BMC Psychiatry

RESEARCH Open Access

The effectiveness of psychological interventions on diabetes distress and glycemic level in adults with type 2 diabetes: a systematic review and meta-analysis

Wanting Zu[1], Shiyun Zhang[1], Lin Du[1], Xuemiao Huang[1], Wenbo Nie[1*] and Lisheng Wang[1,2*]

Abstract

Aims The treatment of diabetes distress plays an important role in diabetes care; however, no meta-analysis has been performed to synthesize the short- and long-term effects of psychological interventions tailored for diabetes distress in people with type 2 diabetes. We aim to evaluate the evidence on tailored psychological interventions for diabetes distress as the primary outcome, focusing on individuals with type 2 diabetes.

Methods Two reviewers independently searched eight databases from their inception to September 2024. EndNote X9 was used to screen records. The Revised Cochrane risk-of-bias tool for randomized trials was used to assess the risk of bias. The GRADE system was used to assess the overall certainty of the evidence. A random effect model was used to determine the mean difference or standardized mean difference with 95% CIs. Subgroup analyses based on several intervention characteristics and sensitivity analyses were also conducted.

Results Totally, 22,279 records were yielded, and we finally included 18 studies in our systematic review. The meta-analysis included data from 16 studies representing 1639 participants. Interventions types included mindfulness-based and cognitive behavioral therapy, among others. Duration of interventions ranged from 4 weeks to 6 months. We found that psychological interventions that measured diabetes distress significantly reduced diabetes distress in the short-term in people with type 2 diabetes (SMD= -0.56; 95% CI= -0.90, -0.22; $p=0.001$). Subgroup analysis indicated that this effect could be enhanced when delivered in a group format, by psychologist, using a technology component, or including participants having elevated baseline diabetes distress. However, the short- and long-term effects on HbA1c were non-significant, with results showing (MD = 0.02; 95% CI = -0.23 to 0.26; $p=0.89$) and (MD = -0.27; 95% CI = -0.64 to 0.10; $p=0.15$), respectively. The long-term effect on diabetes distress was also non-significant (SMD = -0.45; 95% CI = -0.93 to 0.03; $p=0.07$).

*Correspondence:
Wenbo Nie
niewb@jlu.edu.cn
Lisheng Wang
lishengwang@jlu.edu.cn

Full list of author information is available at the end of the article

Conclusions Psychological interventions tailored for diabetes distress in people with type 2 diabetes are effective in reducing the level of diabetes distress immediately after the intervention. More trials are still needed to further enrich the evidence in this area.

Keywords Type 2 diabetes, Diabetes distress, HbA1c, Psychosocial interventions, Systematic review and meta-analysis

Background

Diabetes is a long-term condition that significantly impacts individuals and society, with a global prevalence estimated at 9.3% in 2019, projected to rise to 10.2% by 2030 and 10.9% by 2045 [1, 2]. Among the main types of diabetes, type 2 diabetes accounts for over 90% of the total, and its prevalence is increasing due to an aging population and urbanization [2]. Living with diabetes is always tough since individuals and families have to face the constant demands and challenges of self-management as well as the threats of the occurrence of diabetes-related complications. These ongoing stressors can elicit negative emotions that may hinder individuals' ability to effectively engage in diabetes management [3, 4].

Diabetes distress refers to the specific negative emotional experience resulting from the challenges of managing diabetes, and it can encompass a wide range of emotions [5, 6]. Diabetes distress affects approximately 36% of individuals with type 2 diabetes and is negatively associated with self-management and glycemic control [7–9]. Moreover, it may have a stronger association with glycemic control than depression [10, 11]. Given the importance of diabetes distress and its impact on glycemic control, the primary goal of people with diabetes, it is essential to provide appropriate psychological treatments for people with diabetes [3].

Several systematic reviews and meta-analyses have examined the effectiveness of psychological interventions on diabetes distress and glycemic control, yielding inconclusive results [12–15]. One review found that psycho-education was the only effective intervention for reducing diabetes distress [15]. However, a Cochrane review found no significant effect of psychological interventions on diabetes distress compared to usual care, although small effects on HbA1c were noted at follow-up [12]. Additionally, a review including both people with type 1 diabetes and type 2 diabetes revealed that psychological interventions effectively reduce diabetes distress, with diabetes-specific interventions also lowering HbA1c [14].

Notably, almost all studies included in prior reviews, with the exception of the review conducted by Schmidt et al., only evaluated diabetes distress as a secondary outcome. This suggests that these studies were not specifically designed to target diabetes distress, potentially limiting their applicability and relevance to this particular outcome [14]. While baseline severity is important in mental health trials, the majority of studies, aside from Schmidt et al., used post-intervention outcomes to estimate effect sizes [14, 16, 17]. Furthermore, individuals with type 1 and type 2 diabetes experience different sources of psychological distress due to variations in symptom presentation, age of onset, and social support. For instance, individuals with type 2 diabetes may be judged by others as having the condition due to unhealthy lifestyles, resulting in social stigma [18, 19]. Consequently, we aimed to focus on diabetes distress specifically in individuals with type 2 diabetes to provide evidence that is more relevant to this population.

In summary, the aim of this review is to systematically evaluate the evidence on tailored psychological interventions for diabetes distress as the primary outcome, focusing exclusively on people with type 2 diabetes.

Methods

This systematic review and meta-analysis was conducted and reported following the suggestions of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [20]. The protocol was registered in PROSPERO (registration number: CRD42023411507).

Search strategy

We systematically searched eight English and Chinese electronic databases, namely PubMed, Embase, PsycINFO, CINAHL, the Cochrane Library, China National Knowledge Infrastructure (CNKI), WanFang Data, and VIP from their inception to January 2023, and updated on September 2024. In order to include all potential records, the search strategy used in our review was modified from the search strategy established by Schmidt et al., aiming at diabetes distress generally [14]. The reference lists of the identified articles and reviews were also manually searched to identify additional relevant articles. Details of search strategies are presented in the Supplementary material Table S1.

Eligibility criteria

The following criteria established according to PICOS strategy were used to determine eligibility for inclusion. Studies with incomplete data, conference abstracts, study protocols, editorials and studies that full-texts cannot be obtained were excluded.

(i) Participants: we included studies evaluating adults (≥ 18 years old) with type 2 diabetes in all settings;

Studies for children, adolescents, people with type 1 diabetes, gestational diabetes, or < 70% people were diagnosed as type 2 diabetes were excluded;

(ii) Intervention and comparisons: according to the previous review, psychological intervention in this review is defined as a range of collaborative treatments based on evidence from psychology research and are aimed to reduce diabetes distress, such as mindfulness-based interventions, cognitive behavioral therapy (CBT), acceptance and commitment therapy (ACT), and problem-solving therapy. Whereas interventions that only consist of education without any psychological component were excluded, such as diabetes self-management education and diabetes education. The control group could be usual care, enhanced usual care, waitlist and/or attention control.

(iii) Outcomes: diabetes distress measured by validated measurements (e.g., Problem Areas in Diabetes (PAID) or the Diabetes Distress Scale (DDS)) should be one of the primary outcomes of the original study.

(iv) Study design: randomized controlled trials (RCTs) that reported the process of randomization.

Study selection

All the records retrieved from databases were imported into EndNote X9 to select articles. Two reviewers independently screened the potential records based on titles and abstracts according to the eligibility criteria, resulting in a disagreement rate of 16% during this stage. Full texts were read when decisions could not be made based on titles and abstracts, and any disagreements were resolved through discussion with a third reviewer.

