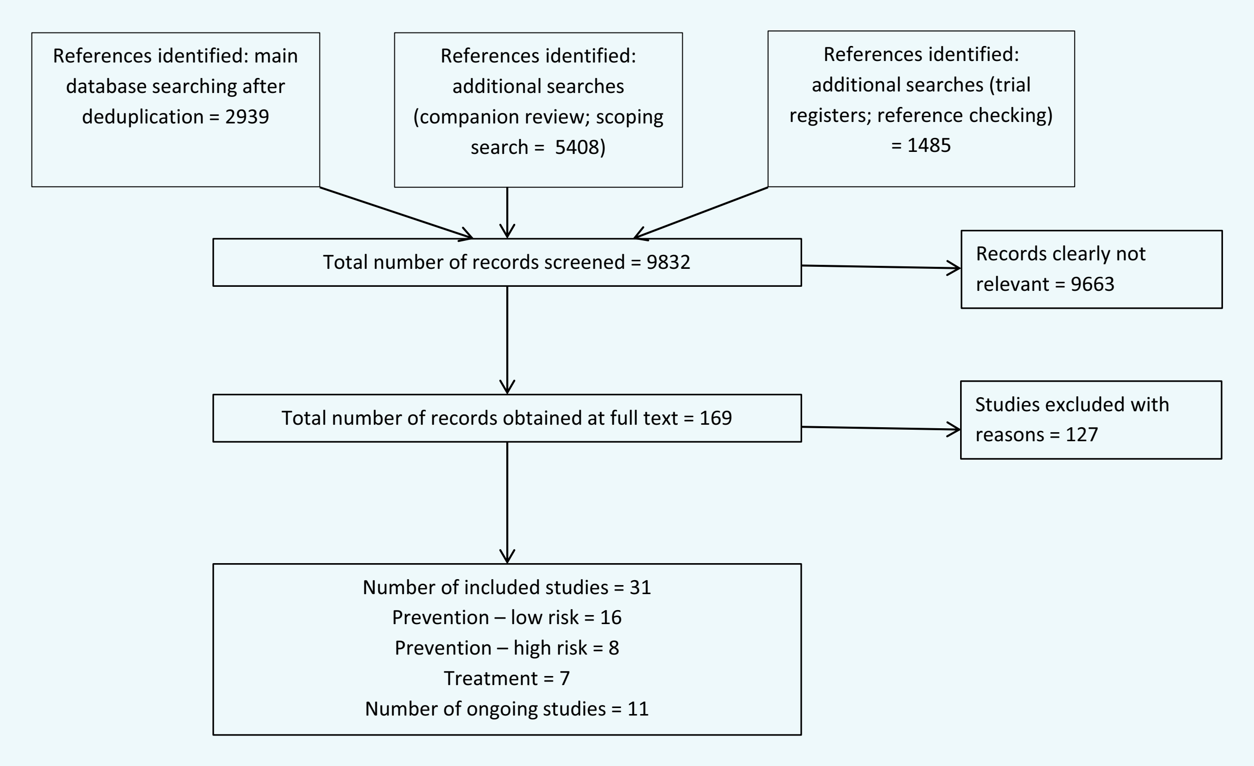

FIGURE 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram for review of psychosocial interventions for preventing or treating diabetic foot ulcer.

more common in treatment studies [S6,S13,S19,S24]. All interventions involved face-to-face sessions; some also used telephone, postal or SMS contacts. Interventions were evenly divided between small group and individual delivery. Intensity and duration varied greatly, from single sessions to multiple sessions over several years. Most were delivered by healthcare practitioners, usually nurses. The most common venue was an outpatient clinic (which would be normally attended by the participants), followed by an inpatient clinic or participants' homes. Some studies had multiple components, e.g. an initial group clinic session followed by home visits. Follow-up ranged from 30 days to 10 years and was longer in prevention studies. Most studies used comparators of 'usual care' or 'standard care', while a minority assigned participants to an alternative intervention. In many instances the usual/standard care included some elements of the intervention, typically in provision of education.

