A systematic review of recruitment strategies and behaviour change techniques in group-based diabetes prevention programmes focusing on uptake and retention

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**Abstract**

Background: Many countries worldwide have developed diabetes prevention programmes (DPPs) that involve lifestyle modification. Research has shown that uptake and retention of DPPs are important and by exploring recruitment strategies and behaviour change techniques (BCTs) used, factors that are most effective in promoting uptake and retention can be identified. Objectives: This review aims to identify recruitment strategies of group-based DPPs that are associated with high uptake and common BCTs associated with high retention. Methods: Papers were identified with a systematic literature search. Programmes that were predominantly group-based and involved lifestyle modification and in which uptake and/or retention could be determined, were included. Intervention details were extracted, recruitment strategies and BCTs identified, and response, uptake and retention rates were calculated. Results: A range of recruitment strategies were used making it difficult to discern associations with uptake rates. For BCTs, all programmes used a credible source, 81% used instruction on how to perform a behaviour and 71% used goal setting (behaviour). BCTs more commonly found in high retention programmes included problem-solving, demonstrating the behaviour, using behavioural practice and reducing negative emotions. Conclusions: Recommendations include that DPPs incorporate BCTs like problem-solving and demonstrating the behaviour to maximise retention.

**Keywords**

Prediabetes

Diabetes Prevention

Group-based

Uptake

Retention

Behaviour change

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# Introduction

Type 2 Diabetes Mellitus (T2DM) prevention is a worldwide health care priority (1), with levels of prediabetes predicted to rise from 374 million in 2019 to 548 million by 2045 (1). This is increasingly important as levels of obesity and physical inactivity being major contributory factors towards the global diabetes burden, are escalating (1,2). Although T2DM directly leads to approximately 1.3 million deaths annually (worldwide), it is a major risk factor for other causes of death and conditions such as cardiovascular disease, kidney diseases and blindness (3).

To delay or prevent the onset of T2DM, many countries like Finland, USA, Australia, China and the UK have implemented diabetes prevention programmes (DPPs) that involve lifestyle modification through physical activity and diet (4–10). A primary objective of DPPs is to support those with prediabetes (i.e., at high risk of T2DM) to lower their risk of developing T2DM through weight loss or management (4,7,11).

It has been recommended that national DPPs incorporate group-based elements or a social dimension (12). Group-based delivery can reduce programme costs as it requires less staff time than individual-based interventions (13). It is important that DPPs are clinically effective and financially viable (14). Programme viability is dependent on reaching and supporting sufficient numbers of the target population; i.e., uptake and retention (15,16).

Uptake relies on effective recruitment strategies (17). Understanding which recruitment strategies are most likely to elicit a response from potential participants (response rate) and lead to them starting a programme (uptake) is important to maximise response and uptake rates, and minimise the risk and financial costs related to insufficient recruitment (17,18).

Retention refers to sustaining participant involvement in the programme for as long as possible (17). To ensure high retention, it is important that DPPs and the lifestyle change (behaviour change) in question are attractive, social and timely (12). Therefore, interventions need to be examined to explore common characteristics of those with high rates of retention. One way of systematically examining interventions is to identify which Behaviour Change Techniques (BCTs) are used (19,20). BCTs are described as the “active ingredients” of behaviour change and are increasingly considered when designing interventions as they are building blocks of interventions (19,21). By identifying BCTs common among DPPs with high rates of retention, programme designers can ensure that these are incorporated to optimise retention.

To summarise, DPPs are an important part of the global response to rising prevalence of T2DM and are recommended to use group-based elements. Uptake and retention are important for DPP viability. By exploring recruitment strategies and BCTs they employ, factors to promote uptake and retention can be identified. To date, there has been no published review on uptake and retention in group-based DPPs where recruitment strategies and BCTs are extracted. This systematic review of the published literature on group-based DPPs aimed to:

* Identify recruitment strategies associated with high response rate and uptake in Diabetes Prevention Programmes that were predominantly group-based and involved lifestyle modification (e.g., diet, physical activity).
* Identify BCTs that are common in Diabetes Prevention Programmes that were predominantly group-based and involved lifestyle modification with high levels of retention.

# Methods

This systematic review is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines (22,23)

* 1. Criteria for inclusion/exclusion (Table 1)

### Design

This was a systematic, critical review of randomised control trials (RCTs), prospective, cohort, pilot and feasibility programmes.

### Participants

Programmes targeting adults aged 18 years and over, with prediabetes or non-diabetic hyperglycaemia, impaired glucose tolerance or impaired fasting glucose were included.

### Interventions

Programmes that were predominantly group-based and involved lifestyle modification (e.g., diet, physical activity) and in which uptake and/or retention could be determined, were included.

### Outcomes

Programmes that had primary outcomes of weight loss or reduction in T2DM risk (reduced glucose levels, calorie intake and/or increased physical activity) were included.

