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Research paper

A randomised controlled feasibility trial of Behavioural activation as a treatment for people with diabetes and depression: (DiaDeM feasibility trial)

Naveed Ahmed [a,k], Gerardo A. Zavala [b,*], Faraz Siddiqui [b], Faiza Aslam [c], Ada Keding [e], Shannon Halmkan [e], Saima Afaq [b,g], Hannah Maria Jennings [b,i], Ashraful Anas [a], Sanjit K. Shaha [a], Kazi Moriom Jahan [a], Abdul Kuddus [a], Zara Nisar [g], Simon M. Walker [d], Anum Naz [c], Hira Shakoor [g], Asima K. Niazi [h], Rowena Jacobs [d], Karen Coales [b], Kishwar Azad [a], Edward Fottrell [f], Zia Ul Haq [g], David Ekers [b,j], Najma Siddiqi [b,i], Catherine Hewitt [e], on behalf of the DiaDeM Global Health Research Group

[a] *Centre for Health Research and Implementation, Diabetic Association of Bangladesh, Bangladesh*
[b] *Department of Health Sciences, University of York, United Kingdom*
[c] *Institute of Psychiatry, Rawalpindi Medical University, Pakistan*
[d] *Centre for Health Economics, University of York, United Kingdom*
[e] *Department of Health Sciences, York, Trials Unit, United Kingdom*
[f] *Institute for Global Health, University College London, United Kingdom*
[g] *Institute of Public Health and Social Sciences, Khyber Medical University, Pakistan*
[h] *Baqai Institute of Diabetes and Endocrinology(BIDE), Karachi, Pakistan*
[i] *Hull York Medical School, York, United Kingdom*
[j] *Tees Esk and Wear Valleys NHS Foundation Trust, York, United Kingdom*
[k] *BIRDEM General Hospital, Bangladesh*

A B S T R A C T

Background: There is a lack of evidence on effective treatments for depression in people with T2DM, particularly in Low and Middle-Income Countries (LMICs). This study aims to test the feasibility and acceptability of a culturally adapted Behavioural Activation (BA) intervention (DiaDeM) for people with depression and T2DM in two South Asian LMICs.

Methods: A multicountry, individually randomised-controlled feasibility trial was conducted from March 2022 to November 2022. We recruited adults from diabetes healthcare facilities in Bangladesh and Pakistan with a diagnosis of depression and T2DM. Consenting individuals were randomised to either optimised usual care or the DiaDeM intervention, which comprised six BA sessions delivered by non-mental health facilitators over six to twelve weeks. Participants were followed up at three and six months post-randomisation. The feasibility and acceptability of recruitment and retention, intervention delivery, and data collection were assessed. A mixed-methods process evaluation was also performed to inform the main trial.

Results: The DiaDeM feasibility trial successfully recruited 128 participants, with 85 % retention at six months follow-up. The majority of participants engaged with the intervention, demonstrating good adherence to the Behavioural Activation (BA) sessions. Data completeness for key outcomes, including depression severity and HbA1c levels, was high across all time points (>90 %). The process evaluation showed high acceptability of the intervention, with participants reporting increased motivation and improved management of both T2DM and depression.

Discussion: Good recruitment and retention rates, completeness of data collection, and high acceptability of the intervention showed that it would be feasible to undertake a full-scale trial.

* Corresponding author at: ATB 148, Department of health sciences, University of York, Heslington, York YO10 5DD, UK, .
E-mail address: g.zavala@york.ac.uk (G.A. Zavala).

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1. Introduction

1.1. Diabetes and depression multimorbidity

The increasing prevalence of depression among people with diabetes presents a significant and complex challenge to individuals, health systems, and society at large (Mendenhall et al., 2014; Lloyd et al., 2018). The interplay between these two conditions is particularly pronounced, as diabetes management demands consistent self-care and lifestyle modifications, which can contribute to emotional distress and exacerbate the risk of depression (Lloyd et al., 2018). Among individuals with diabetes, the risk of co-occurring depression increases by 2 to 3 times (Mendenhall et al., 2014; Lloyd et al., 2018). The presence of both depression and diabetes yields adverse health outcomes, affecting clinical progress, diminishing quality of life, and elevating mortality (Vigo et al., 2016; Andreoulakis et al., 2012). Moreover, the convergence of depression and diabetes exacerbates the decline in diabetes self-management, glycemic control, and diabetes-related complications (van Dooren et al., 2013; Egede and Ellis, 2010; Lustman et al., 2000). Healthcare utilisation and costs rise significantly for individuals with comorbid diabetes and depression compared to those with diabetes alone (Egede et al., 2002).

1.2. Diabetes and depression multimorbidity in the context of South Asia

The prevalence of diabetes in South Asia is one of the highest globally (Misra et al., 2019). It is the most common non-communicable disease (NCD) in South Asia, with an estimated prevalence of 16.7 % in Pakistan and 11.4 % in Bangladesh (Organization WH, 2018; Basit et al., 2021), and the prevalence of depression in people with diabetes is estimated to be 36 % in Bangladesh, (Roy and Lloyd, 2012) and 26 % in Pakistan (Basit et al., 2021). Cultural, social, and economic factors unique to South Asia can influence the experience and expression of both conditions, highlighting the need for comprehensive research and targeted interventions (Holt and van der Feltz-Cornelis, 2012). Addressing the burden of depression in people with diabetes in South Asia requires a better understanding of the intricate connections between physical and mental health, as well as culturally sensitive approaches that consider the multifaceted nature of this challenge (Zavala et al., 2023a). Both pharmacological and psychological approaches have been shown to be effective in treating depression in people with diabetes; however, most of the evidence comes from high-income countries (HIC) (Holt et al., 2014; Markowitz et al., 2011; van der Feltz-Cornelis et al., 2010). In LMICs, a comprehensive and unified approach is needed to address coexisting mental health conditions alongside NCDs, to enhance overall outcomes and quality of life. This is especially critical in South Asia, where overburdened and underfunded health systems struggle to meet the growing demand for integrated care (Organization WH, 2014; Integrating the prevention, treatment and care of mental health conditions and other NCDs within health systems, 2019).

1.3. BA for depression in people with long term conditions

Behavioural Activation (BA) is a behavioural psychotherapy that has gained recognition and significance as an effective treatment for depression (Uphoff et al., 2020a). BA presents a user-friendly psychological intervention that has been culturally tailored for diverse populations (Martin and Oliver, 2019). Its clear-cut approach to activity scheduling avoids the intricacies and potential stigma associated with more complex techniques (Cuijpers et al., 2007). This intervention is resource-efficient and can be readily administered by mental health professionals or even non-mental health specialists. However, a significant gap exists in terms of trial-based evidence regarding the efficacy and effectiveness of BA for treating depression in conjunction with chronic physical conditions, especially in LMICs (Uphoff et al., 2020b; Mitchell et al., 2009; Hopko et al., 2011). A recent systematic review shows that no studies have been performed in LMICs (Uphoff et al., 2020b), another systematic review focusing on South Asia showed that there is no evidence about the effectiveness of BA for people with long term conditions (Zavala et al., 2023b). However it shows that psychological therapies are effective to improve depressive symptoms in people with NCDs (Zavala et al., 2023b).

1.4. Justification to deliver a feasibility trial

Currently, there is insufficient evidence to determine the feasibility of conducting a multicountry full-scale trial to test the effectiveness of BA for depression in people with diabetes in South Asia. We have carefully adapted the BA intervention, called DiaDeM, to suit this context (Zavala et al., 2023a). However, in addition to testing feasibility, it is crucial to determine if any further modifications are needed to better fit the local context. To facilitate the delivery of a full trial, it is essential to first conduct a feasibility study to assess the practicality of recruiting participants, delivering the intervention, retaining participants, and collecting outcome data.

1.5. Aims

The primary objective of this feasibility trial is to evaluate the practicality of implementing the DiaDeM intervention for individuals with diabetes and depression in South Asia. This involves several key specific objectives 1) measuring the overall recruitment rate and retention rates at 3 months and 6 months post-randomisation; 2) to assess the feasibility and acceptability of using the proposed tools and methods for baseline and follow-up outcome measures; 3) evaluate the feasibility of collecting service use and other economic data to support the economic analysis of the main trial and 4) determine the standard deviation for the primary outcome in this population; and 5) identify whether the intervention can be implemented as planned and identify any necessary adaptations before proceeding to a definitive trial.

2. Methods

2.1. Trial design

We conducted a multi-country parallel-arm, individually randomised controlled feasibility trial to evaluate the DiaDeM (BA) intervention in comparison to optimised usual care. The trial has been registered under ISRCTN/75501608, and the corresponding protocol has been published (Aslam et al., 2022).

2.2. Settings

The DiaDeM feasibility trial was conducted in tertiary care facilities in Bangladesh and Pakistan. In Pakistan, the trial included two sites in Rawalpindi City, Punjab province, and one site each in Peshawar and Kohat cities, Khyber Pakhtunkhwa province. The Rawalpindi sites were located in two specialised diabetes clinics within the outpatient departments of Benazir Bhutto Hospital and Rawalpindi District Headquarters Hospital. In Khyber Pakhtunkhwa, the trial sites comprised Kohat District Headquarters Hospital, a public hospital, and Sugar Hospital in Hayatabad, a private specialised diabetes hospital. In Bangladesh, the trial was conducted at two sites managed by the Diabetic Association of Bangladesh. The first site was BIRDEM General Hospital in Shahbagh, Dhaka, a 750-bed tertiary hospital that is the largest diabetes centre in the country, serving 3000 to 3500 patients daily. The second site was Sylhet Diabetic Hospital in Puran Lane, Zindabazar, Sylhet, a 65-bed tertiary hospital dedicated to diabetes care. At both sites, study participants were recruited from the outpatient departments.