Many studies focused on behavioural, knowledge and psychological outcomes. Only nine of 24 prevention studies reported ulceration [S3,S7,S8,S10,S11,S14,S17,S21,S22] and only two of seven treatment studies reported complete healing [S6,S24]. Seven studies reported amputation [S8, S10–S12,S14,S19,S22] and three reported mortality [S11, S14,S22]. Outcome data are summarized in Tables S2 and S3. We focus on studies that reported review primary outcomes and studies that enrolled people with current or prior ulceration.

Reporting and quality of evidence

The quality of methods and reporting were suboptimal in all studies (Tables S4 and S5). Many studies had high risks of important biases, in particular detection bias (unblinded outcome assessment) and attrition bias (randomized participants absent from analyses). All except two studies had several unclear risks of bias, so we were uncertain about their true risk of bias (Table S4). All effect estimates were imprecise, with wide CIs based on low participant and event numbers. All evidence was therefore of low or very low quality [39]; we note where evidence is very low quality. We were unable to use a funnel plot to assess the possibility of publication bias because of the low number of studies in our meta-analysis, however, we found no evidence of publication bias more generally (since most of the studies we identified were small and reported no treatment effect).

TiDIER assessment revealed severe limitations in intervention descriptions in most studies (Table S5) [38]. Levels of detail varied considerably; more recent studies demonstrated better reporting. Many studies did not report a robust theoretical basis for the intervention, although most gave a brief rationale. Items relating to basic intervention descriptions, that is, what was delivered, by whom and how often, tended to be reported. However, there was particularly poor reporting of professionals' modifications and participants' adherence, so we were very unsure about participants' adherence to most interventions. Only five studies reported information on adherence [S2,S5,S23,S29,S31]; only one specifically assessed intervention fidelity [S29].

Prevention studies involving participants without prior foot ulceration

Sixteen studies (3228 participants) enrolled unselected populations or populations selected to exclude those with prior ulceration; the incidence of other risk factors varied and was often not reported [S1,S2,S5,S8–S10,S12,S15–S18,S25,S26, S29–S31]. Most evaluated interventions with a strong educational focus [S1,S2,S5,S10,S12,S15–S18,S25,S26,S29, S30]. Interventions included an educational programme specifically focused on self-efficacy [S29], skills and confidence-building combined with education [S5], education with behavioural contracts [S12], exercise and motivation [S9], podiatric education, care and individualized counselling [S8], and SMS support [S31]. Comparators included usual care or lower intensity or standard education.

Only three of 16 studies reported ulceration [S8,S10,S17], while two reported amputation [S8,S12]. No meta-analysis was conducted because there was heterogeneity in both interventions and populations. Whilst a range of behaviour [S1,S5,S8,S10,S12,S16,S25,S26,S29,S31], knowledge [S8, S10,S15–S18,S29, S31] and psychological outcomes [S5, S17,S25,S29] was reported (Table S3), most measures in most studies did not show clear differences between groups; exceptions were some increases in knowledge or 'adherence'. Several studies also reported measures of foot condition such as problems requiring treatment or lesion scores [S1,S2,S8, S9,S12,S15], while two reported quality of life [S5,S29]. Studies reporting ulceration are highlighted below.

Family involvement in intensive education vs standard care

One study (62 participants) compared intensive diabetes foot education with ongoing family involvement, for 2 years, with usual care. This programme was delivered by a diabetes nurse-led multidisciplinary team and included classes every 3 to 6 months for patients and family members, recruitment of family assistance in daily foot care routines, additional workshops and skills exercises. There was no clear difference in either new ulceration at 2-year follow-up (RR 0.06, 95% CI 0.00 to 1.08) or in amputations (RR 0.19, 95% CI 0.01 to 3.87) [S10].