Table 1 about here

## Search strategy

A comprehensive database search for relevant papers published prior to the 8th of March 2017 was conducted (searching for papers from when the database started to current day). Top-up searches were conducted on the 10th December 2018 and 21st October 2019 (to identify relevant papers published subsequent to the initial search (March 2017-October 2019). Databases included EBSCO (MEDLINE, CINAHL Plus with Full Text, SPORTDiscus with Full Text, PsycINFO, PsycARTICLES); Science Direct; Web of Science, PubMed, ProQuest Nursing & Allied Health Database, Staffordshire University Summon tool and Opengrey. Key search terms were: prediabetes intervention\* OR prediabetes program\* OR diabetes prevention intervention\* OR diabetes prevention program\* AND group\*. Filters were then applied to restrict the search to papers written in English, participants who are adults, papers where the key search terms appeared in the title only. Publication titles and abstracts were screened followed by full text of the selected papers. Reference lists of included papers and relevant reviews were examined for additional papers. Authors were contacted if full text of relevant papers could not be retrieved or to provide additional detail (Figure 1).

Figure 1 about here

## Quality assessment

Quality of studies was assessed using the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies (24). Ten percent of the included papers were independently checked by a second reviewer (second author) and any discrepancies resolved by consensus.

## Data extraction and synthesis

Data were extracted from the included papers: country, study design, setting, intervention type, group components, length of follow-up, recruitment method, sample characteristics, response, uptake and retention rates, and reasons for dropout (Appendix 1: supplementary information).

For each study, the components of the intervention were screened to identify behaviour change techniques using the BCT taxonomy v1 (19). Each technique identified was noted down and carefully compared with the corresponding definition given to ensure that it fitted with the label. A second reviewer (second author) was involved to address any discrepancies which were resolved by consensus.

## Statistical analysis

Due to the heterogeneity of DPPs in terms of intervention components, information provided in relation to response, uptake and retention rates, and BCTs, a systematic, critical review was carried out, not a meta-analysis.

Response rate (%) was calculated (where possible) as the proportion of participants that responded to recruitment, out of the number of participants exposed to the study information via recruitment.

Uptake rate (%) was calculated (where possible) as the proportion of participants that started the group-based DPP, out of the number of participants allocated to the group-based DPP.

Retention rate (%) was calculated (where possible) as the proportion participants that did not drop-out from the group-based intervention, out of the number of participants present at the start. This gave a consistent completion rate for each paper as not all included papers clearly defined completion.

When response, uptake and retention rates were calculated, a second reviewer (fourth author) was involved to ensure consistency in these calculations.

# Results

## Inclusion/exclusion

In Figure 1, the process of paper inclusion/exclusion at each stage is presented. The initial search resulted in 27,137 records (6,499 from the initial search, 14,265 from the first top-up search and 6,373 from the second top-up search). It was not possible to conduct the two top-up searches using the Web of Science database due to changes in institutional subscriptions. Therefore, additional databases (PubMed, ProQuest Nursing and Allied Health and Summon) were used for literature searching. After English language, adults-only and title-only filters were applied, 1,198 titles were found (including 101 from the first top-up search and 85 from the second). After duplicates were removed and the titles and/or abstracts were screened, 146 full texts were retrieved (128 from initial search, 7 from the first top-up search and 11 from the second), of which 33 were included (including 7 from the first top-up search and 2 from the second).

Ten per cent of the 128 papers (n=13) from the initial search were independently checked by a second reviewer (second author) which led to 77% agreement. After detailed discussions, the disagreement was found to be due to ambiguous wording of two criteria (prediabetes and group-based (a necessary component of the programme)) which were then further refined (prediabetes determined by glucose testing; and 50% or more sessions are group-based). Once criteria were refined, the 128 papers were re-examined, and a further 5% of 128 papers (n=6) were independently checked by the second reviewer (second author) reaching 100% agreement. After the two top-up searches were conducted, 10% of 18 papers (n=2) were independently checked by the second reviewer (second author), with 100% agreement. The results of most of these DPPs were generally published in multiple papers, all of which were examined, and relevant information extracted (Appendix 1: supplementary information).

## Design and quality

From the 33 included papers, 13 were RCTs (25,26,35–37,27–34), eight were cohort (one group pre + post (before and after)) (6,16,38–43), six were cohort analytic (two group pre + post) (44–49) and six were controlled clinical trials (50–55). For quality assessment, 10% of the included papers (n=3) were independently checked by a second reviewer (second author). There were six components for each of the three papers and 83% agreement was reached (15/18 components). For majority of the included papers, study design, confounders, data collection methods, number of withdrawals and the reasons for dropout were rated as strong; blinding and selection bias was rated as moderate. Overall, the majority of papers had a quality rating of strong (n=17) (26,28,48,50–55,29–32,34,35,42,47), followed by moderate (n=12) (6,16,43,49,25,27,33,36–38,40,41), and then weak (n=4) (39,44–46) (Table 2).