2.3. Participants

2.3.1. Inclusion and exclusion criteria

We included adults diagnosed with Type 2 diabetes mellitus (T2DM) who attended outpatient health facilities providing established diabetes services in Bangladesh and Pakistan. People with confirmed diagnosis of T2DM and mild, moderate, or severe depression using PHQ-9 and major depressive disorder (MDD) confirmed with MINI.

Patients already receiving psychotherapy for depression or lacking the capacity to provide informed consent and/or to take part in therapy because of cognitive impairment, or severity of mental or physical illness were excluded from the study.

2.4. Recruitment

We invited individuals seeking treatment at specialised diabetes clinics who had been diagnosed with T2DM by the healthcare professionals at the diabetes centres. Diagnosis was made according to standardised criteria, including clinical presentation and measurement of glycemic levels using HbA1C, as documented in the diabetes centres' registration records. Depression status was confirmed through a two-stage screening process; 1) Patient Health Questionnaire-2 (PHQ-2) (Kroenke et al., 2003) which was administered by the health care staff at the respective diabetes centres at the study sites, incorporating it into routine clinical practice; and 2) the 9-item depression module of Patient Health Questionnaire-9 (PHQ-9) administered by the research team after referral from the healthcare staff (Kroenke and Spitzer, 2002; Levis et al., 2019). Those with a score of PHQ-9 $\geq$ 5, were confirmed by clinically trained researchers using the depression schedule of the MINI scale validated in both Bengali and Urdu versions. (version 6.0) (Lecrubier et al., 1997).

2.5. Informed consent

Screened, eligible participants received a study information sheet written in local languages and complying with local and international ethics requirements. Participants were informed that they could withdraw consent and leave the trial at any point in time. Those willing to participate read and signed a consent form; those unable to provide a signature record consent using their thumbprint.

2.6. Interventions

DiaDeM Arm: Participants assigned to the DiaDeM arm received a culturally adapted Behavioural Activation (BA) intervention called DiaDeM. Developed through a co-design approach, DiaDeM includes techniques such as identifying and scheduling pleasurable activities, setting achievable goals, addressing avoidance behaviours, and fostering problem-solving skills. These techniques aim to increase participants' engagement in rewarding activities and enhance their mood. The intervention was delivered by non-mental health specialist staff—referred to as BA facilitators—including diabetes educators, nurses, nutritionists, and paramedics, who were formally trained by BA experts. Each participant in the DiaDeM arm completed six individual sessions, lasting 20–40 min each, conducted face-to-face or remotely over a period of 6 to 12 weeks within the diabetes centres. Sessions were guided by a detailed manual and supervised by mental health specialists (BA supervisors), ensuring consistent delivery across sites. Further details on DiaDeM's components and cultural adaptations are available in a separate publication (Zavala et al., 2023a).

The DiaDeM booklet provided to participants serves as both a structured guide and a source of psychoeducational support. It includes worksheets for activity scheduling, goal setting, and self-monitoring exercises—core components of BA interventions. Additionally, the booklet contains psychoeducational content that explains the link between behaviour and mood, particularly relevant for individuals managing both diabetes and depression. These materials help participants identify and engage in pleasurable and rewarding activities that positively impact their mental and physical health. The booklet supports the BA facilitator to guide ongoing self-directed work between sessions, encouraging participants to practise and reinforce the skills they learn. In addition participants received the 'optimised usual care' leaflet, which described depression and its treatment, including details on how to access help.

Control Arm: Participants randomised to the control arm received optimised routine care. They continued to receive diabetes care from the same facility and were given verbal and written advice on how to access treatment for depression. If they were already receiving treatment for depression, they were advised to continue with it or to seek further assessment and management according to the optimised care pathway. This referral and advice were provided by non-mental health specialist staff working at each facility. Control group participants did not have any further contact with the non-mental health specialist staff for study purposes and continued their routine management at the diabetes centre. Additionally, control participants received an 'optimised usual care' leaflet.

2.7. Sample size

A combined total of 128 participants were enrolled, with 64 individuals each to be selected from Bangladesh and Pakistan. This sample size allows accurate estimations of recruitment (50 %) and follow-up rates (80 %) with margin of error of 9 % and 10 % respectively (O'Neill, 2022).

2.8. Randomisation

Eligible and consenting individuals were randomly allocated 1:1 to either the DiaDeM intervention or optimised usual care using an online form that would return the allocation by email along with a unique trial participant identifier (ID). The patient was informed of their allocation, and this was noted in their records.

2.9. Sequence generation

The randomisation sequence was generated by a statistician from the University of York, who was independent of trial recruitment. The sequence was computer generated (Stata version 15) stratified block allocation, stratifying by country with randomly varying block sizes of 4 and 6.

2.10. Allocation concealment

Randomisation that followed baseline data collection and entry of patient details into the online system ensured concealment of any upcoming allocations.

2.11. Blinding

The trial operated as an assessor-blinded setup. The trial manager established a log of recruited participants and the corresponding RAs responsible for baseline and follow-up assessments. A strict protocol was followed to ensure that the RAs responsible for participant recruitment, randomisation, and allocation solely conducted the baseline assessment for each patient. For subsequent data collection, a different RA completed the case report forms, thereby maintaining assessor blinding. Patients and clinicians were not blind to treatment allocation.

Table 1
Collection schedule of secondary outcomes at baseline, 3 and 6 months.

Trial secondary outcomes	Baseline	Month 3	Month 6
Demographics Adapted from WHO STEPwise approach to Surveillance (STEPs) instrument*, Version 3.2	X		
Physical body measurements (Weight, height, Body Mass Index, waist circumference, hip circumference, waist–hip ratio, and blood pressure)	X		X
Blood tests: Haemoglobin level (Hb), white blood cell count (WBC), renal function tests including serum urea, serum creatinine and estimated Glomerular Filtration Rate (eGFR), triglycerides, total cholesterol, high-Density Lipoprotein cholesterol (HDL), low-Density Lipoprotein cholesterol (LDL), Thyroid function tests including (serum triiodothyronine (T3), Thyroxine test (T4), Thyroid-stimulating hormone (TSH), Random blood sugar (RBS), and Serum Alanine Transaminase.	X		
Blood test: Glycosylated haemoglobin (HbA1c)	X	X	X
Multimorbidity Adapted from WHO STEPwise approach to Surveillance (STEPs) instrument* Version 3.2	X		X
Depressive symptoms Physical health questionnaire (PHQ-9)	X	X	X
Anxiety symtoms Generalised Depression and Anxiety (GAD-7)	X	X	X
Diabetes distress Problem Areas in Diabetes Scale −5 (PAID-5)	X		X
Self-efficacy Diabetes Empowerment Scale-Short form (DES-SF)	X		X
Diabetes self-management and self-care Perceived Diabetes Self-Management Scale (PDSMS) Summary of self-care diabetes activities scale (SDSCA)	X		X
Physical activity International Physical Activity Questionnaires (IPAQ, (short version)	X		X
Tobacco use The STEPs tobacco and smokeless tobacco modules.	X		X
Alcohol use Adapted questions of the STEPs alcohol module.	X		X
Diabetes complications Diabetes-related microvascular and macrovascular complications	X		X
Health-related quality of life (HRQoL) EQ5D-5 L including visual analogue scale (EQ-5d-VAS)	X	X	X
Mediators Knowledge about depression/symptoms and regarding the link between behaviour and depression, intention to plan and regularly do healthy activities, beliefs about consequences, derived from the intervention logic model	X	X	X
Changes in avoidance and activation over the course of Behavioural Activation for depression PREMIUM Abbreviated Activation Scale (PAAS)	X	X	X
Economic outcomes: Employment status; Household status; Productivity loss (income and days (hours) of work lost); Out-of-pocket payments (OOP); Opportunity cost of time (average wage and time); Borrowing / selling assets; Household earnings and expenditure; Catastrophic health spending (OOP as % of household expenditure)	X		X
Health care resource use Modified client service receipt Inventory (CSRI)	X		X
Medication Modified client service receipt Inventory (CSRI)	X		X

* STEPwise approach to NCD risk factor surveillance (STEPS).

2.12. Feasibility Outcomes

2.12.1. Primary Outcomes

1) Recruitment rates, assessed as the number of participants eligible, consenting and randomised, out of those screened; 2) Reasons for ineligibility/non-participation/non-consent of participants; 3) Length of time required to achieve the required sample size; 4) Retention in the study, assessed as the number of participants randomised who are successfully followed up at 3 and 6 months; 5) Retention in treatment reported as the number of sessions attended out of the total number of sessions offered; 6) Intervention fidelity of delivery of the behavioural activation intervention.

2.12.2. Secondary outcomes

Data completeness for the main trial outcomes was assessed at baseline, 3 months, and 6 months,

2.13. Data collection

Table 1 illustrates the time points at which each measurement and outcome was collected during the trial. he following metrics were measured at baseline, 3 months, and 6 months: HbA1c levels, caseness and severity of depression, anxiety, health-related quality of life (HRQoL), mediators, and changes in avoidance and activation throughout BA for depression. Physical body measurements, comorbidities, diabetes distress, self-efficacy, diabetes self-management and self-care, health risk behaviours, diabetic complications, economic outcomes, healthcare resource use, and medications were assessed at baseline and 6 months. Demographic information and blood tests were only measured at baseline.

