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Review Article

The effectiveness of co-created lifestyle interventions in improving health behaviour, physical and mental health in adults with non-communicable diseases: A systematic review with meta-analysis

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ABSTRACT

Objectives: This systematic review aimed to evaluate the effectiveness of co-created lifestyle interventions in modifying health behaviour, and mental/physical health outcomes in individuals with non-communicable diseases (NCDs).
Study design: A systematic review of Randomized Control Trials (RCTs).
Methods: A systematic search of nine databases from inception until March 2023 was performed, plus weekly email alerts of new literature until March 2025. Studies comparing co-created lifestyle interventions with any control were included. Meta-analysis using the random effects model was conducted. Risk of bias was assessed using the Cochrane-RoB-2, and quality of evidence was assessed using GRADE system.
Results: Sixteen RCTs (2201 participants; 74.2 % female; mean 53.8 years) were included. Meta-analysis showed that at <6 months, there is moderate quality evidence that co-created lifestyle interventions significantly improve health behaviour (moderate effect; SMD = 0.49, 95 %CI: 0.33–0.65) and physical health (small effect; SMD = 0.21, 95 %CI: 0.09–0.34), and mental health (small effect; SMD = 0.29, 95 %CI: 0.14–0.43), in individuals with NCDs. At ≥6 months, there is moderate quality evidence that co-created interventions improve health behaviour (small effect; SMD = 0.21, 95 %CI: 0.07–0.35), and mental health (small effect; SMD = 0.19, 95 %CI: 0.12–0.26). A small effect with low quality evidence (SMD = 0.11, 95 %CI: 0.09-0.32) was also observed for physical health, however, it was not statistically significant.

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Conclusions: There is moderate quality evidence that co-created lifestyle interventions for secondary prevention of NCDs have a significant positive impact on the target health behaviour, and on mental health, and physical health outcomes.

1. Introduction

Non-communicable diseases (NCDs) remain a leading cause of morbidity and mortality worldwide, most commonly linked to cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes.[1] Having one morbidity is a primary risk factor for developing additional conditions as well as increased risk of mortality.[2] Lifestyle changes (physical activity, nutrition, medication adherence, reduced tobacco and alcohol intake, etc.) are the main form of primary prevention of NCDs and crucial components of secondary and tertiary prevention.[1] However, many individuals with NCDs struggle to adopt and sustain lifestyle changes, posing a major challenge to disease management.[3] Traditional, top-down approaches to lifestyle intervention design have often failed to yield sustained benefits among people with NCDs.[4] It is thought that a participatory approach would lead to better interventions with better tailoring and adherence.[5]

In recent years, participatory approaches, such as co-creation, have gained prominence in healthcare research and intervention development.[6] Co-creation involves engaging stakeholders from all the nodes of the quadruple helix (academia, industry, government, and users) to collaboratively create effective and sustainable solutions.[7,8] This approach represents a shift away from conventional, expert-driven models towards more inclusive frameworks that empower end-users to take an active role in shaping their healthcare.[9] Co-creation has been associated with improved intervention adherence, enhanced healthcare service delivery, and greater potential for scalability and sustainability.[10–12] Previous research has suggested that co-created interventions can positively impact health outcomes and may be particularly effective in addressing complex health behaviours.[5]

A previous review found that co-created interventions had a small to moderate impact on various health outcomes, including physical health, health-promoting behaviour, accessibility of healthcare services, and self-efficacy.[13] However, the review did not focus on secondary prevention of NCDs. To address this gap, this systematic review examines the effects of co-created lifestyle interventions in individuals with NCDs, conducts subgroup analyses for health behaviour, mental health and physical health outcomes, and establishes both the short-term (<6 months) and medium-to long-term (≥6 months) effects of co-created interventions. By synthesising evidence from existing studies, the review provides insights into the role of co-creation in healthcare intervention development and its potential for widespread implementation.

2. Methods

This systematic review followed the recommendations described in the updated Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) 2020 guideline.[14] The published review protocol[15] was registered within the International Prospective Register of Systematic Reviews (PROSPERO ID: CRD42023391746). This paper reports on the quantitative review evaluating the effectiveness of co-created lifestyle interventions.

2.1. Eligibility criteria

Study design: the review included only randomised controlled trials (RCTs) that evaluated the effect of co-created lifestyle interventions on the health behaviour and/or other health outcomes of individuals with NCDs. Only papers published in the English language were included. Studies such as non-RCTs, cohort studies, case reports, reviews, study protocols and conference abstracts were excluded.

Participants: studies that involved adults (18 years and above) with NCDs. The list and description of NCDs considered in this review is provided in supplementary file, Table S1.