## Participants

Across all included papers the number of participants who started the intervention ranged from 10 to 3,317 participants. Mean participant age ranged from 47.0 (±9.0) to 69.0 (±4.0) years. The majority had predominantly female samples (n=27) (6,16,38–47,25,48,50–55,27,29–32,35,36). Many papers did not state participant ethnicity (n=14) (6,28,46,47,54,55,30,31,33,36,40,41,43,44); others reported majority of white/Caucasian participants (n=9) (16,26,51,27,29,34,37,42,48–50). A small number of papers involved predominantly non-white/Caucasian samples [African-American (n=3) (25,38,45); Latino (Dominican origin) (n=1) (32); Brazilian (n=1) (52); Mexican (n=1) (53), mainly Hispanic sample (n=1) (35); American Indian and Alaska native sample (n=1) (39)].

## Interventions

Intervention type

The overall duration of interventions ranged from 1 day (n=1) (34) to 2 years (n=2) (27,55). All interventions included both diet and exercise components, except one diet only intervention (52).

Country/setting

Most DPPs were delivered in healthcare settings (n=16) (6,25,44,48–50,54,55,26,31–33,36,37,40,43). Others used community (n=7) (16,27,29,35,37,42,48), church (n=4) (29,38,45,53), workplace (n=1) (40) or university settings (n=1) (51). In others, the intervention setting was unknown or unclear (n=8) (28,30,34,39,41,46,47,52). DPPs were mainly conducted in the USA (n=15) (16,25,45,49,51,53,54,27,29,32,35,38,39,42,44); but also Australia (n=3) (6,31,47); UK (n=2) (26,34); Taiwan (n=2) (36,41); Thailand (n=1) (55); New Zealand (n=1) (48); Netherlands (n=1) (37); Poland (n=1) (43); Canada (n=1) (50); France (n=1) (46); Germany (n=1) (28); Greece (n=1) (40); India (n=1) (30); Brazil (n=1) (52) and Japan (n=1) (33).

Group size and frequency

The number of participants in a group session varied from 5-10 participants (34), to 15-20 participants (47), in the 17 papers in which they were reported.

Timing and number of group sessions

Out of the 23 papers in which it was specified, duration of group sessions ranged from 45 minutes (50), to 8 hours (30), with a mean of 2 hours. All papers stated the number of group sessions in their intervention, which varied from 1 (or 2 half days) (26), (30,34) to 74 sessions (46), with a mean of 19 sessions.

Length of follow-up

All DPPs had a baseline measure and most had assessments immediately after the programme to monitor changes in outcomes (n=23) (16,25,40,42,44,45,47–52,27,53–55,29–33,37,39). Time of follow-up varied from 2 weeks (n=1) (35), to 7 years (n=1) (46), with follow-up after 1 year of the intervention being most common (n=8) (6,26,28,34,38,39,41,45).

## Reasons for dropout

Eighteen DPPs reported reasons for participant dropout. These included: lost interest (25,29,37), doctors specifying that participant’s raised blood sugar does not need attention (35), unable to commit to intervention schedule (25,29,39,41–43,51), time constraints (6,32,34,37,43), caring for ill family member (51), distance was too far (25), lack of transport (6,29), fuel costs (6), relocation (29,32–35,39,50,52,55), holiday (34), work commitments (34), family/health related issues or conditions (6,29,32–35,37,41,42), hospitalisation (42), stress due to weight gain (51), pregnancy/disability (34,35,37,46) or poor literacy (6). Compared with completers, non-completers were more likely to be male (26,32,33), have higher BMI (31,43) and waist circumference (31,43), and were younger (39,46).

## Recruitment methods, response rates (RR) and uptake rates

Table 2 shows the recruitment strategies, response rates (RR) and uptake rates (where they could be calculated). For the two programmes where it was possible to calculate RR (37,40), recruitment methods were not clearly described (40) or medical records/referrals were used (37), which prevented meaningful analysis.

It was possible to calculate uptake for 12 DPPs. For the five DPPs with highest uptake (32,37,38,42,46), two used invitation letters/mailing and flyers (32,42), one used presentations and bulletins (38), one used medical records/referrals (37), one used telephone calls, newspaper advertisements, radio and TV (32), and one used posters (42) . For one DPP, it was not possible to determine the methods used (46). For the five lowest uptake DPPs (6,39,41,44,45), two used medical records/referrals (39,44), one used a magazine and website (44), one used bulletins (45), and two did not clearly state the recruitment method used (6,41). Overall, it is difficult to discern any trends from the data in relation to recruitment methods and uptake.