Healthcare resource use was collected using a modified and validated version of the Client Service Receipt Inventory (CSRI) [41]. This inventory is widely used to capture service utilisation in health and social care settings. In this study, data was collected on the use of clinic and outpatient facilities, inpatient stays, tests, imaging, and medication, with details of service specialities. Additional economic data, including

employment status, productivity loss, catastrophic health spending, household expenditure, and household assets, was also collected to capture the broader economic impact on participants.

The baseline and follow-up data, along with anthropometric measurements, were directly entered into a remote data collection software (Qualtrics) using tablets.

2.14. Process evaluation

A mixed-methods process evaluation was embedded within the feasibility trial, focusing on what was delivered, how the delivery was achieved, and how context might affect the delivery of the intervention in order to inform plans for the full trial and future scale-up. The process evaluation followed the Medical Research Council guidance for process evaluation (Moore et al., 2015) and the results are reported in a separate paper [publication forthcoming].

To collect the qualitative information, semi-structured interviews were conducted in each site with patients (both intervention and control), BA facilitators, BA supervisors (approximately $N = 28$ patients; $N = 8$ facilitators; $N = 4$ supervisors) immediately following the intervention. The qualitative data explored experiences of participating in the intervention (both its delivery and receiving it) and its acceptability, identified any barriers and drivers to delivery, including contextual factors affecting delivery and implementation. Unintended consequences of the intervention, mechanisms of change, supervision and training needs were also explored during the different interviews.

Quantitative data on attendance, dropout rates, and intervention delivery were systematically collected as part of the feasibility trial. These metrics were assessed on the dose and reach of the intervention. Additionally, data were gathered on mediators specified in the logic model, such as participants' beliefs about the connection between behaviour and mood, at both baseline and follow-up (Table 1). The process evaluation also incorporated qualitative feedback from both BA facilitators and participants. Facilitators shared insights into the acceptability and feasibility of delivering the intervention, while participants provided feedback on their experiences and any practical challenges faced in engaging with the sessions.

The fidelity assessments focused on two main components: adherence to session content and the quality of facilitator-participant interactions. Two structured checklists were developed to assess each component. The checklist for fidelity to content, broke down each session into the planned steps (i.e. completion of DASS, introductions, recap of last session, introducing the topic, completing an activity etc.). For each step completed a score of “1” was given, the total score was added up enabling us to assess what proportion of steps completed. The criteria checklist for facilitator-participant interaction included rapport-building, reflective listening, encouraging participant questions, summarising information, tailoring the intervention to individual participant needs, emphasising participant choice, and guiding participants through the DiaDeM booklet. Each interaction quality measure was rated as ‘none’ (score 0), ‘partial’ (score 1) or ‘full’ (score 2). The totals were added up, to give an indication of the depth and consistency of facilitator engagement. 10 % of sessions (across sites, and representing all 6 sessions) were evaluated using these checklists. This involved two researchers independently listening to recordings of the sessions and completing the checklists. A third senior researcher oversaw the process, and mediated any inconsistencies in scores. Totals and percentages for fidelity were analysed using descriptive statistics, enabling us to examine the extent of fidelity to content and interaction across the different sites and sessions.

2.15. Economic evaluation

We tested methods of collecting service use and other economic data for the economic analysis of the definitive trial outlined in Table 1. Each participant completed the modified Client Service Receipt Inventory, and we collected data about health care resource use and medications and economic outcomes including employment status, productivity loss and catastrophic health spending.

2.16. Statistical analysis

A descriptive analysis was conducted to outline the baseline characteristics of the study population as well as the trajectories of outcome measures throughout the study. Quantitative variables were presented as mean and standard deviation or as median and interquartile range, depending on their distribution. Categorical variables were described using frequencies and proportions. To illustrate the participant flow throughout the study, a CONSORT diagram was provided (Moher et al., 2001).

The standard deviation of participant's PHQ-9 scores at baseline was used to inform on the sample size for the main trial. Recruitment and follow-up rates were estimated and presented along with 95 % confidence intervals (CI). Similarly, treatment retention rates were summarised using frequencies and percentages for each possible number of sessions attended; the mean number of sessions attended in addition to the standard deviation was also given. To report on data availability, completion rates were given as well as a breakdown on the analysability for each outcome measure.

All data were presented by country and trial arm and no formal statistical comparisons were undertaken. In cases where a participant withdrew their consent to participate, the collected data up to the point of withdrawal were retained and included in the analysis, unless there was a specific request for the withdrawal of all data collected until that point.

3. Results

3.1. Screening, recruitment and eligibility

A total of 741 patients across six centres in Bangladesh and Pakistan were screened for eligibility between March 28th and May 12th, 2022. The screening process followed a two-stage approach: (1) initial screening by healthcare staff using the PHQ-2 to identify individuals with potential depressive symptoms and (2) subsequent assessment with the PHQ-9 and MINI to confirm MDD administered by the research team. 741 possible participants were screened in stage 1, 239 in stage 2, 140 met the eligibility criteria, and 128 provided informed consent and accepted to participate in the trial (Fig. 1). (See Fig. 2.)

[1] This excludes the number of routine patients in District Headquarters Hospital, Pakistan where contact was lost after the feasibility trial ended.

3.2. Exclusion

The main reasons for exclusion were a negative diagnosis for depression (<5 using PHQ-9 or negative MDD using MINI), which accounted for 42 exclusions in Pakistan and 36 in Bangladesh (Appendix, Table S1.). Additionally, 13 patients in Pakistan and 12 in Bangladesh did not consent to participate in the trial. The specific reasons for not wanting to participate in each country are outlined in Table 2.

3.3. Retention

3.3.1. Treatment retention

94 % of the participants attended at least one BA session and 84 % attended all sessions. Treatment retention was lower in Pakistan, where 75 % of participants in the intervention group attended all six sessions, compared to 94 % in Bangladesh (Table 3). All four participants who did not attend any sessions fully withdrew from the study; two were no longer contactable, and two stated they no longer wished to continue.

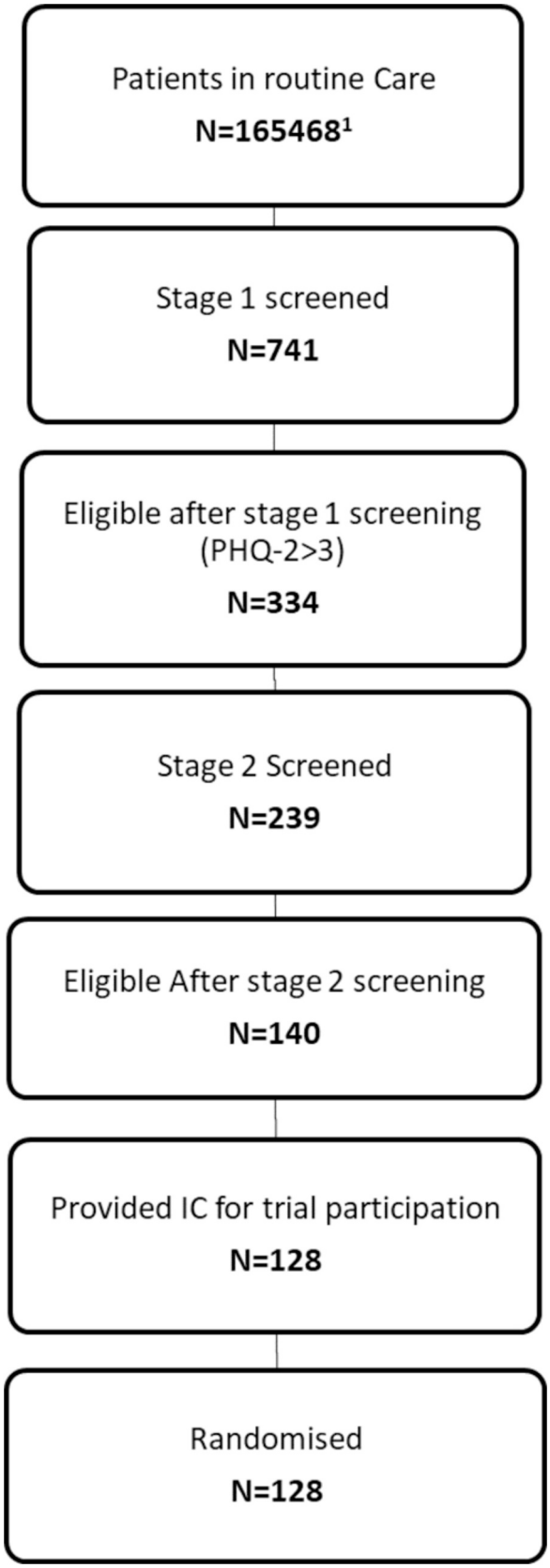

Fig. 1. Recruitment flow diagram.

Additionally, one participant in Pakistan died after receiving two sessions.

3.4. Follow-up Rates

Follow-up rates were 110/128 (86 %, 95 % CI [79 %–91 %]) at 3 months and 109/128 (85 %, 95 % CI[78 %–91 %]) at 6 months. These were higher at sites in Bangladesh (92 % at 3 months, 95 % 6 months) than in Pakistan (80 % at 3 months, 75 % 6 months). As shown in Fig. 3, noticeably lower retention rates were observed in the intervention group for sites in Pakistan.