Specially adapted education for people with impaired cognitive function vs standard education

One study (68 participants) involving people with impaired cognition receiving insulin therapy found similar rates of new ulceration at 6 months between inpatients receiving a specially adapted education (DikoL) programme and those receiving standard education (RR 1.06, 95% CI 0.29 to

3.90). The DikoL programme used 15 instead of 20 teaching hours and was less theoretical, with more time for practical exercises. This was very-low-quality evidence [S17].

Podiatric-based programme compared with usual care

One study (530 participants) found no difference in new ulceration at 7 years between those receiving a 1-year intervention delivered by podiatrists, which involved individualized counselling, education and exercise sessions on foot care and as-needed podiatric treatment, and those receiving written information only (RR 0.99, 95% CI 0.06 to 15.67) [S8]. There was also no clear difference in amputations (but only two events; RR 4.93, 95% CI 0.24 to 102.11) [S8].

Prevention studies involving participants with prior foot ulceration

Eight studies (865 participants) enrolled participants with prior ulceration [S3,S7,S11,S14,S20–S22,S27]. Four included only participants with prior ulceration S7,S11,S21,S27] and four participants with and without prior ulceration [S3,S14, S20,S22]. Six studies evaluated educational interventions (53 to 259 participants) [S3,S7,S11,S14,S20,S22]. Pilot studies evaluated a modified cognitive behavioural therapy intervention (15 participants) [S21] and motivational interviewing (13 participants) [S27]. Six studies reported ulceration [S3,S7,S11,S14,S21,S22].

Educational intervention vs standard care

Five studies (572 participants) compared educational interventions with standard care [S3,S7,S11,S14,S20]. Four reported new ulceration and were pooled in a random-effects meta-analysis; in two (303 participants) [S7,S11], all participants had prior ulceration and, in another two (173 participants) [S4,S14], a proportion had prior ulceration. Studies were undertaken in specialist care outpatient settings and delivered by nurses or researchers in small groups in clinic or individually at participants' homes, where this was reported. Three used single face-to-face sessions, with telephone follow-up in one case; one used four sessions with additional follow-up [S3]. Interventions contained elements such as: single-sex groups with active question-led participation to build confidence [S7]; interactive group sessions with practical exercises [S14]; personalized risk factor exploration and follow-up [S11]; focus groups with patient involvement including specially designed games [S3]. Follow-up ranged from 6 months to 2 years.

There was no clear effect of educational interventions on new ulceration (RR 0.93, 95% CI 0.67 to 1.29; $I^2 = 17\%$); there was no evidence of differential effects depending on whether studies included only participants with prior ulceration.

Two studies reported amputation; one found an RR at 12 months of 0.98 (95% CI 0.41 to 2.34) [S11], another reported no amputations at 6 months [S14]. Two studies reported mortality; there were no clear differences between groups at 6 months (RR 1.47, 95% CI 0.33 to 6.46; $I^2 = 0\%$) [S7,S14]. There was very-low-quality evidence for various psychological and behavioural outcomes. Two studies reported incomplete data for behavioural outcomes: visiting podiatrist and wearing prescribed shoes [S7] and 'adherence to foot inspection' and barefoot walking [S20]. Another reported no between-group differences with regard to Diabetic Foot Scale (short form) and Hospital Anxiety and Depression Scores (HADS) but higher intervention group scores on the Nottingham Assessment of Functional Footcare scale [S11].

Intensive education vs standard education

One study (259 participants) found that intensive education delivered up to four times monthly, including foot-care practices and quizzes, varying intensity with perceived risk, appeared to reduce new ulceration over 10 years, compared with standard education delivered monthly (RR 0.52, 95% CI 0.34 to 0.81) [S22]. There were fewer amputations in the intensive education group (RR 0.62, 95% CI 0.42 to 0.92) but no clear difference in mortality (RR 0.63, 95% CI 0.37 to 1.08); this was very-low-quality evidence [S22].