Table 2 about here

## 3.7 BCTs and retention levels

**Overall patterns**

Table 3 shows the BCTs identified from the DPPs, and the retention rates for 31 DPPs in which they could be calculated. Independent of retention, all DPPs used a credible source (9.1)[[1]](#footnote-2), 81% used instruction on how to perform a behaviour (4.1; n=25), 71% used goal setting (behaviour) (1.1; n=22) and 68% used goal setting (outcome) (1.3; n=21). Six studies included an incentive for participation. This did not fit into any BCT definitions as stated in the Taxonomy v1 (19).

Table 3 about here

High retention

For the ten DPPs with highest retention (25,28,30,32,36,38,41,46,50,54) (Appendix 2: supplementary information):

* all reported using credible source (9.1);
* eight instructed participants how to perform a behaviour (4.1);
* six used goal setting (behaviour) (1.1);
* five demonstrated the behaviour (6.1), used problem-solving (1.2), social support (unspecified) (3.1) or an incentive for participation;
* four used techniques to reduce negative emotions (11.2), used behavioural practice/rehearsal (8.1) or goal setting (outcome) (1.3).

Low retention

For the ten DPPs with lowest retention (16,26,33,35,39,40,42,43,49,53) (Appendix 2: supplementary information):

* all reported using credible source (9.1);
* eight used goal setting (outcome) (1.3);
* seven used goal setting (behaviour) (1.1);
* six instructed how to perform a behaviour (4.1) or used self-monitoring of behaviour (2.3);
* four provided social support (unspecified) (3.1).

# Discussion

Diabetes Prevention Programmes (DPPs) are important to address rising global prevalence of T2DM (4,7–10). Their impact depends on both effectiveness and the ability to reach and engage with those at high risk of T2DM (15,16). We report the first systematic review to explore recruitment strategies associated with high response and uptake rates in group-based DPPs, as well as BCTs associated with high retention.

## Recruitment methods, response rates (RR) and uptake

Recruitment strategies reported in the DPPs varied from referrals, letters, flyers, presentations, bulletins to magazine, posters, newspapers, telephone, website, email, radio, TV and word of mouth. For certain strategies such as medical referrals and invitation letters, it is possible to determine RR, as the number of participants reached is known. This is not the case for many other recruitment strategies such as TV, radio and flyers as there is uncertainty of reaching the target population with these strategies (17). Associations between recruitment methods and RR could not be explored as RR could only be calculated for two DPPs (one used medical records/referrals, one did not state recruitment methods). More consistent and detailed reporting of recruitment methods is required to better understand which are most effective in promoting initial responses given the common challenges in recruiting to DPPs (56).

It was also difficult to state trends in relation to uptake, which could only be calculated for 36% of included DPPs. For most, it was not possible to determine the proportion of the participants who started the programme from those who were allocated to the group-based programme, again highlighting the need for robust reporting (15).

## BCTs and retention

Overall, many different BCTs were identified across DPPs. All DPPs used a “credible source” which is where part or all of the intervention was delivered by a credible spokesperson like a healthcare professional, for example, dieticians who were promoting healthier lifestyle changes or discouraging unhealthy habits (6,25,39,40,44,47,51). The majority of DPPs used “instruction on how to perform a behaviour”, which involved advising participants how to perform a particular behaviour through exercise or cookery classes. Goal setting (behaviour) was also identified in the majority of DPPs, which included setting or agreeing a behavioural goal as part of the intervention, like agreeing to undertake a certain amount of daily exercise. Although NICE guidelines recommend incorporating BCTs such as goal planning for successful behaviour change (57), this BCT was present in both high and low retention programmes, so was not a clear correlate of retention.

Furthermore, the programmes with high levels of retention were more likely to provide incentives for participation, use problem-solving, demonstrate the behaviour, use behavioural practice/rehearsal, and use techniques to reduce negative emotions. Those with lower levels of retention were more likely to use goal setting (outcome); similar findings have been reported for group-based weight management programmes (58). This suggests that to encourage retention, it is more useful to focus on changing a *behaviour* like diet or exercise, rather than an *outcome* such as weight. Programmes with low retention were more likely to include self-monitoring of behaviour. This contradicts research that suggests that self-monitoring of behaviour is one of the BCTs to improve retention or reduce T2DM incidence, so this finding should be treated with caution (59,60). However, it is possible that participants may have felt that self-monitoring their behaviour was burdensome and time consuming (if a high level of self-monitoring was required) resulting in them losing interest in the programme, and therefore dropping out. Another reason may be that self-monitoring led participants to become demotivated to remain in the programme due to not achieving their dietary and/or physical activity expectations after completing questionnaires or activity logs to record their behaviour. This can lead to some individuals feeling discouraged or avoidant (61). This interesting and unexpected finding would merit further investigation.