[1] Although study visits at baseline took place for all participants, baseline PHQ-9 scores are only available for 31 participants in the BA group from each country. This is due to patient data deletion requests; [2] 6-month PHQ-9 scores are only available for 52 participants in Bangladesh (23 in BA group and 29 in control group). This is due to a protocol violation that meant PHQ-9 data were not collected for some participants as part of their follow-up.

3.5. Feasibility and acceptability of collecting baseline and follow up data

The feasibility and acceptability of data collection were high, with comprehensive baseline data gathered for nearly all participants, including demographic information, health measurements, and mental health-related measures. At the three-month follow-up, data completeness was slightly lower, with 51/64 participants in Pakistan and 59/64 in Bangladesh completing assessments. Missing data were due to phone follow-ups and technical issues. At six months, 48 participants in Pakistan and 61 in Bangladesh provided data. Data about the completeness and analyzability of outcomes at each time point can be found in Table S2 (appendix).

3.6. Characteristics of the trial population

Demographic baseline characteristics are presented in Table 4. Two percent of the sample had mild depressive symptoms, 25 % experienced moderate symptoms, 46 % showed moderately severe symptoms, and 27 % reported severe symptoms. We determined HbA1c measures in 62/64 blood samples in Pakistan, with a mean of 9.0 % (SD = 1.9), and in 63/64 samples in Bangladesh, with a mean of 8.6 % (SD = 2.3).

3.7. Outcome measures for the main trial

To ensure clarity and maintain focus on the primary feasibility outcomes, only selected outcome measures were reported. Mean PHQ-9 scores were lower in the intervention group compared to the control group at 6 months in both countries. In Pakistan, the intervention group had a mean score of 7.5 (SD 6.3) compared to 10.1 (SD 7.3) in the control group. In Bangladesh, the intervention group had a mean score of 7.3 (SD 5.4), while the control group scored 12.3 (SD 6.6) (Fig. 4 and Table 5). Similarly, anxiety scores were lower in the intervention group compared to the control group at 6 months in both countries. In Pakistan, the intervention group had a mean GAD-7 score of 7.1 (SD 4.4) compared to 9.9 (SD 6.1) in the control group. In Bangladesh, the intervention group had a mean score of 4.6 (SD 3.8), while the control group scored 8.8 (SD 4.9). There appeared to be no changes in HbA1c or BMI across trial arms or countries at 6 months.

3.8. Withdrawals

Overall, 11 participants withdrew from the trial; 2 from the control arm and 9 from the intervention arm. 8 of these also discontinued their participation in the behavioural activation sessions. Most withdrawals were from participants based in Pakistan (n = 9,82 %).Reasons for withdrawal include: loss of interest (n = 5, 45 %), patients no longer being contactable (n = 3, 27 %), migration (n = 1, 9 %), death (n = 1, 9

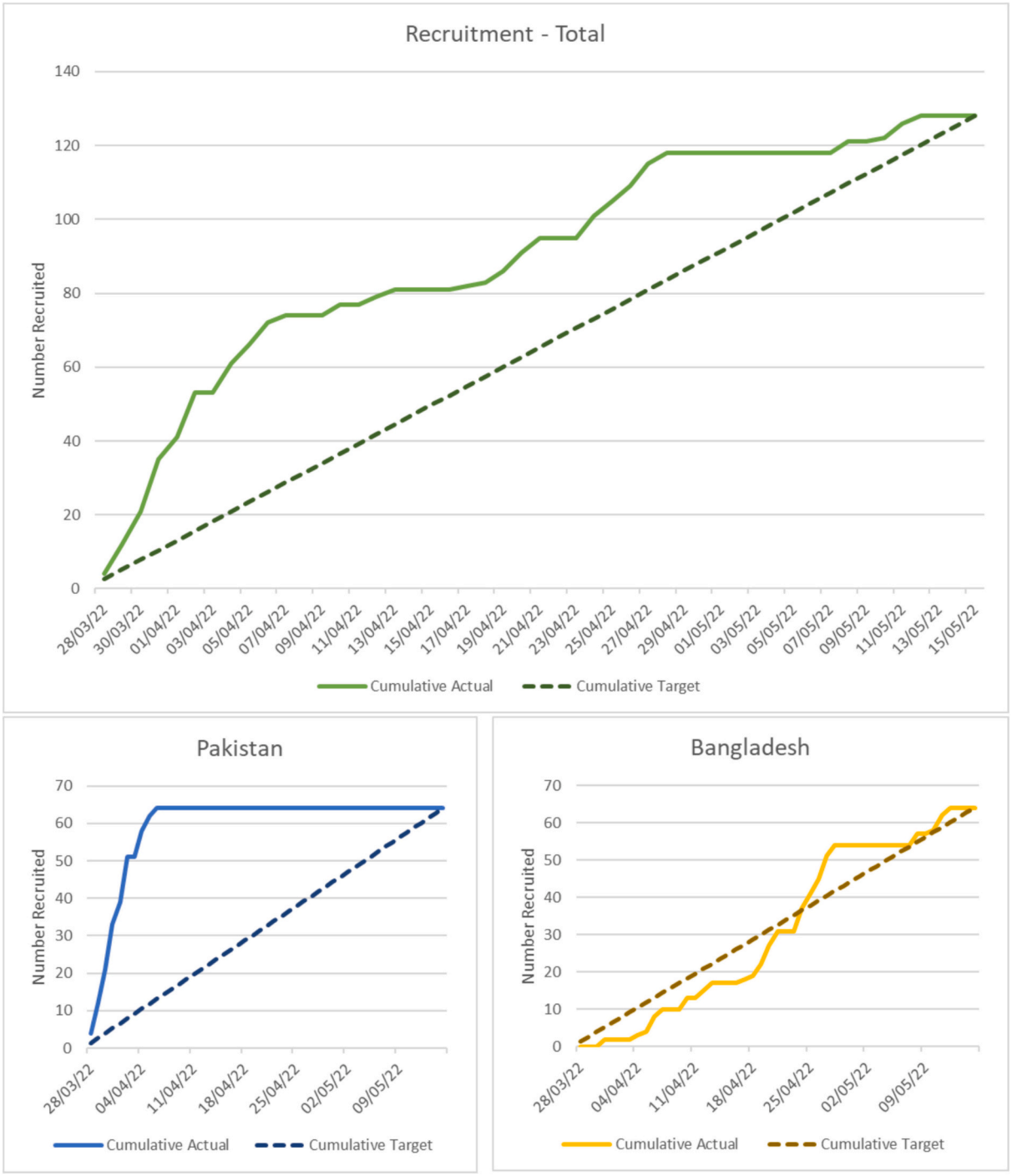

Fig. 2. Recruitment rate overall Bangladesh, and Pakistan.

%) and family bereavement (n = 1, 9 %). Among those that lost interest, specific reasons were provided as: wanting incentives (medicine and good clinical care), issues with time management, wanting to seek mental health support from elsewhere (control group participant), and no longer wanting to be pushed to attend for follow-ups.

3.9. Adverse events

Throughout the trial, there were four reported serious adverse events, with three occurring in Bangladesh and one in Pakistan. Notably, these events were determined to be unrelated to the intervention (1 death due to severe hypoglycemia and 3 hospitalisations resulting in recovery [mild stroke, pneumonia & a fracture of the patella]).

3.10. Main Trial Sample Size Recommendations

The standard deviation (SD) of PHQ-9 scores at baseline was 3.9 (4.2 in Pakistan and 3.6 in Bangladesh). Pragmatically, the standard deviation for the study population of the main trial was estimated as 4.0. Correlations between time points were moderately low ($r = 0.30$ between baseline and 3-month PHQ-9 and $r = 0.24$ between baseline and 6-month PHQ-9) and were not of sufficient magnitude to yield power efficiencies for the main trial sample size. Based on the 85 % follow-up rate in the feasibility study, a conservative planned attrition of 20 % was

Table 2
Reasons for not consenting or participating in the trial.

	Country		Total
Reason	Pakistan	Bangladesh	
Family members did not allow participation[1]	0 (0.0 %)	8 (66.7 %)	8 (32.0 %)
Too far to travel/ Lack of travel facilities	1 (7.7 %)	2 (16.7 %)	3 (12.0 %)
Other (specified below)	0 (0.0 %)	1 (8.3 %)	1 (4.0 %)
No reason available[2]	12 (92.3 %)	1 (8.3 %)	13 (52.0 %)
Total	13	12	25

[1] Mostly applicable to females, one male cited this as reason for non-consent.
[2] Applicable to both patients who did not indicate a reason and those that did not return to provide consent.

Table 3
Intervention Session Attendance.

Total Number of Behavioural Activation Sessions Attended	Pakistan $n = 32$	Bangladesh n = 32	Total $n = 64$
0/6	4 (13 %)	0 (0 %)	4 (6 %)
1/6	2 (6 %)	0 (0 %)	2 (3 %)
2/6	1 (3 %)	1 (3 %)	2 (3 %)
3/6	0 (0 %)	0 (0 %)	0 (0 %)
4/6	1 (3 %)	0 (0 %)	1 (2 %)
5/6	0 (0 %)	1 (3 %)	1 (2 %)
6/6	24 (75 %)	30 (94 %)	54 (84 %)
Mean number of sessions attended per participant (SD)	4.8 (2.3)	5.8 (0.7)	5.3 (1.8)

assumed for the main trial. Intra-class correlation coefficients (ICCs) varied considerably: ICC of 0.04 in Bangladesh (95 % CI: 0 to 0.40, 3 facilitators with 10–11 patients per facilitator) and ICC of 0.31 in Pakistan (95 % CI: 0 to 0.86, 5 facilitators with 2–10 patients per facilitator). Such feasibility estimates are unreliable and were not used for the main trial sample size calculation.