Data extraction

Two reviewers independently extracted the data using a standardized table, which includes information about publication (first author, year, and country), participants (sample size, mean age, gender, and baseline scores of measurements of participants), intervention (setting, type, content, frequency, duration, and delivery method), control, outcome measurements, follow-up timepoints, and other relevant information. Authors were contacted by email for missing information. Any disagreements about data extraction were resolved by consultation with a third reviewer.

For studies with multiple follow-up time points, we separately extracted the results of the earliest and the longest post-intervention time point to analyze the short-term and long-term effectiveness of interventions. For studies with several intervention groups, we only extracted intervention and control groups that met our inclusion criteria. If two intervention groups were compared with the same control group, the sample size of the control group would be halved to avoid double counting [21].

Risk of bias and certainty of evidence

Quality of included studies was evaluated and cross-checked by two reviewers using the Revised Cochrane risk-of-bias tool for randomized trials (RoB 2) [22]. Risk of bias of each study was assessed by answering signaling questions of five domains, namely bias arising from the randomization process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in measurement of the outcome, and bias in selection of the reported result. Each domain was rated as "low risk of bias," "some concerns," or "high risk of bias". Finally, the overall risk of bias was judged according to the worst risk of bias in any of the above domains [22]. Additionally, we used the GRADE profiler (GRADEpro) to assess the overall certainty of the evidence. According to the GRADE system, the certainty of evidence for each outcome is classified into four levels: high, moderate, low, and very low [23]. In cases of disagreement, a third researcher was consulted to achieve agreement.

Data synthesis and analysis

If more than three studies reported the same outcome, then a meta-analysis was performed to calculate effect sizes. We used mean change and standard deviation (SD) of the outcome measurements from baseline to each time point to calculate the effect size of the intervention. The pooled effects would be expressed as Mean Difference (MD) with the 95% CI if the outcome was measured by the same instrument. Standardized Mean difference (SMD) would be presented when the same outcome was measured by different instruments [21]. The magnitude of the effect size was interpreted as small (SMD < 0.2), medium (SMD < 0.5), large (SMD < 0.8), and very large (SMD < 1.2) [24]. *I-square* statistic (I^2) was used to assess heterogeneity, and the level of heterogeneity was rated as low (25%), moderate (50%), or high (75%) [25]. The random effect model was used for calculating the pooled effect since a random effect model takes into account both within and between study variances and thus would be more conservative than the fixed effect model [26].

Subgroup analysis would be performed when heterogeneity was detected. And sensitivity analysis was performed to assess the robustness of the outcome. Publication bias was assessed by using a funnel plot and Egger's test when more than 10 studies. Review Manager 5.4 and Stata 17.0 were used for meta-analysis. Studies were excluded from meta-analysis and summarized in a narrative way if they did not report means and SDs, or any other relevant statistics.

Results

Study selection

Totally, 22,279 records were yielded from eight English and Chinese electronic databases, and 16,461 records remained after removing duplicate records. Then, 16,016 records were excluded based on titles and abstracts. Finally, we included 18 studies in our narrative review, but only 16 studies were included in the meta-analysis because we were unable to obtain outcome data for one of the studies [27]. Additionally, another study's primary aim was to explore the feasibility of the intervention, which included only a small number of participants and did not report significance tests [28]. The process of selection is presented in Fig. 1.

Study characteristics

The eighteen included studies were published from 2004 to 2023, and four of them were conducted in the US [27, 29–31], three in China [32–34], four in the Netherlands [17, 35–37], two in Australia [38, 39], and one each in UK [28], Pakistan [40], Iran [41], Malaysia [42], and Korea [43]. Most of the included studies were two-arm trials except for two studies that were three-arm trials [29, 43], and the sample size of included studies ranged from 24 [37] to 392 [29]. The mean age of participants ranged from 36.93±6.87 [40] to 70.7±6.6 [36]. Diabetes distress was measured as (one of the) primary outcome(s) in all included studies, and DDS-17 was used in seven studies [29, 32, 39–43], PAID-20 in eight studies [17, 27, 28, 31, 35–38], CDDS-15 in one study [33], PAID-5 in one study [30], and SF-PAID-C in one study [34]. Eight studies included participants in both the intervention and control groups who had baseline diabetes distress levels above the threshold (DDS-17≥3 or PAID≥40) [31–34, 40–43].

As for the intervention types of included studies, six studies used mindfulness-based interventions [17, 27, 32, 37, 38, 43], three studies used motivational interviewing-based interventions [31, 34, 35], two studies used problem-solving-based interventions [29, 39], three study used Acceptance and Commitment Therapy-based interventions [28, 33, 41], two study cognitive behavioral therapy [36, 40], one study combined traditional cognitive behavioral therapy and mindfulness therapy [30], and one study constructed a value-based emotion-cognition-focused intervention [42]. The duration of interventions ranged from 4 weeks [34] to 6 months [31], with the longest follow-up time extending to 12 months [42]. The description of the interventions is presented in Table 1. Four studies used technology-based components to deliver intervention [27–29, 32], and two of them used mobile applications [27, 32]. Three studies explicitly described the method used to ensure intervention fidelity [27, 32, 42].

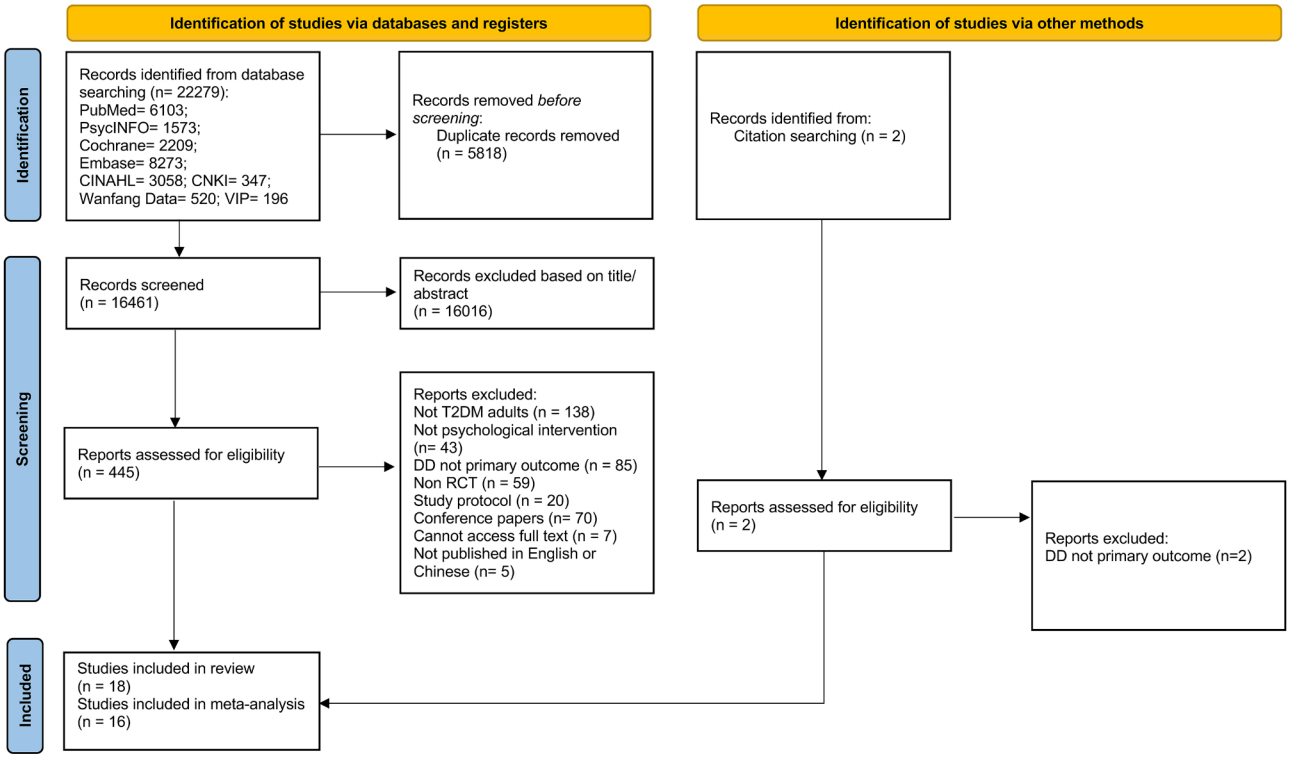


Fig. 1 PRISMA flow chart

Table 1 Characteristics of included studies ($n = 18$)