Cognitive behavioural intervention vs standard care

A pilot study (15 participants) in people with prior ulceration found no difference in ulceration between a specially adapted group cognitive behavioural therapy-based intervention over several months and standard care (one ulcer per group; RR 0.63, 95% CI 0.05 to 7.90); the study was not designed to detect a difference [S21]. The study focused on social support, illness cognition, mood and self-care behaviours. The intervention group reported increased self-care behaviours and greater belief in treatment effectiveness.

Motivational interviewing vs standard care

A pilot study (13 participants) compared a brief motivational interviewing intervention with standard care in people with prior ulceration [S27]. Ulceration was not reported. There was no sustained difference in an objective measure of 'recommended footwear adherence' over 3 months.

Treatment studies involving participants with current ulceration

We identified seven treatment studies (418 participants); in five studies participants were inpatients for diabetic foot ulcer treatment [S4,S6,S19,S23,S28], while two enrolled outpatients [S13,S24]. All were underpowered to detect important clinical differences (30–100 participants) and interventions varied considerably, although three were primarily educational [S4,S23,S28]. Five studies reported some wound healing measure, but only two reported complete healing [S6,S24].

Continuous pharmacist support vs usual care

A study of continuous pharmacist support (data from 29 participants), incorporating three to four treatment-focused counselling sessions, discharge conversations and 3-monthly post-discharge follow-up meetings, information and planning support, found no difference in complete healing at 12 months compared with usual care (RR 1.03, 95% CI 0.65 to 1.61) [S6]. It is unclear whether pharmacist support reduced new ulceration (RR 0.37, 95% CI 0.11 to 1.22). These completed case analyses provided very-low-quality evidence.

Understanding well-being vs usual care

One study (60 participants) compared an ’understanding well-being’ intervention (three discussion and reflection sessions over 6 weeks combined with diary writing) to usual care [S24]. Time to complete healing was measured over 6 weeks; the HR was reported not to show difference between the groups (*P* value reported), but attrition and imprecision were high. Other outcomes included self-efficacy, self-care and quality of life. This was all very-low-quality evidence.

Foot-care education plus motivation and a topical platelet gel vs platelet gel alone

One study (100 participants) compared education with a motivational component (three sessions with a registered nurse over 20 days) plus a medical intervention (platelet gel) with the gel alone. Wound status, measured by the modified Bates-Jensen wound assessment tool found no difference in change scores at 30 days [S4].

Self-care capacity enhancement vs usual care

One study (60 participants) compared initial small group training aimed at enhancing participants’ capacity for self-care (twice-weekly follow-up home visits over 4 months) to usual care [S28]. Aspects of healing status [categorical descriptors of wound dimensions and healing phase (epithelializing/granulating/inflammatory)] showed very-low-quality evidence of benefit to the intervention. There was also improvement in self-care status.

Decision navigation vs usual care

A pilot study (30 participants) compared decision navigation for diabetic foot ulcer care, involving an assistant psychologist using a semi-structured telephone interview to develop personalized plans and accompanying participants to their consultant appointment, to usual care [S13]. The focus was psychological outcomes including: decisional self-efficacy scale; ’adherence’; decision conflict; decision regret; and health-related quality of life. Healing rate was reported as a *P* value for change in ulcer size over 12 weeks, without between-group comparisons. Adjusted analyses showed no clear differences between groups except for decision conflict (reduced in the intervention group).

Supportive psychotherapy vs usual care

One study (30 participants) compared between three and 11 weekly sessions of supportive inpatient psychotherapy with usual care. There was no difference in amputations (RR 1.00, 95% CI 0.31 to 3.28) [S19]. This study primarily addressed depression and reported reduced scores on the HADS and the Problem Areas in Diabetes Scale in the intervention group but increases in the control group, using baseline-adjusted analyses.

Self-care and self-efficacy vs usual care

One study (60 participants) compared a weekly foot self-care and self-efficacy group programme to usual care [S23]. No review primary outcomes were assessed. There was very-low-quality evidence of an intervention benefit on management self-efficacy and foot self-care behaviour scales.