3.11. Intervention delivery

The intervention was delivered by eight facilitators, with their caseloads ranging from 2 to 11 participants. Among the BA participants, an average of 5.3 intervention sessions were delivered per participant, with Bangladesh delivering an average of 5.8 sessions (SD 0.7) and Pakistan delivering 4.8 sessions (SD 2.3). The overall participation rate

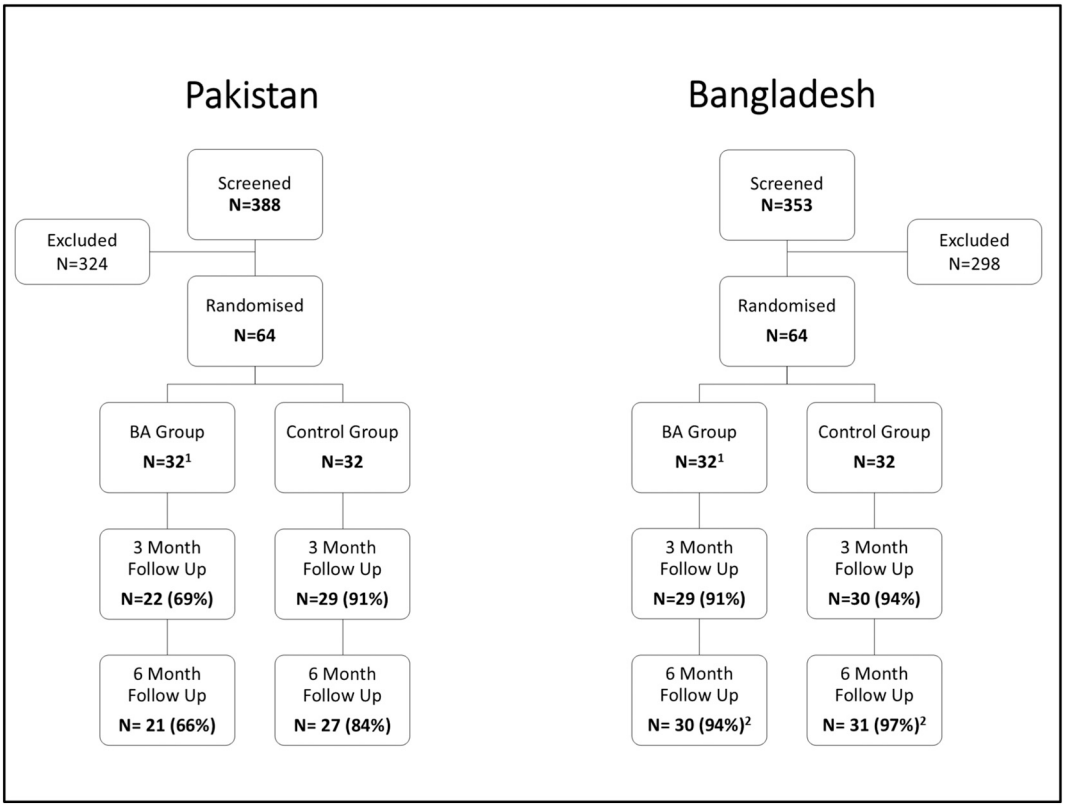

Fig. 3. Follow up rates by country and trial arm.

Table 4
Baseline characteristics of the population by country and trial arm.

	Pakistan		Bangladesh	
	Intervention *N* = 31	Control N = 32	Intervention N = 31	Control N = 32
Age				
N	31	31	31	32
Mean (SD)	49.2 (10.3)	49.9 (10.0)	51.0 (11.5)	48.4 (10.0)
Median (IQR)	48.0 (45.0–55.0)	51.0 (42.0–57.0)	50.0 (39.0–60.0)	50.0 (40.0–56.0)
Min, Max	28.0, 72.0	30.0, 69.0	26.0, 71.0	22.0, 67.0
Gender				
Female	23 (74.2 %)	25 (78.1 %)	20 (64.5 %)	23 (71.9 %)
Male	8 (25.8 %)	7 (21.9 %)	11 (35.5 %)	9 (28.1 %)
Marital Status				
Currently married	28 (90.3 %)	26 (81.2 %)	22 (71.0 %)	27 (84.4 %)
Currently married	0 (0.0 %)	0 (0.0 %)	3 (9.7 %)	0 (0.0 %)
Widowed	2 (6.5 %)	4 (12.5 %)	5 (16.1 %)	4 (12.5 %)
Never Married/Divorced	1 (3.2 %)	2 (6.2 %)	1 (3.2 %)	1 (3.1 %)
Ethnic Group				
Bengali	0 (0.0 %)	0 (0.0 %)	31 (100.0 %)	32 (100.0 %)
Punjabi	15 (48.4 %)	12 (37.5 %)	0 (0.0 %)	0 (0.0 %)
Pushtoon	10 (32.3 %)	13 (40.6 %)	0 (0.0 %)	0 (0.0 %)
Other/Missing	6 (19.4 %)	7 (21.9 %)	0 (0.0 %)	0 (0.0 %)
Education				
No formal education	14 (45.2 %)	14 (43.8 %)	9 (29.0 %)	9 (28.1 %)
Primary not completed	2 (6.5 %)	2 (6.2 %)	5 (16.1 %)	6 (18.8 %)
Primary completed	4 (12.9 %)	6 (18.8 %)	11 (35.5 %)	7 (21.9 %)
Secondary completed	7 (22.6 %)	6 (18.8 %)	1 (3.2 %)	5 (15.6 %)
Higher Secondary and above completed	4 (12.9 %)	4 (12.5 %)	5 (16.1 %)	5 (15.6 %)
Employment				
Homemaker	8 (25.8 %)	15 (46.9 %)	16 (51.6 %)	23 (71.9 %)
Employed	11 (35.5 %)	8 (25.0 %)	11 (35.5 %)	8 (25.0 %)
Unemployed	8 (25.8 %)	6 (18.8 %)	1 (3.2 %)	1 (3.1 %)
Retired & Refused	4 (12.9 %)	3 (9.4 %)	3 (9.7 %)	0 (0.0 %)
Location type of home				
A large city	11 (35.5 %)	13 (40.6 %)	22 (71.0 %)	27 (84.4 %)
A suburb near a large city	6 (19.4 %)	6 (18.8 %)	3 (9.7 %)	1 (3.1 %)
A small city or town	11 (35.5 %)	9 (28.1 %)	5 (16.1 %)	3 (9.4 %)
A rural area	3 (9.7 %)	4 (12.5 %)	1 (3.2 %)	1 (3.1 %)

in at least one BA session was 84 %, with Bangladesh at 94 % and Pakistan at 75 %. Follow-up rates stood at 86 % at 3 months (Bangladesh: 92 %, Pakistan: 80 %) and 85 % at 6 months (Bangladesh: 95 %, Pakistan: 75 %). The baseline standard deviation (SD) for the anticipated primary outcome (PHQ-9) in the main trial was 3.9, with a baseline SD of 3.6 in Bangladesh and 4.2 in Pakistan.

3.12. Fidelity

Fidelity to content: Fidelity content ranged from averages of 85 % (sessions 2 and 4) to 93 % (session 3), meaning most of the intervention steps appear to have been followed during the sessions most of the time. There are some differences between countries. In Bangladesh average fidelity ranged from 87 % (session 5) to 100 % (session 1) and in Pakistan it ranged from 75 % (session 4) to 93 % (session 6). Interactiveness fidelity: The results from the fidelity index scores reveal that overall interaction was very high, – with almost 100 % of interaction areas being judged as partial or full, and 78 % as full (see table S4). Rapport building was the highest area (95 % judged as fully interactive) and emphasising choice the lowest (75 % as fully interactive).

4. Further modifications to the intervention

Based on the process evaluation, several modifications were made to the intervention and preparations for the main trial. To enhance the training component, all training sessions were conducted in-person for the main trial, addressing the need for more comprehensive and hands-on training. Clearer explanations of certain concepts were also incorporated into both the training sessions and the participant materials. For instance, the “outside-in approach” and the “staying well plan” were clarified to ensure participants could better understand and apply these concepts.

Additionally, best practices for supervising and supporting facilitators were refined to ensure consistent support across all trial sites. This included developing a Standard Operating Procedure (SOP) for supervisors and establishing regular online meetings for supervisors throughout the full trial to provide ongoing support. To improve the BA materials, the patient booklet was redesigned to be more user-friendly. This involved simplifying the language, adding stickers, and incorporating more pictures to enhance engagement and comprehension. These modifications aimed to make the intervention more accessible and effective for all participants.

4.1. Deviations from the protocol

Two protocol violations were identified: First, in Bangladesh, the PHQ-9 questionnaire was stopped after the second question for nine participants at the 6-month follow-up due to a research assistant's misinterpretation of questionnaire administration. Second, eight patients in Pakistan and thirteen in Bangladesh were randomised despite not meeting the criteria for major depressive episodes during the screening process. This resulted from a misunderstanding of the eligibility criteria outlined in the MINI screening tool.