In the high retention programmes, “incentive for participation” involved participants being given cash, gift vouchers or certificates at various points in the programme. This behaviour change technique does not fit into any of the 93 BCTs from the taxonomy as it refers to using rewards to encourage taking part, rather than rewards to encourage performing the health behaviour. This suggests that providing incentives for people to participate in behaviour change programmes should be considered to promote retention in DPPs by motivating participants to continue attending (12). However, providing monetary incentives to participants may not be feasible or sustainable in many settings, particularly in low- and middle-income countries, so non-monetary rewards, such as certificates or other incentives might also be worth considering. Some qualitative evidence suggested attrition was related to effectiveness of incentives (62), but whether incentives promote retention requires further investigation (63). Problem-solving was more likely to be included in high-retention programmes. It involved identifying barriers to making lifestyle changes and devising strategies to overcome them. This enables participants to have an active involvement in making the desired changes, and may encourage them to continue with the programme (58).

Demonstration of the behaviour included participants being shown how to perform the behaviour, for example how to exercise was demonstrated during physical activity sessions through observation (30,46,54), healthy eating was demonstrated through showing portion sizes (54) or healthy cooking methods (32). Behavioural practice/rehearsal involved participants cooking healthy foods (25,46) or participating in physical activity within the sessions (30,46,54). Demonstrating and rehearsing the ideal behaviour as part of the behaviour change strategy, may equip participants with the confidence and capability to make the desired lifestyle changes and ultimately motivate them to continue with the programme (64). This is supported by research on RCTs that found DPPs which successfully reduced T2DM incidence and had good retention had used BCTs such as demonstration and rehearsal of the ideal behaviour (60).

Although only few programmes included the BCT “reducing negative emotions”, it was more prevalent in those with high retention. It was related specifically to stress-management and educating participants in finding ways to reduce stress. This supports previous findings which have suggested it is important for retention (58). As there are established links between cognitions, emotions and behaviour (20,65,66), it is important to consider emotional changes and how to deal with negative emotion as part of a behaviour change programme (67). If people are given the correct tools to deal with negative emotions, and programmes can address these potential emotional changes, this may help to increase participants’ motivation and capability of change (64,67), promote good decision-making (66) and ultimately increase programme retention.

## Considerations/limitations and future research

Several limitations are recognised. Firstly, although results from the searches were discussed regularly by the research team, the search was conducted entirely by one author (first author) which may compromise the comprehensiveness of the search. Secondly, it was not possible to determine whether some DPPs were group-based due to insufficient reporting. This may have led to some group-based DPPs not being included, despite our systematic review methods and requests to authors for clarifying information. In addition, the review only considered programmes which identified people who had glucose-defined prediabetes; other lifestyle-based diabetes prevention programmes conducted in the community or healthcare settings use diabetes risk scores or HbA1c to identify high-risk individuals. Lack of reported information prevented rates being determined, particularly for response and uptake. Additionally, participants often drop out of sessions progressively, which is an important part of the retention issue. However, it was not possible to explore this matter in such depth due to the heterogeneity of sessions across the included DPPs and also the lack of reported information on completion. It was also not possible to code BCTs for some of the DPPs due to insufficient information in the papers. For example, some authors stated the use of social support which is important to include in group-based DPPs (12,57,68), whereas others did not provide enough detail to be coded specifically as a BCT. This included one DPP (52) which stated that “discussion-format group sessions that took place”, but provided no further detail on what this entailed.

Future qualitative work could explore in depth the factors that impact the decisions of participants to start and continue with attending group-based DPPs. A qualitative approach would provide a richer insight into the facilitators and barriers, as well as exploring strategies to overcome challenges to maximise uptake and retention (69). Future studies of DPPs need to include detailed reporting of recruitment processes, sufficient information to allow extraction of BCTs and calculation of response, uptake and retention rates. This will enable better evaluation of group-based DPPs and provide evidence to help improve uptake and retention.

# Conclusion

This review indicated that group-based DPPs with highest retention tend to include incentives for participation, problem-solving, reducing negative emotions, behaviour demonstration and practice. Identification of links between recruitment strategies and response or uptake rates were limited by reporting. By clinicians and programme organisers focusing their efforts on identifying effective recruitment strategies and incorporating ideal behaviour change techniques into their programmes, this will contribute towards maximising response, uptake and retention rates. More comprehensive reporting of recruitment strategies and intervention components is essential to allow accurate evaluations of DPPs, to ensure they are more cost-effective and viable.