Interventions: studies that explored lifestyle co-created interventions aiming to modify health behaviours such as physical activity/nutrition and/or health outcomes in individuals with NCDs.

Outcomes: studies that reported outcomes that measured secondary, and/or tertiary prevention of NCDs were included. Examples of such outcomes included: health behaviour-physical activity (e.g., self-reported, activity monitor, physical activity questionnaires), tobacco intake, alcohol intake, sedentary lifestyle, diet, screening behaviour, help-seeking behaviour; and health outcomes-quality of life (QoL), biomedical markers (e.g., lipid profile, blood pressure, blood glucose, body mass index, inflammatory markers), depression, anxiety, overall health status, disease severity, morbidity and mortality rates. The review evaluated the short-term (<6 months) and medium-to long-term (≥6 months)[16] effects of co-created interventions on the outcomes.

2.2. Information sources and search strategy

A systematic search of nine electronic databases to identify potentially eligible studies was performed by one reviewer (EMA) in consultation with a librarian. The search strategy was developed using controlled vocabularies (e.g., MeSH terms) and free-text terms relevant to the review topic. The databases searched included MEDLINE (via OVID), CINAHL (via EBSCO Host), EMBASE (via OVID), PsycINFO (via OVID), Scopus, Web of Science, Cochrane Library, grey literature sources such as clinical trial register, and a specific Co-creation Database.[8] The search covered studies from database inception (1964) until March 2023. To facilitate the identification of studies that were published after the official search date, weekly email alerts of new literature were set up in three main databases (MEDLINE, EMBASE, and PsycINFO) via OVID until March 2025, as recommended in the Cochrane Handbook.[17] To ensure robustness, the same search strategy used for the initial search was used to identify articles sent through the email alerts. Articles received were screened for eligibility as they came. In addition, a manual search of the reference list of included studies was conducted. A sample of the search strategy is provided in supplementary file, Table S2.

2.3. Study selection and data extraction

The study selection process was conducted based on the predetermined inclusion criteria. All retrieved studies were compiled, and duplicate records were removed using Covidence. Two reviewers (from EMA, IBA, IIA, AOI, CMO, MN, and MCO) independently assessed the titles and abstracts of all identified studies. Next, the full-text versions of studies that met the initial screening criteria were independently screened by two reviewers (from EMA, IBA, IIA, OKO, and AOI). In cases where disagreements arose regarding inclusion, a third reviewer (CS) was consulted to resolve discrepancies.

Data extraction was conducted by four reviewers (EMA, PMD, IBA, and GRL) following the guidance from the Cochrane Consumers and Communication Review Group.[18] The following data items were extracted; author details, country of study, study aim, participants' characteristics, study sample size, study design, intervention co-creation process, intervention description, comparison group intervention (if applicable), study setting, intervention duration, time of outcome assessment, outcome(s) assessed, outcome(s) measurement methods, baseline outcome values (treatment group), and post-intervention

outcome values.

2.4. Risk of bias assessment

The Cochrane Collaboration Risk of Bias Tool 2 (ROB 2)[19] was used to assess potential bias. This tool comprised five domains: (1) bias arising from the randomisation process, (2) deviations from the intended interventions, (3) missing outcome data, (4) bias in outcome measurement, and (5) bias in the selection of the reported result. Each domain was rated as 'low risk,' 'high risk,' or 'some concerns,' leading to an overall risk of bias classification as either 'low risk', 'high risk', or 'unclear risk'.[19] Two reviewers (EMA and KF) independently evaluated the potential risk of bias. Any disagreements were discussed to reach a consensus, and a third reviewer (IBA) was consulted when necessary.

2.5. Data analysis/synthesis

Results from the RCTs were pooled together in a meta-analysis using the Comprehensive Meta-analysis software 3.3 (CMA 3.3). The random effects model of meta-analysis was used to account for heterogeneity in included studies. Standardised mean differences (SMD) were used as the effect measure (with 95 % confidence intervals), considering the wide range of outcome measures used in the included studies.[20] SMDs were interpreted as small effect (<0.40), moderate effect (0.40–0.70), and large effect (>0.70).[21] A sub-group analysis was conducted to pool studies with similar outcomes together. The aim of our study was to evaluate the effects of lifestyle co-created interventions on broad outcome categories (health behaviour, mental health and physical health) and not specific outcomes, hence we used the broad classification scheme suggested by O'Mara Eves et al.[22] for the meta-analyses. This method has also been used in other meta-analysis studies, for example, the study by Halvorsrud et al.[13] Heterogeneity was evaluated by visually examining the Forest plots, the p-value of Cochran's Q test ($p < 0.05$), and the I^2 statistic value.[23] Substantial heterogeneity was determined when the I^2 statistic is >50 %. Sensitivity analyses were conducted to ensure robustness, including fixed effects meta-analysis,[24] and excluding studies with high risk of bias. One-study-removed sensitivity analysis was also applied to reduce subgroup heterogeneity and also account for studies with high dominance, considering effect sizes outside the 95 % confidence interval of the mean effect size as outliers.[25] The funnel plot for asymmetry was used to examine publication bias, followed by the Egger regression test.[23] Following Cochrane guidelines, publication bias was assessed only for outcomes with a minimum of 10 studies.[17]