5. Discussion

5.1. Key findings

We found it feasible and acceptable to deliver the DiaDeM intervention in a full trial. Recruitment and retention rates were high,

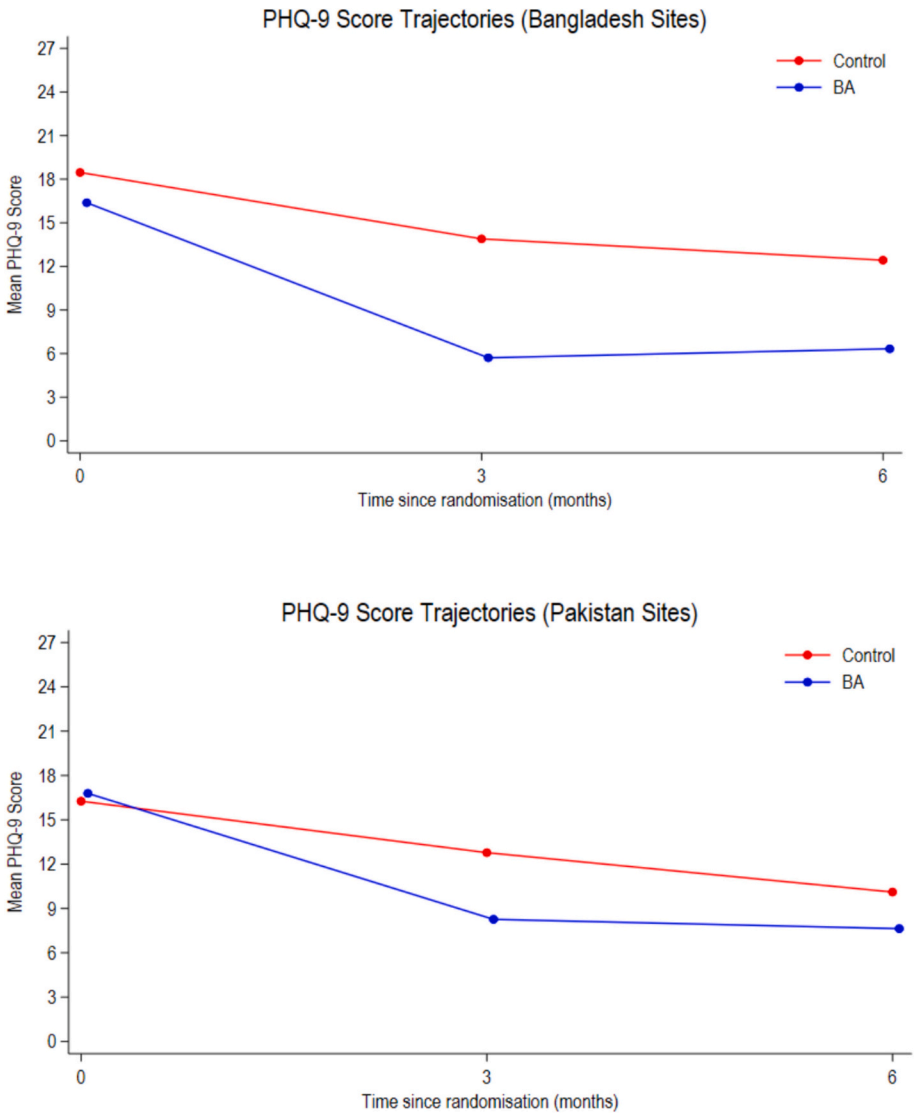

Fig. 4. Mean PHQ-9 score trajectories by trial arm for participants in Bangladesh and Pakistan.

reflecting strong participation and willingness among individuals with T2DM and depression to engage in BA interventions. Data collection was feasible and acceptable using the proposed tools and methods, with nearly all participants providing necessary information on demographic data, physical and mental health indicators, and economic outcomes. The intervention delivery was effective, with particularly high attendance rates for the BA sessions in Bangladesh. The successful collection of economic data, including healthcare resource use, medications, employment status, productivity loss, and catastrophic health spending, supports the feasibility of gathering comprehensive economic data for the main trial. Additionally, the trial's implementation fidelity was high, with minor adaptations made based on process evaluation findings to ensure the clarity and cultural relevance of the intervention materials. These findings confirm that the intervention can be implemented as planned and highlights the necessity of minor modifications before proceeding to a definitive trial.

5.2. Explanation about findings

The DiaDeM feasibility trial experienced a surprisingly quick recruitment rate, especially in Pakistan, where the target was achieved in just 10 days. This rapid recruitment contrasts with trials in high-income countries (HICs), where recruitment often proceeds more slowly due to various factors such as overexposure to research procedures, time burden to the participants, extensive public health campaigns, and greater general health literacy (Briel et al., 2021). The quick recruitment in Pakistan may reflect a significant interest among people with diabetes in accessing talking therapies, which are often unavailable in both Bangladesh and Pakistan. The lack of readily accessible mental health services in these countries likely drives the high participation rates, as individuals seize the opportunity to engage in interventions that address both their mental and physical health needs (Zavala et al., 2023b). The recruitment in Bangladesh on the other hand was completed in a relatively steady manner over a span of 41 days.

5.3. Study feasibility and challenges

Despite the overall success of the DiaDeM feasibility trial, several challenges were encountered, particularly in Pakistan. While the rapid recruitment rate in Pakistan demonstrated significant interest, it also led to issues with maintaining a steady pace in participant recruitment, intervention delivery, and outcome measurement. The accelerated recruitment created a strain on resources, which in turn affected the consistency and quality of intervention delivery. For the main trial we will incorporate strategies for more controlled recruitment processes, enhanced training for research staff, scheduling and setting a maximum

Table 5
Baseline and follow up outcome measures by country and trial arm.

	Pakistan		Bangladesh	
	Intervention *N* = 31	Control *N* = 32	Intervention N = 31	Control N = 32
Mental Health Related Outcome Measures				
Depressive symptoms (PHQ-9 score 0–27)				
Baseline				
N	31	32	31	32
Mean (SD)	16.7 (4.7)	16.6 (3.6)	17.1 (3.9)	18.0 (3.3)
Median (IQR)	17.0 (14.0–19.0)	18.0 (14.0–19.0)	17.0 (14.0–20.0)	18.0 (16.0–20.0)
Min, Max	5.0, 25.0	9.0, 24.0	10.0, 25.0	10.0, 23.0
3-Months Post Randomisation				
N	22	29	29	30
Mean (SD)	8.7 (5.7)	13.0 (5.7)	6.2 (3.0)	13.8 (4.6)
Median (IQR)	7.5 (4.0–14.0)	13.0 (10.0–17.0)	7.0 (3.0–8.0)	13.5 (11.0–17.0)
Min, Max	1.0, 19.0	1.0, 23.0	1.0, 11.0	4.0, 22.0
6-Months Post Randomisation				
N	21	27	23	29
Mean (SD)	7.5 (6.3)	10.1 (7.3)	7.3 (5.4)	12.3 (6.6)
Median (IQR)	6.0 (3.0–11.0)	10.0 (4.0–14.0)	6.0 (3.0–10.0)	14.0 (7.0–18.0)
Min, Max	0.0, 21.0	0.0, 23.0	2.0, 22.0	2.0, 24.0
Generalised Anxiety (GAD-7 score 0–21)				
Baseline				
N	31	32	31	32
Mean (SD)	14.0 (3.4)	13.2 (4.0)	14.5 (3.8)	15.0 (4.1)
Median (IQR)	14.0 (12.0–16.0)	12.0 (10.0–16.5)	14.0 (13.0–17.0)	16.0 (11.5–18.0)
Min, Max	6.0, 21.0	6.0, 21.0	5.0, 21.0	7.0, 21.0
3-Months Post Randomisation				
N	22	29	29	30
Mean (SD)	8.0 (5.1)	13.4 (4.7)	4.5 (3.5)	9.4 (3.3)
Median (IQR)	7.5 (4.0–12.0)	14.0 (12.0–16.0)	4.0 (2.0–7.0)	9.0 (8.0–11.0)
Min, Max	1.0, 17.0	0.0, 20.0	0.0, 16.0	0.0, 18.0
6-Months Post Randomisation				
N	21	27	30	31
Mean (SD)	7.1 (4.4)	9.9 (6.1)	4.6 (3.8)	8.8 (4.9)
Median (IQR)	7.0 (4.0–10.0)	11.0 (5.0–15.0)	3.5 (2.0–7.0)	9.0 (4.0–11.0)
Min, Max	0.0, 15.0	0.0, 19.0	0.0, 13.0	1.0, 21.0
Diabetes Related Outcome Measures				
Diabetes Related Stress (PAID 0–20)				
Baseline				
N	31	32	31	32
Mean (SD)	11.3 (4.2)	10.9 (3.5)	13.7 (5.1)	15.1 (4.6)
Median (IQR)	12.0 (9.0–15.0)	11.0 (9.5–14.0)	15.0 (10.0–18.0)	15.0 (13.0–19.0)
Min, Max	1.0, 18.0	3.0, 15.0	4.0, 20.0	4.0, 20.0
6-Months Post Randomisation				
N	21	27	30	31
Mean (SD)	9.1 (6.4)	9.1 (6.8)	6.5 (4.4)	12.2 (5.8)
Median (IQR)	9.0 (5.0–13.0)	8.0 (4.0–14.0)	5.0 (4.0–9.0)	12.0 (8.0–18.0)
Min, Max	0.0, 19.0	0.0, 20.0	1.0, 18.0	0.0, 20.0
Diabetes Related Self-Efficacy (DES-SF 1–5)				
Baseline				
N	31	32	31	32
Mean (SD)	3.3 (0.8)	3.3 (0.7)	3.7 (0.4)	3.5 (0.5)
Median (IQR)	3.5 (2.6–4.0)	3.4 (2.8–3.9)	3.8 (3.4–4.0)	3.4 (3.1–3.6)
Min, Max	1.6, 4.4	1.6, 4.2	2.6, 4.2	2.8, 4.9
6-Months Post Randomisation				
N	21	27	30	31
Mean (SD)	3.6 (0.6)	3.6 (0.7)	3.9 (0.6)	3.6 (0.5)
Median (IQR)	3.9 (3.1–4.1)	3.8 (3.0–4.1)	4.0 (3.6–4.1)	3.6 (3.2–4.0)
Min, Max	2.4, 4.5	1.8, 4.5	2.2, 5.0	2.2, 4.4
Diabetes Related Self Management (PDSMS 8–40)				
N	31	32	31	32
Mean (SD)	25.8 (3.4)	25.9 (3.1)	27.8 (3.6)	26.8 (3.0)
Median (IQR)	25.0 (24.0–28.0)	26.0 (24.0–27.5)	27.0 (26.0–30.0)	27.0 (25.5–29.0)
Min, Max	20.0, 33.0	20.0, 34.0	17.0, 36.0	20.0, 33.0
6-Months Post Randomisation				
N	21	27	30	31
Mean (SD)	26.6 (2.2)	26.5 (3.9)	26.3 (3.9)	26.4 (4.3)
Median (IQR)	26.0 (25.0–28.0)	26.0 (24.0–28.0)	25.0 (23.0–29.0)	25.0 (24.0–30.0)
Min, Max	24.0, 31.0	15.0, 32.0	22.0, 35.0	19.0, 34.0
Physical Outcome Measures				
Glycosylated haemoglobin (HbA1c) (in %)				
Baseline				
N	31	31	31	32
Mean (SD)	8.8 (1.9)	9.1 (2.0)	8.5 (2.3)	8.7 (2.4)
Median (IQR)	8.3 (7.3–10.1)	9.1 (7.5–11.0)	8.1 (6.8–10.5)	9.0 (6.9–10.7)