# Declarations of interest

Declarations of interest: none

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*Table 1: Inclusion/exclusion criteria*

|  |  |
| --- | --- |
| **Inclusion** | **Exclusion** |
| Group-based (necessary component; ≥50% sessions are group-based) | Mostly individual sessions  Optional group sessions/unclear if group-based  Unable to determine both uptake and retention |
| Prediabetes  Non-diabetic hyperglycaemia (determined by glucose testing)  Impaired glucose tolerance/Impaired fasting glucose | Confirmed T2DM  Combination of T2DM and prediabetes  T1DM  Gestational diabetes/post-partum  Normal glucose levels/metabolic syndrome**.** |
| Adults ≥18yrs |  |
| English language |  |
| RCTs/prospective/cohort/relevant studies within reviews/pilot studies/feasibility studies | Qualitative studies (methodology and/or analysis)  Case studies  Mixed methods, process evaluation, reviews, protocols (with no data)/observational only |
| Face-to-face  Intensive lifestyle modification | Intervention included: metformin/drugs/medication.  Intervention only used cable television/digital platforms/handheld device/video/mobile app/web-based/e-learning/video conferencing |
| Primary outcomes: weight loss/T2DM risk reduction |  |
|  |  |

*Figure 1: PRISMA diagram of papers included/excluded for review*

Records identified through database searching: (initial search-before filters): **n=27,137** (14,265 from 1st top-up search, 6,373 from 2nd)

Records identified through database searching: Initial search (after filters applied): **n=1,198** (including 101 from 1st top-up search, 85 from 2nd)

After screening by title and/or abstract: **n=146** (including 7 from 1st top-up search, 11 from 2nd)

After screening full-text articles, final inclusion of papers: **n=33** (including 7 from 1st top-up search, 2 from 2nd)

Papers identified through:

EBSCO: n=1,776

Science Direct: n=1,257

Web of Science: n=3,661

PubMed: n=3,207

ProQuest Nursing and Allied Health: n=15,434

Summon: n=1,787

Open Grey: n=15

Papers identified through:

EBSCO: n=587

Science Direct: n=33

Web of Science: n=240

PubMed: n=52

ProQuest Nursing and Allied Health: n=24

Summon: n=43

Open Grey: n=55

Other sources:

Reviews identified: n=11 (164 papers checked by title/abstract and included n=24)

Records excluded based on title and/or abstract: n=1,052

Reasons:

* Duplicates (n=234)
* Design (qualitative/ process evaluation/ clinical drug trials/not DPP) (n=305)
* Sample (not prediabetes only/not adults) (n=183)
* Primary outcomes (not weight loss and/or T2DM risk reduction) (n=251)
* Not face-to-face group-based (n=79)

Full-text articles excluded: n=113

Reasons:

* Not mainly group-based (n=39)
* Primary outcomes (not weight loss and/or T2DM risk reduction) (n=9)
* Sample not prediabetes only (via glucose testing) (n=21)
* Uptake and retention cannot be determined (n=4)
* Design (qualitative/ process evaluation/protocols/ clinical drug trials) (n=13)
* DPP already excluded (n=16)
* DPP already included (n=11)

Table 2: Papers detailing quality rating (overall), recruitment strategies, response and uptake rates (high-low)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Fianu (2016) | Davis-Smith (2007) | Duijzer (2017) | Ockene (2012) | Quinones (2018) | Makrilakis (2010) | Moin (2017) | Laatikainen (2007) | Boltri (2011 | Tsai (2018) | Jiang (2013) | Almeida (2010) | Alva (2009) |
| Quality rating (overall) | W | M | M | S | S | M | M | M | W | M | W | W | M |
| Response rates (%) | - | - | 53.6 | - | - | 41.0\* | - | - | - | - | - | - | - |
| Uptake rates (%) | 93.0 | 90.0 | 89.7 | 85.8 | 85.7 | 76.1 | 64.1 | 63.3 | 50.0 | 32.5 | 31.0 | 8.3 | - |
| **Recruitment methods** |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Referrals/medical records |  |  | X |  |  |  | X |  |  |  | X | X | X |
| Post/letters/mailing |  |  |  | X | X |  |  |  |  |  |  |  |  |
| Flyers |  |  |  | X | X |  |  |  |  |  |  |  |  |
| Presentations |  | X |  |  |  |  |  |  |  |  |  |  |  |
| Newsletters/bulletins |  | X |  |  |  |  |  |  | X |  |  |  |  |
| Posters |  |  |  |  | X |  |  |  |  |  |  |  |  |
| Newspapers advertisements |  |  |  | X |  |  |  |  |  |  |  |  |  |
| Magazines/brochures |  |  |  |  |  |  |  |  |  |  |  | X |  |
| Telephone |  |  |  | X |  |  |  |  |  |  |  |  |  |
| Radio |  |  |  | X |  |  |  |  |  |  |  |  |  |
| TV |  |  |  | X |  |  |  |  |  |  |  |  |  |
| Website/social media |  |  |  |  |  |  |  |  |  |  |  | X |  |
| Unclear/too general |  |  |  |  |  |  |  | X |  |  |  |  |  |
| Not stated | X |  |  |  |  | X |  |  |  | X |  |  |  |

Key: N/A (-); \*This figure might be questionable as in the recruitment strategy, for occupational settings, a day was organised when questionnaires were given, meaning some may have been informed about the study but not given the questionnaire to complete; Strong (S); Moderate (M); Weak (W).