Author (year) Country	Study design/ Sample size	Description of Intervention	Delivery mode/ Therapists/Setting	Control	Outcome Measures	Measurement Time points/ Follow up times	Intervention fidelity	Funding
Guo et al. 2022 China	2 arm RCT Total: 100	Nurse-led MBSR therapy + diabetes education: 8 daily sessions of 120 min plus an 8-week technology-based maintenance practice. The eight themes are mindfulness training, nonjudging, patience, the beginner's mind, trust, nonstriving, acceptance, and letting go.	face to face group-based technology-based; trained nurse; hospital	regular diabetes education	Diabetes distress (DDS-17); Diabetes self-efficacy; Diabetes self-management; HbA1c	baseline; 8 weeks; 12 weeks	the intervention fidelity was ensured by the research assistant based on a fidelity checklist	Yes
DiNardo *et al.* * 2022 USA	2 arm RCT Total: 132	Mind-STRIDE + DSMES: 90 min intervention delivered following the DSMES. The intervention was adapted from MBSR and consisted of group discussion, a didactic presentation of chronic stress and diabetes, formal meditation practice, and activities targeting sensory, cognitive, and behavioral awareness. A 30 min booster session at 4 weeks. Home practice was supported by a workbook and a mobile application.	face to face group-based technology-based; trained nurse; outpatient diabetes clinic	DSMES: a one-session 3-hour group session	Diabetes distress (PAID-20); Diabetes self-care; Diabetes self-efficacy; Post-traumatic stress; Depression; Mindfulness; HbA1c; Mean arterial pressure; Anthropometric characteristics; Patient satisfaction; Participant engagement	baseline; 12 weeks; 24 weeks	the research coordinator and/or the principal investigator reviewed each audio recording within 1 week to ensure fidelity.	Yes
Li et al. 2020 China	2 arm RCT Total: 225	An education program using MI techniques: The education program consisted of four modules, held once a week, that each lasted approximately 1.5 to 2 h. The content was designed based on MI theory and the theory of patient empowerment, and was grouped into four broad headings: Knowing Diabetes, Diabetes Self-Care, Healthy Diet, and Physical Exercise.	face to face group-based; trained nurse; outpatient clinic and a family medicine clinic, as well as three community health centers	health education	Diabetes distress (SF-PAID-C); Patient Enablement Index; Stages of Change score	baseline; 4 weeks; 3-month	Not report	Yes
Maghsoudi et al. 2019 Iran	2 arm RCT Total: 80	ACT intervention: eight 90-min sessions, one session per week. The sessions mainly included introduction, core concepts in ACT, conclusion and home work.	face to face group-based; clinical psychologist and nurse; community center	routine educations	Diabetes distress (DDS-17)	baseline; 8 weeks; 2-month	Not report	Not report
Chew et al. 2018,2019 Malaysia	cluster RCT Total: 124	VEMOFIT programme: 4 biweekly sessions over 6 weeks (main intervention), with a booster session at 3 months. The contents included exploring personal beliefs regarding diabetes as a disease, the need for screening diabetes-related complications, control targets, healthy life-styles, and medication management; training emotional skills with regard to recognizing and managing emotions in the self and others; and providing social support and setting short- and long-term goals.	face to face group-based; physician and nurse; public health clinics	attention control	Diabetes distress (DDS-17); depression; illness perceptions; quality of life; diabetes self-efficacy; self-care activities; positive emotions; HbA1c; systolic and diastolic blood pressure; LDL cholesterol.	baseline; 6 weeks; 6-month 12-month	use elements of a framework to make treatment fidelity explicit	Yes

Table 1 (continued)

Author (year) Country	Study design/ Sample size	Description of Intervention	Delivery mode/ Therapists/Setting	Control	Outcome Measures	Measurement Time points/ Follow up times	Intervention fidelity	Funding
Pearson et al. 2018 Australia	2 arm RCT Total: 67	Mindfulness intervention: an audio CD of guided breath awareness with an instruction sheet. Participants were asked to listen for 30 min/day over 8 weeks.	self-directed individual-based; the CD was composed of a mindfulness trainer; outpatient clinics	usual care	Diabetes distress (PAID-20); Depression, Anxiety and Stress; Diabetes Self-Care; HbA1c; blood pressure	baseline, 8 weeks, 12 weeks,	Not report	Yes
Rees et al. 2017 Australia	2 arm RCT Total: 40	PST-D intervention: up to 8 sessions, each lasting 45–60 min. The contents included an introduction, the development of a problem list related to diabetes, and choose a specific problem to work on through problem-solving steps.	telephone or face to face; individual-based; a trained research assistant supervised by a clinical psychologist retinal clinics at hospital	usual care	Diabetes distress (DDS-17); depression; diabetes self-care behaviors; HbA1c	baseline; 3-month; 6-month	Not report	Yes
Wagner et al. 2016 USA	2 arm RCT Total: 107	diabetes education + stress management intervention: 2.5 h diabetes education plus a manualized, culturally based intervention comprised of 8 group sessions across 8– 10 weeks. It mainly included psychoeducational training based on CBT and mindfulness therapy and physical relaxation training. A CD player and a CD were also provided for home practice.	face to face group-based; community health worker outpatient clinic at hospital	diabetes education	Diabetes distress (PAID-5); Depression; Anxiety; Diabetes self-care; Self-reported health status; HbA1c; Urinary cortisol	baseline; post-intervention; 3-month	Not report	Yes
Kasteleyn et al. 2016 Netherlands	2 arm multi-center RCT Total: 161	participants in the intervention group were visited three times at their homes to discuss illness perceptions; MI strategies were used to increase self-efficacy.	face to face individual-based; trained nurse; hospital	attention control	Diabetes distress (PAID-20); well-being; health status; Euroqol Visual Analogue Scale; anxiety and depression; HbA1c, blood pressure and cholesterol levels	baseline; 5-month;	Not report	Yes
Schroevers et al. 2015 Netherlands	2 arm RCT Total: 24	individual MBCT: 8 weekly individual sessions of 60 min plus 30 min daily home practice; the intervention was modified from the standardized and well-described 8-week MBCT group protocol; an informational booklet and CDs with guided exercises were provided for home practice.	face to face individual-based; trained therapists with a degree in clinical psychology diabetes outpatient clinic	waitlist control	Diabetes distress (PAID-20); Depressive symptoms; Mindfulness and Attention Regulation	baseline; 8 weeks; 3-month	Not report	Not report

Table 1 (continued)