(*continued on next page*)

Table 5 (*continued*)

	Pakistan		Bangladesh	
	Intervention $N = 31$	Control $N = 32$	Intervention N = 31	Control N = 32
Min, Max	5.8, 14.0	5.7, 12.0	3.9, 13.4	4.1, 13.6
3-Months Post Randomisation				
N	17	26	29	30
Mean (SD)	8.6 (1.8)	9.2 (2.5)	8.3 (1.6)	8.6 (2.2)
Median (IQR)	8.2 (7.3–9.8)	8.6 (6.7–11.5)	8.1 (6.9–9.2)	8.6 (7.2–10.0)
Min, Max	6.3, 12.2	5.3, 13.8	6.3, 12.8	5.0, 13.8
6-Months Post Randomisation				
N	21	26	30	31
Mean (SD)	9.3 (2.3)	9.2 (2.5)	8.9 (2.2)	9.4 (2.5)
Median (IQR)	9.1 (7.2–10.2)	9.3 (7.0–11.6)	8.6 (6.8–11.0)	9.3 (7.1–11.1)
Min, Max	5.9, 14.5	5.6, 14.4	5.6, 13.2	5.8, 15.2
Body Mass Index (BMI)				
Baseline				
N	31	32	31	31
Mean (SD)	30.2 (5.5)	28.3 (4.8)	25.3 (4.8)	26.0 (4.7)
Median (IQR)	30.9 (25.6–33.5)	27.8 (25.7–30.7)	24.3 (22.4–28.3)	25.1 (23.3–29.3)
Min, Max	20.4, 41.7	19.4, 40.2	17.5, 38.2	15.4, 36.2
6-Months Post Randomisation				
N	18	26	30	31
Mean (SD)	31.8 (5.1)	28.7 (4.6)	24.9 (4.2)	26.1 (5.3)
Median (IQR)	32.1 (28.2–35.5)	27.9 (26.0–31.2)	24.6 (21.8–28.4)	25.9 (22.3–29.7)
Min, Max	22.4, 41.9	21.5, 39.3	17.9, 34.0	16.8, 41.4

number of participants to recruit on a daily basis. One of the notable difficulties encountered during the trial was the collection of data on tobacco use. Issues with the form's skip logic led to missing data for tobacco use questions. To address this, the data collection tool was adjusted to ensure that all relevant questions were asked consistently, regardless of previous responses.

5.4. Intervention acceptability fidelity and future changes

The DiaDeM feasibility trial demonstrated high acceptability and fidelity of the intervention, with participants generally responding positively to the BA sessions. The intervention's cultural tailoring, including simplified language and visual aids, made it more accessible and engaging for participants (Zavala et al., 2023a). The attendance rate gives further evidence about its acceptability. However, minor adjustments were necessary based on process evaluation. These included clearer explanations of key concepts and improved training sessions for facilitators, which has already been included. To enhance consistency across sites, best practices for supervising and supporting facilitators were refined, including the development of a Standard Operating Procedure (SOP) and regular online meetings for all the facilitators to join and share experiences. Future changes will focus on further simplifying intervention materials and ensuring rigorous training to maintain high fidelity and engagement.

5.5. Implications and further research

The feasibility findings from our trial have several implications for future research and clinical practice. Firstly, the successful recruitment and retention of participants suggest that there is interest and willingness among individuals with diabetes and depression to engage in behavioural activation interventions. This highlights the importance of integrating mental health interventions into diabetes care programs in low- and middle-income countries like Bangladesh and Pakistan. Secondly, the effective delivery of the adapted intervention underscores the potential for scalable mental health interventions tailored to local contexts. By incorporating cultural adaptation and community engagement strategies, interventions can be made more acceptable and accessible to diverse populations. Lastly, the feasibility of measuring outcome measures suggests that future efficacy trials assessing the effectiveness of the intervention are warranted. Longitudinal studies with larger sample sizes are needed to further evaluate the impact of the intervention on depression symptoms, diabetes management, and overall quality of life among individuals with diabetes in these settings.

5.6. Strengths and limitations

The DiaDeM feasibility trial had several strengths, including high recruitment and retention rates, demonstrating interest and willingness of participants to engage in the intervention. The successful implementation across multiple sites in Bangladesh and Pakistan, along with comprehensive data collection on a wide range of health and economic outcomes, highlights the robustness of the study design. The cultural adaptation of the BA intervention ensured its relevance and acceptability to the target population, contributing to high attendance rates and overall positive responses from participants (Zavala et al., 2023a).

However, the study also had limitations. The rapid recruitment in Pakistan, while indicative of strong interest, created logistical challenges that impacted the consistency of intervention delivery and data collection. Instances of missing data and protocol deviations highlighted the need for more rigorous training and robust data collection tools. Additionally, the generalizability of the findings may be limited by the specific settings and populations studied (Weiss et al., 2008). We will address these limitations by implementing more controlled recruitment processes and enhancing the training and support for research staff to ensure high-quality intervention delivery and accurate outcome measurement for the main trial.

6. Conclusion

The DiaDeM feasibility trial demonstrated that a culturally adapted BA intervention for T2DM and depression is practical and acceptable in South Asia. Despite the trial not being powered to detect efficacy, the results appear to be positive in improving depression outcomes. These findings support the potential for a larger-scale efficacy trial.

CRediT authorship contribution statement

Naveed Ahmed: Writing – review & editing, Writing – original draft, Project administration. **Gerardo A. Zavala:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **Faraz Siddiqui:** Writing – review & editing, Project administration,

Conceptualization. **Faiza Aslam:** Writing – review & editing, Supervision, Project administration, Investigation. **Ada Keding:** Writing – review & editing, Methodology, Formal analysis, Data curation. **Shannon Halmkan:** Writing – review & editing, Investigation, Formal analysis, Data curation. **Saima Afaq:** Writing – review & editing, Supervision, Project administration. **Hannah Maria Jennings:** Writing – review & editing. **Ashraful Anas:** Writing – review & editing, Visualization, Project administration. **Sanjit K. Shaha:** Writing – review & editing, Supervision, Project administration. **Kazi Moriom Jahan:** Writing – review & editing, Project administration. **Abdul Kuddus:** Writing – review & editing, Supervision, Project administration. **Zara Nisar:** Writing – review & editing, Supervision, Project administration. **Simon M. Walker:** Writing – review & editing. **Anum Naz:** Writing – review & editing, Supervision, Project administration. **Hira Shakoor:** Writing – review & editing, Project administration. **Asima K. Niazi:** Writing – review & editing. **Rowena Jacobs:** Writing – review & editing. **Karen Coales:** Writing – review & editing, Project administration. **Kishwar Azad:** Supervision, Project administration. **Edward Fottrell:** Writing – review & editing, Methodology. **Zia Ul Haq:** Writing – review & editing, Supervision. **David Ekers:** Writing – review & editing, Supervision, Project administration. **Najma Siddiqi:** Writing – review & editing, Supervision, Methodology, Investigation, Funding acquisition. **Catherine Hewitt:** Writing – review & editing, Project administration, Investigation, Formal analysis, Data curation.