2.6. Confidence in cumulative evidence

The Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system was used to assess the quality of cumulative evidence from the systematic review.[26] The quality of evidence was assessed across five domains, including bias risk, consistency, directness, precision, and publication bias. The cumulative evidence from the review was categorised as "high quality," "moderate quality," "poor quality," or "very low quality" evidence.[26]

2.7. Deviation from registered protocol

This systematic review has some deviations from the initial protocol registered on PROSPERO. The initial plan was to include both RCTs and non-RCTs. However, during the review process, the decision was made to include only RCTs as they constitute the highest level of evidence for determining intervention effectiveness.[27] This deviation was made to enhance the methodological rigour and ensure that the conclusions drawn are based on the most robust available evidence.

3. Results

A total of 20,154 records were identified through the search of databases. After duplicate removal, the titles and abstracts of 14,783 records were screened leading to the exclusion of 14,569 records. The full text of 214 studies were then screened leading to the inclusion of 16 studies in the systematic review (see PRISMA flow diagram in Fig. 1).

3.1. Characteristics of the included studies

There were a total of 2201 participants (range 18–1009; 74.2 % female) in the included studies, mean age of 53.82 (range 26–80.4) years.[28–43] The study populations comprised of individuals with varying NCDs including cardiovascular diseases, cancers, diabetes mellitus, respiratory conditions, musculoskeletal conditions, dementia, chronic kidney disease, and mental health conditions. The included studies were conducted in different countries: eight in the USA, six in the UK and in Australia, two in Denmark, and one in each of Bangladesh, Germany, Hong Kong, the Netherlands, Spain and Sweden. The interventions in the included studies targeted modifying one or more health promoting behaviours such as physical activity, nutrition, and/or improving mental/physical health outcomes in individuals with NCDs. See Table 1 for summarized characteristics of included RCTs, the full description is provided in Supplementary file, Table S3.

3.2. Risk of bias in included studies

Overall, risk of bias was low in seven trials[35–39,42,43] (43.75 %), had some concerns in eight trials[28–34,40] (50 %), and was high in one trial[41] (6.25 %). More than 50 % of the trials had low risk of bias in the individual domains: randomisation process, deviations from intended interventions, missing outcome data, measurement of outcome, and selection of the reported result. The trial with high risk of bias was due to the randomisation process, as allocation sequence concealment was not implemented (see Supplementary file, Fig. S1).

3.3. Meta-analyses

The results of the meta-analysis of the RCTs showed that at <6 months, there is moderate quality evidence (see Supplementary file, Table S4 for GRADE assessment) that co-created interventions significantly improve health behaviour (moderate effect; SMD = 0.49, 95 %CI: 0.33–0.65, n = 12), physical health (small effect; SMD = 0.21, 95 %CI: 0.09–0.34, n = 16), and mental health (small effect; SMD = 0.29, 95 % CI: 0.14–0.43, n = 34), in individuals with NCDs (See Fig. 2 for the Forest plot). This result was retained after conducting sensitivity analyses (Supplementary file, Table S5; Fig. S2–S4). Low heterogeneity was observed for the meta-analysis of RCTs at <6 months for health behaviour ($I^2 < 0.001$, Tau-squared<0.001) and physical health ($I^2 < 0.001$, Tau-squared<0.001), however, marked heterogeneity was observed for mental health ($I^2 = 66.55$, Tau-squared = 0.108). Egger's regression test showed no significant small-study effects (publication bias) for health behaviour (p = 0.881), and physical health (P = 0.462). However, a significant small-study effect was observed for mental health (p = 0.03), which was adjusted using the trim and fill method (adjusted effect size/SMD = 0.19, 95 %CI: 0.02–0.37). See Supplementary file, Fig. S5–S7 for the funnel plots.

Considering the limitations of broad classification meta-analysis where some studies are included more than once, a meta-analysis of separate mental health outcomes (depression and anxiety) was conducted. The results also showed that at <6 months, co-created interventions significantly improved depression (large effect; SMD = 0.82, 95 %CI: 0.22–1.41, n = 8) and anxiety (small effect; SMD = 0.30, 95 % CI: 0.02–0.58, n = 5). This result was retained after conducting sensitivity analyses (Supplementary file, Fig. S8–S11).