Author (year) Country	Study design/ Sample size	Description of Intervention	Delivery mode/ Therapists/Setting	Control	Outcome Measures	Measurement Time points/ Follow up times	Intervention fidelity	Funding
Jung et al. 2015 Korea	3 arm cluster RCT Total: 56	(1) K-MBSR + education: twice per week for 8 weeks; eight themes facilitated mindful walking, eating, and breathing and silent sitting meditation; each session lasted between 60–120 min. Participants were encouraged to practice K-MBSR at home. (2) Walking exercise: brisk walking for 30–60 min, three to four times per week; participants attended lectures regarding proper walking techniques before beginning the walking program.	face to face group-based; trained nurse; outpatient department at hospital	diabetes education	Diabetes distress (DDS-17); Perceived Stress Response Inventory; Cortisol levels; fasting blood glucose; Vascular inflammation	baseline; 8 weeks;	Not report	Not report
Van Son et al. 2013, 2014 Netherlands	2 arm RCT Total: 139	MBCT: 8 weekly 2-hour sessions; the central component was the development of mindfulness through practicing meditation exercises; a 2-hour booster session was added 3 months after the intervention; homework assignments took about 30 min, 5 days/week.	face to face group-based; certified psychologist outpatient diabetes clinics	usual care	Diabetes distress (PAID-20); Depression; Anxiety; Perceived stress; mood; health-related quality of life; HbA1c	baseline; 4 weeks; 8 weeks; 6-month	Not report	Yes
Fisher et al. 2013 USA	3 arm RCT Total: 392	(1) CASM: a 40-min Web-based diabetes self-management improvement program with an automated "behavior chain" booster at 5 months. (2) CAPS: a 60-min in-person intervention that included CASM plus PST with a booster session at 5 months. (3) Leap Ahead: a 20-min, computer-delivered health risk appraisal along with diabetes education.	face to face individual-based; Web-based; trained college graduate interventionists supervised by the investigators; community medical groups and diabetes education centers	none	Diabetes distress (DDS-17); Physical activity; Healthy eating; Medication adherence; HbA1c	baseline; 4-month; 12-month	Not report	Yes
Lamers et al. 2011 Netherlands	2 arm RCT Total: 208	Minimal psychological intervention + usual care: tailor-made, the number of visits depends upon progress. On average, persons in the intervention group had 4 sessions of approximately 1 h on average. It included elements of CBT and self-management and consisted of five steps.	face to face individual-based; trained nurse; primary care practices	usual care	Diabetes distress (PAID-20); diabetes-specific symptom distress; HbA1c	baseline; 1 week; 3-month; 9-month	Not report	Yes
Whittemore et al. 2004 USA	2 arm RCT Total: 49	Nurse-coaching intervention + standard diabetes care: a total of 6 sessions were provided over 6 months, with 5 of the 6 sessions provided in the first 3 months. The component included assessment, education reinforcement, problem solving and motivational guidance, psychosocial support.	face to face individual-based; nurse; outpatient diabetes education center	Standard diabetes care	Diabetes distress (PAID-20); self-management variables; diabetes integration; BMI; HbA1c	baseline; 3-month; 6-month	Not report	Yes

Table 1 (continued)

Author (year) Country	Study design/ Sample size	Description of Intervention	Delivery mode/ Therapists/Setting	Control	Outcome Measures	Measurement Time points/ Follow up times	Intervention fidelity	Funding
Abbas, et al. 2023 Pakistan	2 arm RCT Total: 90	CBT: 8 to 10 CBT-based therapeutic sessions were completed in 16 weeks, and frequency was one session in 10–12 days intervals with 45–60 min. The main components were psychoeducation, cognitive conceptualization, adherence training, activity scheduling, problem-solving, improving coping strategies, muscle relaxation and imagery, and, lapse and relapse prevention.	face to face individual-based; clinical psychologists; psychological clinic	waitlist control	Diabetes distress (DDS-17); Depression; Anxiety; quality of life; treatment adherence; physical activity	baseline; 4-month;	Not report	Not report
Kılıç, *et al.* * 2023 UK	2 arm RCT Total: 33	ACSBT-D: integrated psychological flexibility and self-compassion concepts from ACT and MSC; 5 weekly sessions delivered online (Qualtrics), each approximately 30 min. The sessions focused on developing acceptance, commitment, and self-compassion and self-care in diabetes.	self-directed online individual-based; no therapist support	waitlist control	Diabetes distress (PAID-20); depression; anxiety; well-being, diabetes-related quality of life; diabetes self-management; self-compassion; psychological inflexibility	baseline; 5 weeks; 9 weeks post-randomization	Not report	Yes
Ngan, et al. 2023 Hong Kong, China	2 arm RCT Total: 48	ACT-DE: 5-session ACT-integrated diabetes education over 6 weeks. Each session lasted about 120 min in groups of 6 participants. The sessions mainly included diabetes education, ACT sessions, and a booster session.	face to face group-based; nursing researchers; diabetes outpatient clinic	diabetes education and usual care	Diabetes distress (CDDS-15); diabetes self-care behavior; self-efficacy; psychological inflexibility	baseline; 6 weeks;	Not report	Yes

ACT, Acceptance and commitment therapy; ACT-DE, ACT-integrated diabetes education; ACSBT-D, Acceptance, Commitment, and Self-Compassion based treatment in Diabetes; CASM, computer-assisted self-management; CAPS, CASM plus PST; CBT, cognitive behavioral therapy; CDDS-15, Chinese Diabetes Distress Scale; DDS, Diabetes Distress Scale; DSMES, diabetes self-management education and support; K-MBSR, Korean mindfulness-based stress reduction; MBCT, mindfulness-based cognitive therapy; MBSR, mindfulness-based stress reduction; Mind-STRIDE, Mindful STress Reduction In Diabetes Education; MI, motivational interviewing; MSC, Mindful Self-Compassion Course; PAID, Problem Areas in Diabetes questionnaire; PST-D, problem-solving therapy for diabetes; RCT, randomized controlled trial; SF-PAID-C, Chinese version of short-form PAID; VEMOFIT, value-based emotion-focused educational programme

*Excluded from the meta-analysis

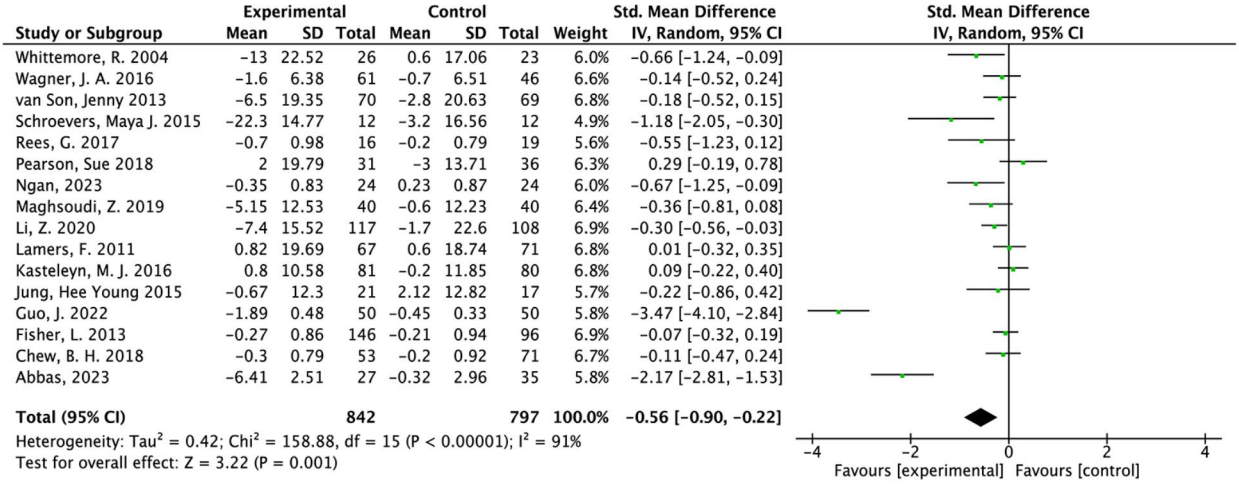
Risk of bias and certainty of evidence

Overall, five of the eighteen included studies were rated as high risk of bias, and the remaining thirteen studies were rated as having some concerns (Supplementary material Figure S1). Two studies did not explicitly describe the process of randomization were rated as high risk of bias in domain "bias arising from the randomization process" [30, 31]. Two studies were rated as high risk of bias in domain "bias due to deviations from intended interventions" because of the nature of psychological interventions that participants and providers are aware of the assigned intervention and they did not report appropriate analysis methods to estimate the effect of assignment to intervention [39, 43]. A single study was rated as high risk of bias in domain "missing outcome data" [28]. The overall certainty of the evidence was low for diabetes distress, and high for glycemic level (Supplementary material Table S3).