Discussion

Twenty-four of 31 studies in the present review examined ulcer prevention rather than treatment of current ulcers. All except one prevention study enrolled outpatients, whereas five treatment studies involved inpatients, although most people with diabetic foot ulcers are treated as outpatients. Most participants were older people with type 2 diabetes. Most participants in treatment studies and prevention studies after prior ulceration were men. In these respects the populations may be representative of clinical practice and it was also noticeable that there were few exclusion criteria based around comorbidities, which would limit the applicability of the findings in practice. Both high- and low- to middle-income countries were represented.

Most prevention interventions were primarily educational in focus. Interventions were delivered face-to-face, individually, or to small groups, usually by healthcare professionals. Treatments were most commonly delivered by nurses and seldom by health or other psychologists; varying levels of detail were given about the training provided to personnel. This may mean that the interventions were delivered in a more pragmatic, but less ideal way, but it was difficult to determine the extent to which this was the case from the published studies. The most common setting was an outpatient clinic, although both inpatient clinics and home visits were included. These factors may also mean that many interventions are easily compatible with normal clinical practice. A wide range of approaches were taken to make both educational and more psychologically focused interventions meaningful and effective; more recent studies often focused on participant-driven concerns.

Despite the relatively large number of studies identified, there was limited evidence for the impact of interventions aimed at either prevention or treatment of foot ulcers: ulceration and healing outcomes were often not reported and, where reported, showed no clear effects and were additionally affected by limitations in study size, design and reporting. The extent to which the included studies may be considered to have assessed the effectiveness of the interventions in situations analogous to clinical practice varies. The relatively unselected populations enrolled in the included studies, the settings and personnel delivering most interventions, and the fact that comparisons were with ’usual care’, ’standard care’ or an alternative intervention mean that most of the existing studies are pragmatic in nature [44].

The study outcomes reported reflected the type of interventions assessed and the populations enrolled. As most interventions were primarily educational, their objective, especially in populations without prior ulceration, was often changes in foot care behaviour, knowledge or beliefs. The primary outcomes in the present review (incidence of new or recurrent ulceration and complete healing of active ulcers) were reported by a minority of studies. New or recurrent ulceration was reported in only nine of 24 prevention trials of which six enrolled participants with prior ulceration; one treatment trial reported re-ulceration [S3,S6–S8,S10,S11, S14, S17,S21,S22]. Complete wound healing (the outcome that matters most to people living with ulcers) [45,46] was reported by only two of seven treatment trials [S6,S24]; three studies reported other measures of healing [S4,S13,S28]. Outcome reporting was often limited to *P* values, measures of within-group change, or statements of statistical significance. The outcomes assessed and measures reported varied widely, this was particularly the case for psychological outcomes. While there were reporting limitations associated with the studies identified, we found no evidence of a pattern of missingness in the studies identified that would indicate publication bias. The fact that so many of the included studies were both small and reported no intervention effect supports the view that we have identified the majority of the existing studies.

Most studies, including those which reported ulceration or healing, were not well designed to assess these outcomes, often having too few participants or insufficient follow-up. The median (range) sample size was 60 (30–100) in treatment studies and 103 (13–530) in prevention studies.This meant that effect estimates were imprecise, especially where incidence of ulceration was low. In most instances we could not use meta-analysis to combine studies because the interventions compared or the population enrolled were too heterogenous. Assessment of risk of bias showed many studies with multiple domains at high risk of bias and almost all had several unclear risks of bias.

The combination of heterogeneity, imprecision and risk of bias means that all the evidence in the review was of low or very low quality. Many of the findings were therefore very uncertain or were of low certainty but suggested that there was no clear effect of the intervention, with CIs that included the possibility of both benefit and harm, as well as no effect. Where evidence is drawn from studies with methodological issues and low numbers of participants it is difficult to determine whether there is truly no effect of the interventions assessed; further research is very likely to change the findings. We are uncertain not only about the effects of interventions but about whether these uncertain findings are reliable [39].