Registration

The protocol has been registered at ISRCTN (identifier 75,501,608) https://www.isrctn.com/ISRCTN75501608(14/04/2022, Version: v1.2),

Protocol

The protocol has been published at the F1000Research and is accessible at doi:10.12688/f1000research.121895.1

Author Statement

The conceptualization of the study was led by Najma Siddiqi, Catherine Hewitt, Edward Fottrell, Naveed Ahmed, and Simon M. Walker. Naveed Ahmed and Gerardo A. Zavala were responsible for writing the original draft, while Gerardo A. Zavala, Faraz Siddiqui, Najma Siddiqi, Zia Ul Haq, Edward Fottrell, and Catherine Hewitt handled project administration. Najma Siddiqi secured funding for the study. Data collection and validation were conducted by Ada Keding, Shannon Halmkan, Saima Afaq, Hannah Maria Jennings, Ashraful Anas, Sanjit K. Shaha, Kazi Moriom Jahan, Zara Nisar, Anum Naz, Hira Shakoor, and Asima K. Niazi, with statistical analysis performed by Shannon Halmkan and Ada Keding. Supervision was provided by Rowena Jacobs, Simon M. Walker, Najma Siddiqi, Gerardo A. Zavala, Edward Fottrell, Ada Keding, and Catherine Hewitt. Methodology was developed by Catherine Hewitt, Edward Fottrell, Najma Siddiqi, Hannah Maria Jennings, Rowena Jacobs, and Simon M. Walker. All authors participated in reviewing and editing the manuscript and approved the final version.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2024.11.079.

References

Andreoulakis, E., Hyphantis, T., Kandylis, D., Iacovides, A., 2012. Depression in diabetes mellitus: a comprehensive review. Hippokratia 16, 205–214.

Aslam, F., Afaq, S., Siddiqui, F., Zavala, G.A., 2022. An Adapted Behavioural Activation Intervention (DiaDeM) for People with Diabetes and Depression in South Asia: A Feasibility Study Protocol. Available: https://f1000research.com/articles/11-887.

Basit, A., Askari, S., Zafar, J., Riaz, M., Fawwad, A., 2021. NDSP members. NDSP 06: prevalence and risk factors for obesity in urban and rural areas of Pakistan: a study from second National Diabetes Survey of Pakistan (NDSP), 2016-2017. Obes. Res. Clin. Pract. 15, 19–25.

Briel, M., Elger, B.S., McLennan, S., Schandelmaier, S., von Elm, E., Satalkar, P., 2021. Exploring reasons for recruitment failure in clinical trials: a qualitative study with clinical trial stakeholders in Switzerland, Germany, and Canada. Trials 22, 844.

Cuijpers, P., van Straten, A., Warmerdam, L., 2007. Behavioral activation treatments of depression: a meta-analysis. Clin. Psychol. Rev. 318–326. https://doi.org/10.1016/j.cpr.2006.11.001.

Egede, L.E., Ellis, C., 2010. Diabetes and depression: global perspectives. Diabetes Res. Clin. Pract. 87, 302–312.

Egede, L.E., Zheng, D., Simpson, K., 2002. Comorbid depression is associated with increased health care use and expenditures in individuals with diabetes. Diabetes Care 25, 464–470.

Holt, R.I.G., de Groot, M., Golden, S.H., 2014. Diabetes and depression. Curr. Diab. Rep. 14, 491.

Holt, R.I.G., van der Feltz-Cornelis, C.M., 2012. Key concepts in screening for depression in people with diabetes. J. Affect. Disord. 142 (Suppl), S72–S79.

Hopko, D.R., Armento, M.E.A., Robertson, S.M.C., Ryba, M.M., Carvalho, J.P., Colman, L. K., et al., 2011. Brief behavioral activation and problem-solving therapy for depressed breast cancer patients: randomized trial. J. Consult. Clin. Psychol. 79, 834–849.

Integrating the prevention, treatment and care of mental health conditions and other NCDs within health systems. 2019 [cited 26 Aug 2021]. Available: http://www.euro.who.int/en/media-centre/events/events/2019/04/WHO-conference-NCDs-Ashgabat-2019/news/news/2019/03/integrating-the-prevention,-treatment-and-care-of-mental-health-conditions-and-other-ncds-within-health-systems.

Kroenke, K., Spitzer, R.L., 2002. The PHQ-9: a new depression diagnostic and severity measure. Psychiatr. Ann. 509–515. https://doi.org/10.3928/0048-5713-20020901-06.

Kroenke, K., Spitzer, R.L., Williams, J.B.W., 2003. The patient health Questionnaire-2: validity of a two-item depression screener. Med. Care 41, 1284–1292.

Lecrubier, Y., Sheehan, D.V., Weiller, E., Amorim, P., Bonora, I., Harnett Sheehan, K., et al., 1997. The Mini international neuropsychiatric interview (MINI). A short diagnostic structured interview: reliability and validity according to the CIDI. Eur. Psychiatry 224–231. https://doi.org/10.1016/s0924-9338(97)83296-8.

Levis, B., Benedetti, A., Thombs, B.D., 2019. DEPRESsion screening data (DEPRESSD) collaboration. Accuracy of patient health Questionnaire-9 (PHQ-9) for screening to detect major depression: individual participant data meta-analysis. BMJ 365, l1476.

Lloyd, C.E., Nouwen, A., Sartorius, N., Ahmed, H.U., Alvarez, A., Bahendeka, S., et al., 2018. Prevalence and correlates of depressive disorders in people with type 2 diabetes: results from the international prevalence and treatment of diabetes and depression (INTERPRET-DD) study, a collaborative study carried out in 14 countries. Diabet. Med. 35, 760–769.

Lustman, P.J., Anderson, R.J., Freedland, K.E., de Groot, M., Carney, R.M., Clouse, R.E., 2000. Depression and poor glycemic control: a meta-analytic review of the literature. Diabetes Care 23, 934–942.

Markowitz, S.M., Gonzalez, J.S., Wilkinson, J.L., Safren, S.A., 2011. A review of treating depression in diabetes: emerging findings. Psychosomatics 52, 1–18.

Martin, F., Oliver, T., 2019. Behavioral activation for children and adolescents: a systematic review of progress and promise. Eur. Child Adolesc. Psychiatry 28, 427–441.
Mendenhall, E., Norris, S.A., Shidhaye, R., Prabhakaran, D., 2014. Depression and type 2 diabetes in low- and middle-income countries: a systematic review. Diabetes Res. Clin. Pract. 103, 276–285.
Misra, A., Gopalan, H., Jayawardena, R., Hills, A.P., Soares, M., Reza-Albarrán, A.A., et al., 2019. Diabetes in developing countries. J. Diabetes 11, 522–539.
Mitchell, P.H., Veith, R.C., Becker, K.J., Buzaitis, A., Cain, K.C., Fruin, M., et al., 2009. Brief psychosocial-behavioral intervention with antidepressant reduces poststroke depression significantly more than usual care with antidepressant: living well with stroke: randomized, controlled trial. Stroke 40, 3073–3078.
Moher, D., Schulz, K.F., Altman, D.G., 2001. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomised trials. Lancet 357, 1191–1194.
Moore, G.F., Audrey, S., Barker, M., Bond, L., Bonell, C., Hardeman, W., et al., 2015. Process evaluation of complex interventions: Medical Research Council guidance. BMJ 350, h1258.
O'Neill, B., 2022. Sample size determination with a pilot study. PLoS One 17, e0262804.
Organization WH, 2014. Others. Integrating the response to mental disorders and other chronic diseases in health care systems. Available: https://apps.who.int/iris/bitstream/handle/10665/112830/9789241506793_eng.pdf.
Organization WH, 2018. Others. National STEPS survey for non-communicable diseases risk factors in Bangladesh 2018. Available: https://apps.who.int/iris/bitstream/handle/10665/332886/STEPS-BAN-eng.pdf.
Roy, T., Lloyd, C.E., 2012. Epidemiology of depression and diabetes: a systematic review. J. Affect. Disord. 142 (Suppl), S8–21.
Uphoff, E., Ekers, D., Robertson, L., Dawson, S., Sanger, E., South, E., et al., 2020a. Behavioural activation therapy for depression in adults. Cochrane Database Syst. Rev. 7, CD013305.
Uphoff, E., Pires, M., Barbui, C., Barua, D., Churchill, R., Cristofalo, D., et al., 2020b. Behavioural activation therapy for depression in adults with non-communicable diseases. Cochrane Database Syst. Rev. 8, CD013461.
van der Feltz-Cornelis, C.M., Nuyen, J., Stoop, C., Chan, J., Jacobson, A.M., Katon, W., et al., 2010. Effect of interventions for major depressive disorder and significant depressive symptoms in patients with diabetes mellitus: a systematic review and meta-analysis. Gen. Hosp. Psychiatry 32, 380–395.
van Dooren, F.E.P., Nefs, G., Schram, M.T., Verhey, F.R.J., Denollet, J., Pouwer, F., 2013. Depression and risk of mortality in people with diabetes mellitus: a systematic review and meta-analysis. PLoS One 8, e57058.
Vigo, D., Thornicroft, G., Atun, R., 2016. Estimating the true global burden of mental illness. Lancet Psychiatry 3, 171–178.
Weiss, N.S., Koepsell, T.D., Psaty, B.M., 2008. Generalizability of the results of randomized trials. Arch. Intern. Med. 133–135.
Zavala, G.A., Afaq, S., Anas, A., Ahmed, N., Aslam, F., Benkalkar, S., et al., 2023a. Adaptation of a behavioural activation intervention for depression in people with diabetes in Bangladesh and Pakistan: DiaDeM intervention. Glob. Implement. Res. Appl. 3, 44–55.
Zavala, G.A., Jennings, H.M., Afaq, S., Alam, A., Ahmed, N., Aslam, F., et al., 2023b. Effectiveness and implementation of psychological interventions for depression in people with non-communicable diseases in South Asia: systematic review and meta-analysis. Int. J. Forensic Ment. Health 1–25.