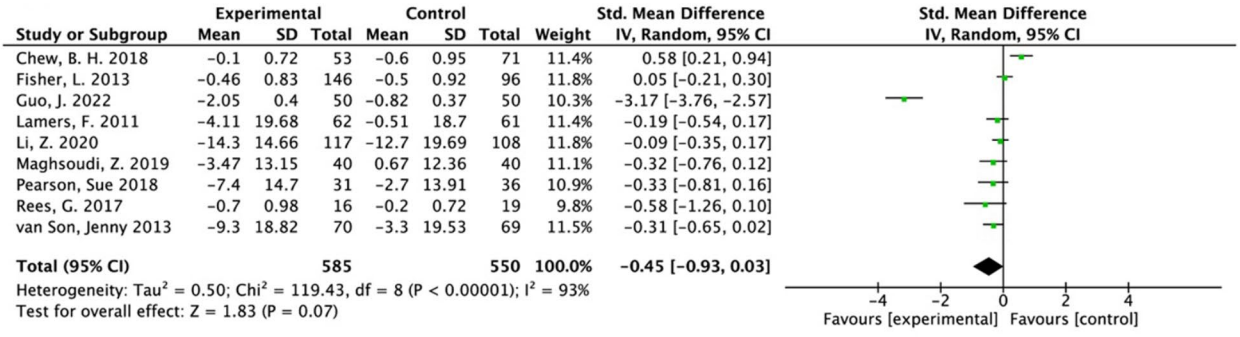
Effects of interventions

Primary outcome: diabetes distress

As for the short-term effect of psychological interventions on diabetes distress, we included 16 studies with 1639 participants to calculate the pooled effect size. A random effect model revealed a significant and medium reduction in diabetes distress compared with the control group (SMD= -0.56; 95% CI= -0.90, -0.22; $p=0.001$) (Fig. 2). These studies showed high heterogeneity ($I^2=91\%$, $p<0.00001$). One of the 18 studies that cannot be pooled in the meta-analysis due to insufficient outcome data was a technology-based mindfulness intervention for US military veterans with diabetes distress [27]. Veterans with elevated diabetes distress ($n=132$) were randomly assigned to the Mind-STRIDE intervention group (a 90-min intervention adapted from the Mindfulness-Based Stress Reduction program) or control group. Significant reductions in diabetes distress were observed in both groups with a non-significant group by time



(a)



(b)

Fig. 2 Effect of psychological interventions on diabetes distress. (**a**) short-term; (**b**) long-term

interaction, however, the distal effect between 12 and 24 weeks was significantly favoring the intervention group. Similarly, significant improvement of HbA1c was also observed in both groups with non-significant intervention effects [27]. Another study that we did not include in the meta-analysis was a feasibility trial whose primary aim was to explore the feasibility of an online psychological intervention incorporating elements of ACT and Mindful Self-Compassion Course in improving psychological distress in people with type 2 diabetes. The study reported a treatment completion rate of 47.37% (only 9 participants were considered treatment completers), which led the authors to note that the effects of the intervention are challenging to interpret due to the small sample size and the low completion rate [28].

9 studies including 1135 participants provided the follow-up data for calculating the long-term effect of psychological intervention on diabetes distress. At 3–12 months post-intervention, a random effect model revealed a medium but non-significant effect (SMD= -0.45; 95% CI= -0.93, 0.03; $p=0.07$) (Fig. 2) with high heterogeneity ($I^2=93\%$, $p<0.00001$).

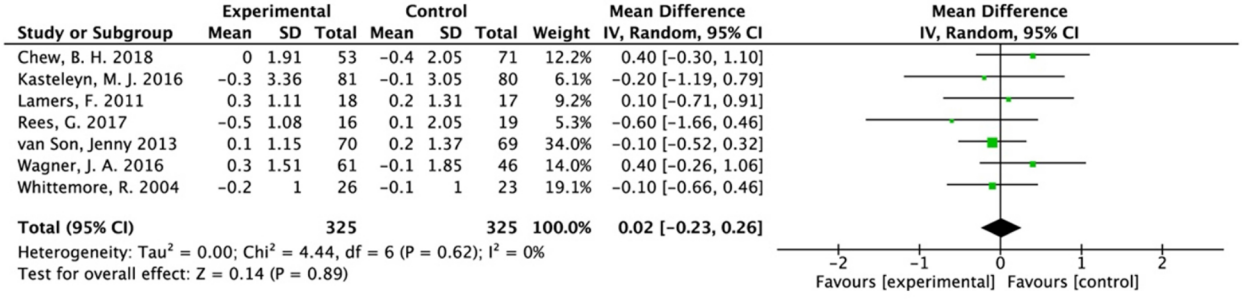
Secondary outcome: glycemic level

7 studies including 650 participants examined the effect of psychological interventions on HbA1c immediately after intervention. Compared with the control group, a random effect model revealed a non-significant effect on HbA1c at the first time point of post-intervention (MD=0.02; 95% CI= -0.23, 0.26; $p=0.89$) (Fig. 3) with low heterogeneity ($I^2=0\%$, $p=0.62$).

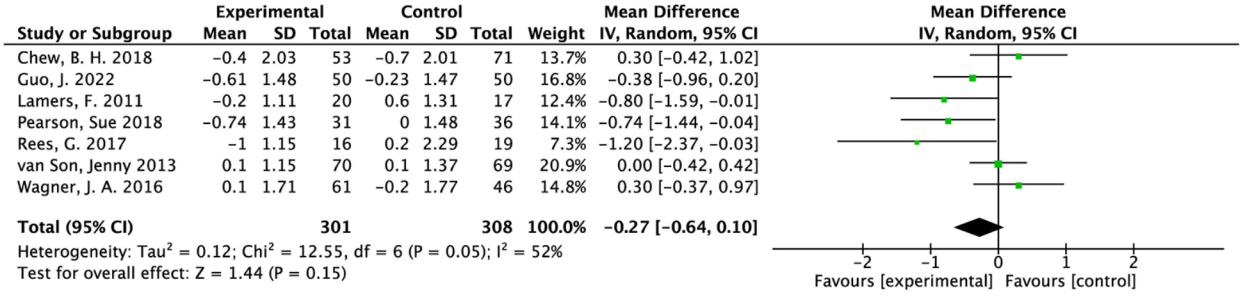
7 studies including 609 participants provided the follow-up data for calculating the long-term effect of psychological interventions on HbA1c. At 3–12 months post-intervention, a random effect model revealed a non-significant effect on HbA1c (MD= -0.27; 95% CI= -0.64, 0.10; $p=0.15$) (Fig. 3) with moderate heterogeneity ($I^2=52\%$, $p=0.05$).

Subgroups and sensitivity analyses

Based on our previous literature review, we believe that the following intervention characteristics may introduce heterogeneity; therefore, we conducted subgroup analyses accordingly: (a) the provider of the psychological intervention, specifically whether they are professional psychologists; (b) the inclusion of a technology component; (c) the format of the intervention, whether



(a)



(b)

Fig. 3 Effect of psychological interventions on HbA1c. (**a**) short-term; (**b**) long-term

individual or group-based; and (d) the baseline scores of diabetes distress, specifically whether they are above the cut-off, to explore potential heterogeneity across subgroups.