Application of the TiDIER checklist [38] demonstrated that, although most studies reported a rationale for intervention(s), this was only rarely embedded in a theoretical basis for effectiveness. Only three (educational) studies in people without prior ulceration reported such a theoretically based rationale, none assessed ulceration [S25,S29,S30]. Studies in people with prior ulceration mostly did not report clear rationales for how interventions might impact outcomes, although most did report ulceration [S4,S6,S11,S14]. The exception was a pilot study of specially adapted cognitive behavioural therapy, and this was not powered to assess recurrent ulceration [S21]. Several treatment studies assessed interventions with clear reasoning for their likely efficacy in relation to the psychological and behavioural outcomes, which were their primary focus [S13,S19,S23,S24, S28]. However, only one study related the process to wound healing [S24] and none were powered to assess this. Studies providing clear intervention rationales were published relatively recently.

Interventions were described in varying detail; a few educational studies provided only minimal detail for us to identify an eligible psychosocial component [S4,S14,S15, S18,S22], a majority gave partial information and a minority (mostly psychological studies) provided full information on all aspects of programmes [S11,S13,S19,S21,S25,S28, S29]. Approximately half the interventions reported details on tailoring for either some participants (e.g. ensuring cultural appropriateness, provision in participants’ first language, adaptation to medical needs, educational or literacy capabilities) [S2,S3,S6,S7,S23,S29] or all participants (individualized and participant-driven approaches) [S8,S13,S15,S19,S22,S26–S28]. In most cases fidelity of intervention delivery and level of participant adherence were unclear. Exceptions were four studies which reported measures to improve or define adherence [S2,S5,S23,S31] and one which implemented a detailed protocol to ensure fidelity [S29].

In conclusion, during the period 2014–2015, £1 in every £140 spent by the NHS in England was consumed by the costs of managing the diabetic foot, and these costs are rising

[12]. Observational evidence has continued to highlight psychological and behavioural associations with ulcer outcomes. Yet the focus in intervention studies has steadfastly remained on educational interventions, as reflected in previous systematic reviews and most studies identified by the present rigorous review.

We have identified a growing body of randomized evidence which explores interventions aimed at supporting people with diabetes in avoiding and managing ulceration. If we are to realize improvements in foot ulcer outcomes for patients and healthcare providers, as noted by the National Institute for Health and Care Excellence [47], we need robust trial evidence of psychosocial interventions with a clear theoretical basis that examine effects on clinical outcomes. Such trials should be appropriately powered with adequate follow-up to assess effectiveness in preventing ulceration and, ultimately, amputation. Where appropriate they should follow guidance on the development and evaluation of complex interventions [48].

Trials with high relevance to clinical practice may deliver interventions using healthcare professionals routinely present in clinic settings; there may be a balance to be struck between expertise and transferability. As an example, one of our identified studies used research nurses to deliver an intervention after they had received training from a psychologist.

Trials in people with active ulceration should ideally assess time to healing and re-ulceration. The limited reporting of both methodology and key outcomes (new or recurrent ulceration, complete healing and quality of life), and the wide range of measures employed to capture outcomes such as foot-care behaviours and knowledge and, especially, psychological health, underlines the need for future trials to refer to the ongoing COMET initiative, which will provide a core outcome set for management of foot ulceration in people with diabetes [49]. Issues with methodology and reporting highlight the need for adherence to good reporting practice for RCTs [50].

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Competing interests

None declared.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix S1. Supplementary references and search strategy.
Table S1. Summary of characteristics of studies of psychosocial interventions for preventing or treating foot ulceration in diabetes.
Table S2. Summary of key outcomes across studies of psychosocial interventions for preventing or treating DFU.
Table S3. Summary of review secondary outcomes across studies of psychosocial interventions for preventing or treating DFU.
Table S4. Risk of bias in studies of psychosocial intervention for preventing or treating DFU.
Table S5. TiDIER summary table for reporting of psychosocial interventions for treating or preventing DFU.