Table 2 Cont`d: Papers detailing quality rating (overall), recruitment strategies, response and uptake rates (high-low)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Gilis-Januszewska (2018) | Katula (2013) | Yeh (2015) | Yates (2009) | Miller (2016) | Pimentel (2010) | Davies (2016) | Gagnon (2011) | Kulzer (2009) | Payne (2008) | Sakane (2011) | Vincent (2014) | Coppell (2017) | Marrero (2016) | Parikh (2010) | Chen (2017) | McDermott (2014) | Moore (2011) | Bernstein (2014) | Aekplakorn (2019) |
| Quality rating (overall) | M | M | S | S | S | S | S | S | S | S | M | S | S | S | S | M | S | S | M | S |
| Response rates (%) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Uptake rates (%) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Recruitment methods** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Referrals/medical records |  | X |  |  |  |  |  | X |  | X |  | X | X |  |  |  |  | X |  |  |
| Post/letters/mailing |  | X |  | X | X |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Flyers/leaflets | X | X |  |  | X |  |  |  |  |  | X | X |  |  |  |  |  |  |  |  |
| Presentations |  | X |  |  |  |  |  |  |  |  |  | X |  |  | X |  |  |  |  | X |
| Newsletters/bulletin |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Posters |  | X |  |  |  |  |  |  |  |  | X |  |  |  |  |  |  |  |  |  |
| Magazines/brochures |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Telephone |  |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Website/social media |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  |  |  |  |  |  |
| Email |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Newspapers |  | X |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Word of mouth |  |  |  |  |  |  |  |  |  |  | X |  |  |  |  |  |  |  |  |  |
| Unclear/too general |  |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  | X |  |  |  |
| Not stated |  |  | X |  |  |  |  |  | X |  |  |  |  | X |  | X |  |  | X |  |

Key: N/A (-); Strong (S); Moderate (M); Weak (W).

Table 3: Retention rates (high-low) for those interventions where BCTs have been identified

|  | Bernstein (2014) | Tsai (2018) | Yeh (2015) | McDermott (2014) | Chen (2017) | Fianu (2016) | Gagnon (2011) | Ockene (2012) | Kulzer (2009) | Davis-Smith (2007) | Aekplakorn (2019) | Yates (2009) | Moore (2011) | Pimentel (2010) | Miller (2016) | Duijzer (2017) | Katula (2013) | Marrero (2016) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Retention rates (%) | 100 | 100 | 100 | 95.2 | 95.0 | 94.1 | 92.3 | 92.1 | 91.4 | 90.0 | 89.2 | 89.1 | 87.9 | 87.5 | 85.0 | 84.9 | 84.1 | 83.9 |
| 1. **Goals and planning** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1.1 Goal setting (behaviour) | X | X |  |  | X |  | X | X |  | X |  | X | X |  | X | X | X |  |
| 1.2 Problem-solving | X | X |  |  | X |  | X | X |  |  | X | X | X |  | X |  | X | X |
| * 1. Goal setting (outcome) |  | X |  |  |  |  | X | X |  | X |  |  | X |  | X | X | X | X |
| 1.4 Action planning |  | X |  |  |  | X |  | X |  |  |  | X |  |  | X |  |  |  |
| 1.5 Review behaviour goal(s) |  | X |  |  | X |  |  | X |  |  |  |  |  |  | X |  |  |  |
| 1.6 Discrepancy between current behaviour and goal |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1.7 Review outcome goal(s) |  | X |  |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  |
| **2. Feedback and monitoring** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2.1. Monitoring of behaviour by others without feedback |  |  |  |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  |
| 2.2. Feedback on behaviour |  |  |  |  |  |  | X |  |  |  |  |  |  |  | X |  |  |  |
| 2.3. Self-monitoring of behaviour |  | X |  |  | X |  |  | X | X |  |  | X |  |  | X |  | X |  |
| 2.4 Self-monitoring of outcome(s) of behaviour |  | X |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  | X |
| 2.5 Monitoring outcome(s) of behaviour by others without feedback |  |  |  |  |  |  |  |  |  | X |  |  |  |  |  |  |  |  |
| 2.7 Feedback on outcome(s) of behaviour |  |  |  |  |  |  |  |  |  |  |  |  |  |  | X | X |  |  |
| **3. Social support** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **X** |  |  |
| 3.1. Social support (unspecified) |  | X |  | X | X |  |  | X |  | X | X |  |  |  | X | X |  |  |
| 3.2 Social support (practical) |  |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |
| 3.3. Social support (emotional) | X | X |  |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |
| **4. Shaping knowledge** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4.1. Instruction on how to perform the behaviour | X | X | X | X | X | X | X | X |  |  | X |  | X | X | X | X | X | X |
| **5. Natural consequences** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5.1. Information about health consequences |  | X |  |  |  |  |  |  |  |  |  | X |  |  |  |  |  |  |
| **6. Comparison of behaviour** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6.1. Demonstration of the behaviour | X |  | X | X |  | X |  | X |  |  |  |  |  |  |  | X |  |  |
| **7. Associations** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 7.1. Prompts/cues |  |  |  |  |  |  |  |  |  | X |  |  |  |  |  |  |  |  |
| **8. Repetition and substitution** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 8.1. Behavioural practice/rehearsal | X |  | X | X |  | X |  |  |  |  |  |  |  |  |  | X |  |  |
| 8.7. Graded tasks |  |  |  |  |  |  | X |  |  |  |  | X |  |  |  |  |  |  |
| **9. Comparison of outcomes** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 9.1. Credible source | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| 9.2 Pros and cons |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **11. Regulation** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 11.2. Reduce negative emotions | X | X |  | X | X |  |  |  |  |  |  |  | X |  |  |  |  |  |
| **13. Identity** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 13.2. Framing/reframing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | X |  |
| **New BCTs** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Incentive for participation | X | X |  |  | X | X |  | X |  |  |  |  |  |  |  |  |  |  |