Regarding the short-term effects on diabetes distress, we did not observe a significant decrease in heterogeneity across subgroups. However, as shown in Table 2, interventions delivered in a group format resulted in a significant and larger effect (SMD= -0.65; 95% CI= -1.20, -0.10; $p=0.02$). Similarly, interventions targeting participants with baseline diabetes distress scores above the cut-off demonstrated a significant and larger effect (SMD= -0.97; 95% CI= -1.65, -0.30; $p=0.005$). Furthermore, interventions provided by professional psychologists also yielded a significant and larger effect (SMD= -0.93; 95% CI= -1.78, -0.09; $p=0.03$). Interventions containing a technology component yielded a larger but non-significant effect (SMD= -1.76; 95% CI= -5.09, 1.58; $p=0.30$).

As for the long-term effect, interventions delivered by professional psychologists significantly reduced diabetes distress (SMD= -0.31; 95% CI=0.58, -0.05; $p=0.02$) with low heterogeneity ($I^2=0\%$, $p=0.97$), whereas intervention effects of other subgroups were non-significant (Supplementary material Table S2).

We performed sensitivity analysis by removing one study in each turn. When the study conducted by Guo et al. [32] was removed from the analysis of the short-term effect of psychological intervention on diabetes distress, the heterogeneity reduced ($I^2=76\%$), whereas the overall effect also declined (SMD= -0.34; 95% CI= -0.56, -0.12; $p=0.003$) (Supplementary material Figure S2).

Publication bias

The funnel plot suggested the possibility of publication bias, as studies with small samples were expected to appear in the lower right corner (Supplementary material Figure S3). Additionally, Egger's test indicated potential publication bias ($p=0.019$).

Discussion

This systematic review and meta-analysis examined the effectiveness of psychological intervention on diabetes distress of people with type 2 diabetes. Sixteen studies with 1639 participants were included in the meta-analysis. Our results indicated that psychological interventions measured diabetes distress as a primary outcome could significantly reduce diabetes distress in short-term with large effect compared with control groups, which is consistent with the previous study conducted by Schmidt et al., which included both type 1 and type 2 diabetes, but inconsistent with the study conducted by Chew et al., which found a small and non-significant effect of psychological intervention on diabetes distress of people with type 2 diabetes. The possible reason for the conflicting results might be the different inclusion criteria as we only included studies that measured diabetes distress as a primary outcome while studies included in Chew et al. mostly measured diabetes distress as a secondary outcome. We believe that designing specific psychological interventions with diabetes distress as the primary outcome is important, not only due to the high prevalence of diabetes distress but also because it is distinct from general psychological distress in its focus on diabetes-specific psychological issues. Unlike interventions that target general psychological distress, such as anxiety and depression, focusing on diabetes distress aligns more

Table 2 Subgroup analysis on the short-term effect of psychological interventions on DD

Title	Number of trials	Number of participants	Statistical method	Effect size	Overall effect, *p* value	Heterogeneity I^2 value
Overall effect	16	1639	SMD (IV, Random, 95% CI)	-0.56 [-0.90, -0.22]	$p=0.001$	91%
1. provider of intervention						
1.1 non-professional psychologist	12	1334	SMD (IV, Random, 95% CI)	-0.45 [-0.83, -0.06]	$p=0.02$	91%
1.2 professional psychologist	4	305	SMD (IV, Random, 95% CI)	-0.93 [-1.78, -0.09]	$p=0.03$	91%
2. whether contains a technology component						
2.1 contains a technology component	2	342	SMD (IV, Random, 95% CI)	-1.76 [-5.09, 1.58]	$p=0.30$	99%
2.2 without technology component	14	1297	SMD (IV, Random, 95% CI)	-0.37 [-0.61, -0.12]	$p=0.003$	77%
3. delivery format						
3.1 individual	8	778	SMD (IV, Random, 95% CI)	-0.46 [-0.90, -0.02]	$p=0.04$	87%
3.2 group	8	861	SMD (IV, Random, 95% CI)	-0.65 [-1.20, -0.10]	$p=0.02$	93%
4. baseline DD scores						
4.1 above cutoff	8	726	SMD (IV, Random, 95% CI)	-0.97 [-1.65, -0.30]	$p=0.005$	94%
4.2 below cutoff	8	913	SMD (IV, Random, 95% CI)	-0.09 [-0.27, 0.09]	$p=0.32$	42%

DD, diabetes distress; SMD, Standardized Mean difference

closely with the unique challenges faced by individuals with diabetes. Furthermore, we only included interventions for people with type 2 diabetes rather than interventions for mixed populations since people with type 1 and type 2 diabetes might have different struggles with diabetes. For example, the negative emotions of people with type 2 diabetes link more closely with lifestyle changes, the permanence of diabetes, and lack of sufficient social support [18, 44, 45]. Therefore, summarizing the evidence for the effects of psychological interventions designed for this specific population is necessary, while future research needs to continue to be explored because of the limited number of trials in this area.

According to the further subgroup analysis, we found that the effect of interventions could be bolstered by several intervention characteristics, including group format, supported by a technology component, provided by professional psychologists and baseline diabetes distress scores of participants above the cut-off. The greater effect of interventions delivered through small groups may be because group members can share feelings and exchange experiences, a process that may be an important source of social support [46, 47]. The larger effect of interventions supported by a technology component is in line with the results of a previous review, which examined psychoeducational interventions for type 2 diabetes distress [48]. In our narrative review, three studies used either mobile app-based or web-based mode to support the delivery of interventions, and all them showed promising results in improving diabetes distress [27, 29, 32]. Besides, the reason of dropout of participation of intervention were similar among included studies, such as time conflicts, lack of interest and travel long distance to healthcare settings [31, 35, 37]. Given the cost-effectiveness and accessibility of technology-based platforms, it would boost the adherence of psychological interventions and help overcome the barriers existed in currently traditional intervention delivery mode; however, the evidence in this area is still limited and needed to be explored in the future [49, 50]. The finding that participants with baseline diabetes distress levels above the cut-off benefitted more from the psychological intervention is consistent with the review conducted by Schmidt et al. [14], but we produced a larger effect in this particular population. The potential reason for this finding may be a floor effect, suggesting that participants without diabetes distress benefit less from interventions that reduce diabetes distress [17, 29]. Therefore, future studies aimed at improving diabetic distress should consider including only participants with elevated levels of diabetic distress at baseline. In addition, although current guidelines recommend that all members of the healthcare team, including specialist nurses, can provide psychological interventions for people with diabetes [3], the present study found that interventions delivered by psychologists have a greater effect. Therefore, promoting a collaborative care model and encouraging online support from psychological professionals could help broaden access to psychological services. However, due to the limited number of studies in the subgroup analyses, this finding warrants further exploration.

Additionally, we used follow-up data from included studies to detect the long-term effect on diabetes distress, and we found a medium but non-significant effect. In the subgroup analysis, we found that interventions delivered by professional psychologists showed a significant and medium effect, suggesting that the maintenance of the intervention effect might require the guidance of professional psychologists [17, 41]. However, the number of studies included in the subgroup analysis was limited, thus the results should be interpreted with caution. And the medium to long-term effect of psychological interventions in this population should be further examined in high-quality trials.

Finally, we did not find short- and long-term effects of psychological intervention on HbA1c, which is inconsistent with the findings of Chew et al. who showed a small benefit on HbA1c at 6–12 months of follow-up [12]. However, our results are consistent with studies by Schmidt et al. and Mathiesen et al. who found that a reduction in diabetes distress did not appear to be associated with an improvement in HbA1c [13, 14]. We assume that the possible reason might be the potential mechanism of the association between diabetes distress and glycemic level, as indicated by previous research that self-management activities might mediate the pathways between diabetes distress and glycemic outcomes [45, 51]. Thus, substantial improvements in glycemic outcomes might take time and require interventions that have both emotional and educational components to provide knowledge for self-management and techniques for dealing with negative feelings [6]. However, longitudinal studies exploring the underlying mechanism are scarce in this area, and the causative link between diabetes distress and glycemic level still needed to be explored to maximize the intervention effect. Another point to note is that we only focused on psychological interventions that included diabetes distress as a primary outcome, which may have led to inaccurate estimates of the effect of psychological interventions to improve glycemic level.

Strength and limitations

As far as we know, this is the first systematic review and meta-analysis exploring the short and long-term effects of diabetes distress tailored psychological intervention on diabetes distress and HbA1c in people with type 2 diabetes. Although the number of included studies is limited, we verify the evidence that psychological interventions

tailored for diabetes distress showed promising results in this specific population. Moreover, according to our subgroup analysis, the short-term effect of interventions could be bolstered when delivered in a group format, using a technology component, provided by psychologists, or including participants having elevated baseline diabetes distress scores.

Nevertheless, some limitations of this review should be acknowledged. Firstly, due to the nature of psychological interventions that blinding is difficult to implement and the fact that diabetes distress is a self-report outcome, most of the included studies are rated as some concerns or of high risk in methodological quality. Secondly, although we tried to explore the potential origins of the considerable heterogeneity across studies, we failed to find a significant decrease in heterogeneity according to subgroups performed in this review. However, we further performed sensitivity analysis and we found a significant decrease in heterogeneity after removing the study conducted by Guo et al. [32], whereas the effect of interventions also declined. This might be because this study was conducted in a hospital setting as most other studies were conducted in community settings, as well as it was the only included study that used a mobile app to support the intervention. Thirdly, there were relatively insufficient studies for some subgroups, thus more studies in this area are needed to draw sound conclusions. Given the above limitations, the results of this review should be interpreted with caution.

Conclusions

In this review, we found evidence supporting that psychological interventions tailored for diabetes distress in people with type 2 diabetes are effective in reducing the level of diabetes distress in the short term, and the intervention effect could be enhanced when delivered in a group format, using a technology component, provided by psychologists, or including participants having elevated baseline diabetes distress scores. More trials are needed to combine efficient intervention components and to explore the long-term effect of psychological interventions on diabetes distress as well as the underlying mechanism of improvement in glycemic level.

Abbreviations

CI	Confidence Interval.
SMD	Standardized Mean difference.
SD	Standard Deviation.
MD	Mean Difference.
RCT	Randomized Controlled Trial.
RoB 2	Revised Cochrane risk-of-bias tool for randomized trials.
PAID	Problem Areas in Diabetes.
DDS	Diabetes Distress Scale.
CDDS-15	Chinese Diabetes Distress Scale.
SF-PAID-C	Chinese version of short-form PAID.
ACT	Acceptance and Commitment Therapy.
CBT	Cognitive Behavioral Therapy.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12888-024-06125-z.

Supplementary Material 1

Supplementary Material 2

Acknowledgements

None.

Author contributions

ZWT and WLS designed the study; ZWT, ZSY and HXM performed study screening, data extraction; ZWT and ZSY performed quality assessment; ZWT drafted this paper; WLS and NWB provided guidance and amendments. All authors contributed to the interpretation of the findings and approved the final version of the article to be published.

Funding

This work was supported by the Science and technology Enhancement Program of Hebei Province [No. 22567663H].

Data availability

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]School of Nursing, Jilin University, No.965 Xinjiang Street, Changchun, Jilin 130021, China
[2]Yanda Medical Research Institute, Hebei Yanda Hospital, Langfang 065201, China

Received: 14 July 2023 / Accepted: 30 September 2024
Published online: 08 October 2024

References

1. International Diabetes Federation. IDF diabetes atlas 8th edition. Int Diabetes Fed. 2017;:905–11.
2. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: results from the International Diabetes Federation Diabetes Atlas, 9th edition. Diabetes Res Clin Pract. 2019;157:107843.
3. Young-Hyman D, de Groot M, Hill-Briggs F, Gonzalez JS, Hood K, Peyrot M. Psychosocial Care for people with diabetes: a position Statement of the American Diabetes Association. Diabetes Care. 2016;39:2126–40.
4. Snoek FJ, Bremmer MA, Hermanns N. Constructs of depression and distress in diabetes: time for an appraisal. Lancet Diabetes Endocrinol. 2015;3:450–60.
5. Fisher L, Polonsky WH, Hessler D. Addressing diabetes distress in clinical care: a practical guide. Diabet Med. 2019. dme.13967.
6. Skinner TC, Joensen L, Parkin T. Twenty-five years of diabetes distress research. Diabet Med. 2019. dme.14157.
7. Perrin NE, Davies MJ, Robertson N, Snoek FJ, Khunti K. The prevalence of diabetes-specific emotional distress in people with type 2 diabetes: a systematic review and meta-analysis. Diabet Med. 2017;34:1508–20.
8. Co MA, Tan LSM, Tai ES, Griva K, Amir M, Chong KJ, et al. Factors associated with psychological distress, behavioral impact and health-related quality of