Table 3 Cont`d: Retention rates (high-low) for all those interventions where BCTs have been identified

|  | Payne (2008) | Coppell (2017) | Laatikainen (2007) | Makrilakis (2010) | Davies (2016) | Jiang (2013) | Sakane (2011) | Gilis-Januszewska (2018) | Parikh (2010) | Moin (2017) | Vincent (2014) | Quinones (2018) | Alva (2019) | Almeida (2010) | Boltri (2011) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Retention Rates (%) | 80.3 | 78.8 | 76.2 | 76.1 | 76.1 | 74.1 | 70.6 | 70.2 | 70.0 | 66.3 | 65.8 | 61.1 | 53.2 | - | - |
| **1.Goals and planning** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1.1 Goal setting (behaviour) | X | X | X | X |  | X | X | X |  | X |  | X | X | X |  |
| 1.2 Problem-solving | X |  |  |  |  |  |  |  |  |  | X |  | X | X |  |
| 1.3 Goal setting (outcome) | X | X | X | X | X | X | X | X |  | X |  | X | X | X |  |
| 1.4 Action planning | X |  |  |  | X |  | X |  |  |  |  |  |  | X |  |
| 1.7 Review outcome goal(s) |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |
| **2. Feedback and monitoring** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2.1 Monitoring of behaviour by others without feedback | X |  |  |  |  |  |  |  |  |  |  |  | X |  |  |
| 2.2. Feedback on behaviour |  |  |  |  |  | X |  |  |  |  | X | X |  |  |  |
| 2.3. Self-monitoring of behaviour | X |  | X | X | X | X | X |  |  |  | X | X |  |  |  |
| 2.4 Self-monitoring of outcome(s) of behaviour | X |  |  | X |  | X |  |  |  |  |  |  |  |  |  |
| 2.5 Monitoring outcome(s) of behaviour by others without feedback |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |
| 2.7 Feedback on outcome(s) of behaviour |  |  |  |  |  |  | X |  |  |  |  |  |  |  |  |
| **3 Social support** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3.1. Social support (unspecified) |  | X | X |  | X |  |  | X |  | X | X |  |  |  | X |
| 3.2. Social support (practical) |  |  |  |  |  |  |  | X |  |  |  |  |  |  |  |
| 3.3. Social support (emotional) | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **4. Shaping knowledge** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4.1. Instruction on how to perform the behaviour | X | X | X |  | X |  | X | X | X |  | X |  | X | X |  |
| **6. Comparison of behaviour** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6.1. Demonstration of the behaviour | X |  |  |  |  |  |  | X |  |  | X |  |  |  |  |
| **8. Repetition and substitution** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 8.1. Behavioural practice/rehearsal |  |  |  |  |  |  |  | X |  |  | X |  |  |  |  |
| 8.7. Graded tasks | X |  |  |  | X |  |  |  |  |  |  |  |  |  |  |
| **9. Comparison of outcomes** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 9.1. Credible source | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| **10. Reward and threat** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 10.4. Social reward |  |  |  |  |  |  |  |  |  |  | X |  |  |  |  |
| **11. Regulation** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 11.2. Reduce negative emotions | X |  |  |  |  |  |  |  |  |  | X |  | X |  |  |
| **New BCTs** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Incentive for participation |  |  |  |  |  |  |  |  | X |  |  |  |  |  |  |

Key: N/A (-)

1. Please note that the numbers assigned in parentheses at the end of each BCT represent their number in the BCT Taxonomy v1 (19) [↑](#footnote-ref-2)