life among patients with type 2 diabetes mellitus. J Diabetes Complications. 2015;29:378–83.
9. Chew B-H, Vos RC, Pouwer F, Rutten GEHM. The associations between diabetes distress and self-efficacy, medication adherence, self-care activities and disease control depend on the way diabetes distress is measured: comparing the DDS-17, DDS-2 and the PAID-5. Diabetes Res Clin Pract. 2018;142:74–84.
10. Fisher LPHD, Mullan JTPHD, Arean PPHD, Glasgow REPHD, Hessler DPHD, Masharani UMD. Diabetes distress but not clinical depression or depressive symptoms is Associated with Glycemic Control in both cross-sectional and longitudinal analyses. Diabetes Care. 2010;33:23–8.
11. Van Bastelaar KMP, Pouwer F, Geelhoed-Duijvestijn PHLM, Tack CJ, Bazelmans E, Beekman AT, et al. Diabetes-specific emotional distress mediates the association between depressive symptoms and glycaemic control in type 1 and type 2 diabetes: distress mediates relation between depression and HbA1c. Diabet Med. 2010;27:798–803.
12. Chew BH, Vos RC, Metzendorf M-I, Scholten RJ, Rutten GE. Psychological interventions for diabetes-related distress in adults with type 2 diabetes mellitus. Cochrane Database Syst Rev. 2017;2017.
13. Mathiesen AS, Egerod I, Jensen T, Kaldan G, Langberg H, Thomsen T. Psychosocial interventions for reducing diabetes distress in vulnerable people with type 2 diabetes mellitus: a systematic review and meta-analysis. Diabetes Metab Syndr Obes Targets Ther. 2018;12:19–33.
14. Schmidt CB, Van Loon BJP, Vergouwen ACM, Snoek FJ, Honig A. Systematic review and meta-analysis of psychological interventions in people with diabetes and elevated diabetes-distress. Diabet Med. 2018;35:1157–72.
15. Sturt J, Dennick K, Hessler D, Hunter BM, Oliver J, Fisher L. Effective interventions for reducing diabetes distress: systematic review and meta-analysis. Int Diabetes Nurs. 2015;12:40–55.
16. Chaimani A. Accounting for baseline differences in meta-analysis. Evid Based Ment Health. 2015;18:23–6.
17. Van Son J, Nyklíček I, Pop VJ, Blonk MC, Erdtsieck RJ, Spooren PF, et al. The effects of a mindfulness-based intervention on emotional distress, quality of life, and HbA1c in outpatients with diabetes (DiaMind). Diabetes Care. 2013;36:823–30.
18. Orben K, Ritholz MD, McCalla M, Beverly EA. Differences and similarities in the experience of living with diabetes distress: a qualitative study of adults with type 1 and type 2 diabetes. Diabet Med. 2022;39.
19. Browne JL, Ventura A, Mosely K, Speight J. 'I call it the blame and shame disease': a qualitative study about perceptions of social stigma surrounding type 2 diabetes. Open Access.
20. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;:n71.
21. Higgins JP, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, et al. Cochrane handbook for systematic reviews of interventions. Wiley; 2019.
22. Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Boutron I et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ. 2019;:l4898.
23. Guyatt G, Oxman AD, Akl EA, Kunz R, Vist G, Brozek J, et al. GRADE guidelines: 1. Introduction—GRADE evidence profiles and summary of findings tables. J Clin Epidemiol. 2011;64:383–94.
24. Sawilowsky SS. New effect size rules of Thumb. J Mod Appl Stat Methods. 2009;8:597–9.
25. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ. 2003;327:557–60.
26. Chen H, Manning AK, Dupuis J. A method of moments Estimator for Random Effect Multivariate Meta-Analysis. Biometrics. 2012;68:1278–84.
27. DiNardo MM, Greco C, Phares AD, Beyer NM, Youk AO, Obrosky DS, et al. Effects of an integrated mindfulness intervention for veterans with diabetes distress: a randomized controlled trial. BMJ Open Diabetes Res Care. 2022;10:e002631.
28. Kılıç A, Hudson J, Scott W, McCracken LM, Hackett RA, Hughes LD. An online acceptance, commitment, and self-compassion based treatment to decrease psychological distress in people with type 2 diabetes: a feasibility randomised-controlled trial. Internet Interv. 2023;33:100658.
29. Fisher L, Hessler D, Glasgow RE, Arean PA, Masharani U, Naranjo D, et al. REDEEM: a pragmatic trial to reduce diabetes distress. Diabetes Care. 2013;36:2551–8.
30. Wagner JA, Bermudez-Millan A, Damio G, Segura-Perez S, Chhabra J, Vergara C, et al. A randomized, controlled trial of a stress management intervention for latinos with type 2 diabetes delivered by community health workers: outcomes for psychological wellbeing, glycemic control, and cortisol. Diabetes Res Clin Pract. 2016;120:162–70.
31. Whittemore R, Melkus GD, Sullivan A, Grey M. A nurse-coaching intervention for women with type 2 diabetes. Diabetes Educ. 2004;30:795–804.
32. Guo J, Wang H, Ge L, Valimaki M, Wiley J, Whittemore R. Effectiveness of a nurse-led mindfulness stress-reduction intervention on diabetes distress, diabetes self-management, and HbA1c levels among people with type 2 diabetes: a pilot randomized controlled trial. Res Nurs Health. 2022;45:46–58.
33. Ngan HY. Preliminary efficacy of an acceptance-based diabetes education (ACT-DE) programme for people with type 2 diabetes on diabetes distress and self-care behaviours: a pilot randomised controlled trial. J Context Behav Sci. 2023.
34. Li Z, Chen Q, Yan J, Liang W, Wong WCW. Effectiveness of motivational interviewing on improving care for patients with type 2 diabetes in China: a randomized controlled trial. BMC Health Serv Res. 2020;20:57.
35. Kasteleyn MJ, Vos RC, Rijken M, Schellevis FG, Rutten GEHM. Effectiveness of tailored support for people with type 2 diabetes after a first acute coronary event: a multicentre randomized controlled trial (the Diacourse-ACE study). Diabet Med. 2016;33:125–33.
36. Lamers F, Jonkers CCM, Bosma H, Knottnerus JA, Van Eijk JTM. Treating depression in diabetes patients: does a nurse-administered minimal psychological intervention affect diabetes-specific quality of life and glycaemic control? A randomized controlled trial: Depression treatment and diabetes outcomes. J Adv Nurs. 2011;67:788–99.
37. Schroevers MJ, Tovote KA, Keers JC, Links TP, Sanderman R, Fleer J. Individual mindfulness-based cognitive therapy for people with diabetes: a pilot randomized controlled trial. Mindfulness. 2015;6:99–110.
38. Pearson S, Wills K, Woods M, Warnecke E. Effects of Mindfulness on psychological distress and HbA1c in people with diabetes. Mindfulness. 2018;9:1615–26.
39. Rees G, O'Hare F, Saeed M, Sudholz B, Sturrock BA, Xie J, et al. Problem-solving therapy for adults with diabetic retinopathy and diabetes-specific distress: a pilot randomized controlled trial. BMJ Open Diabetes Res Care. 2017;5:e000307.
40. Abbas Q. Cognitive behavior therapy for diabetes distress, depression, health anxiety, quality of life and treatment adherence among patients with type-II diabetes mellitus: a randomized control trial. 2023.
41. Maghsoudi Z, Razavi Z, Razavi M, Javadi M. Efficacy of Acceptance and Commitment Therapy for emotional distress in the Elderly with type 2 diabetes: a Randomized Controlled Trial. Diabetes Metab Syndr Obes Targets Ther. 2019;12:2137–43.
42. Chew BH, Vos RC, Stellato RK, Ismail M, Rutten GEHM. The effectiveness of an emotion-focused educational programme in reducing diabetes distress in adults with type 2 diabetes mellitus (VEMOFIT): a cluster randomized controlled trial. Diabet Med. 2018;35:750–9.
43. Jung HY, Lee H, Park J. Comparison of the effects of Korean mindfulness-based stress reduction, walking, and patient education in diabetes mellitus: Korean mindfulness meditation. Nurs Health Sci. 2015;17:516–25.
44. Tanenbaum ML, Kane NS, Kenowitz J, Gonzalez JS. Diabetes distress from the patient's perspective: qualitative themes and treatment regimen differences among adults with type 2 diabetes. J Diabetes Complications. 2016;30:1060–8.
45. Hernandez L, Leutwyler H, Cataldo J, Kanaya A, Swislocki A, Chesla C. Symptom Experience of older adults with type 2 diabetes and diabetes-related distress. Nurs Res. 2019;68:374–82.
46. Afshar R, Tang TS, Askari AS, Sidhu R, Brown H, Sherifali D. Peer support interventions in type 2 diabetes: review of components and process outcomes. J Diabetes. 2020;12:315–38.
47. Heisler M. Overview of peer support models to improve diabetes self-management and clinical outcomes. Diabetes Spectr. 2007;20:214–21.
48. Perrin N, Bodicoat DH, Davies MJ, Robertson N, Snoek FJ, Khunti K. Effectiveness of psychoeducational interventions for the treatment of diabetes-specific emotional distress and glycaemic control in people with type 2 diabetes: a systematic review and meta-analysis. Prim Care Diabetes. 2019;13:556–67.
49. Yap JM, Tantono N, Wu VX, Klainin-Yobas P. Effectiveness of technology-based psychosocial interventions on diabetes distress and health-relevant outcomes among type 2 diabetes mellitus: a systematic review and meta-analysis. J Telemed Telecare. 2021. 1357633X2110583.
50. White V, Linardon J, Stone JE, Holmes-Truscott E, Olive L, Mikocka-Walus A, et al. Online psychological interventions to reduce symptoms of depression, anxiety, and general distress in those with chronic health conditions: a systematic review and meta-analysis of randomized controlled trials. Psychol Med. 2022;52:548–73.

51. Hessler D, Strycker L, Fisher L. Reductions in Management Distress following a randomized distress intervention are Associated with improved diabetes behavioral and glycemic outcomes over Time. Diabetes Care. 2021;44:1472–9.

Publisher's note