At ≥6 months, there is moderate quality evidence that co-created

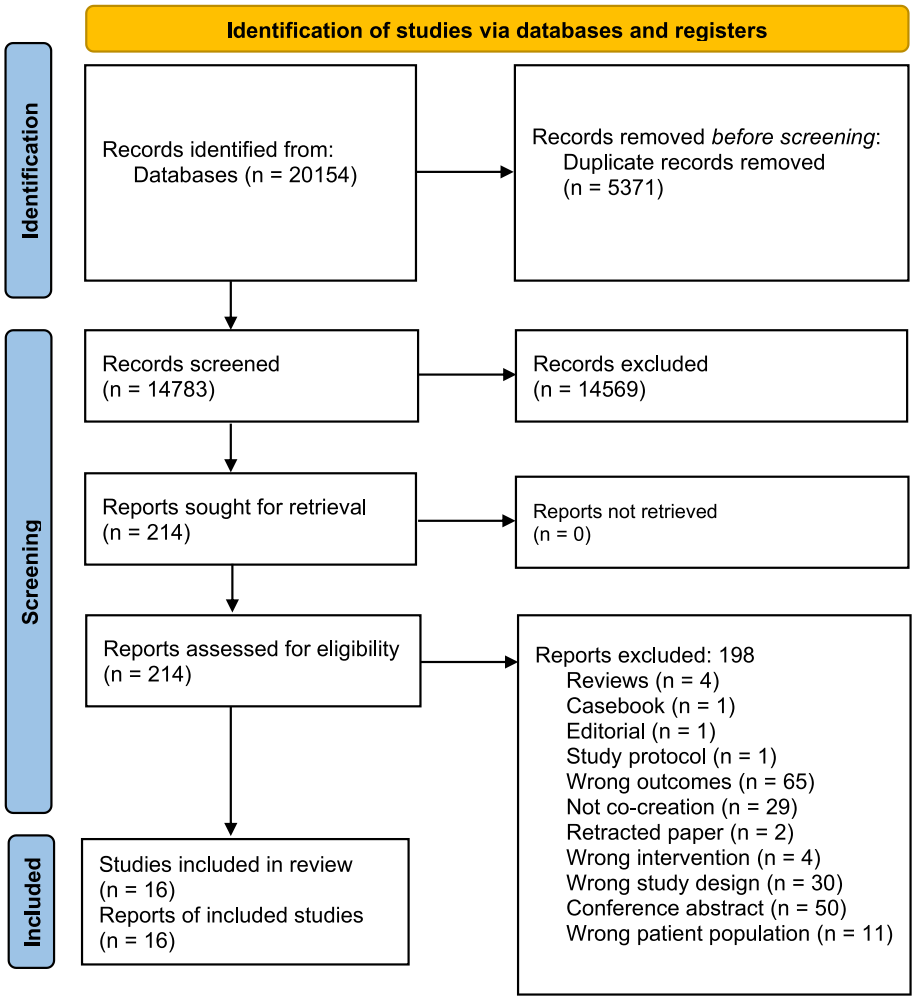

Fig. 1. PRISMA diagram for the systematic review of effects of co-created lifestyle interventions in people with NCDs.

interventions improve health behaviour (small effect; SMD = 0.21, 95 % CI: 0.07–0.35, n = 6), and mental health (small effect; SMD = 0.19, 95 % CI: 0.12–0.26, n = 16). A small effect with low quality evidence (SMD = 0.11, 95 %CI: 0.09-0.32, n = 8) was also observed for physical health, however, this result was not statistically significant (Fig. 3). The result was also similar after conducting sensitivity analyses (Supplementary file, Table S5; Fig. S12–S14). Low heterogeneity was observed for the meta-analysis of RCTs at ≥6 months for health behaviour ($I^2 < 0.001$, Tau-squared <0.001), mental health ($I^2 < 0.001$, Tau Squared <0.001), and physical health ($I^2 = 9.19$, Tau-squared = 0.008). Egger's regression test showed no significant small-study effects (publication bias) for the outcome with minimum of 10 studies (mental health: p = 0.932) (Supplementary file, Fig. S15).

4. Discussion

This systematic review and meta-analysis provide evidence supporting the effectiveness of co-created lifestyle interventions in improving health behaviour, mental health, and physical health outcomes among adults with NCDs. Our findings indicate that, at less than six months (short term), co-created lifestyle interventions have a moderate effect on health behaviour (moderate quality evidence) and small effects on mental (moderate quality evidence) and physical health outcomes (moderate quality evidence). At six months and above (medium- to long-term), there was moderate quality evidence that co-created lifestyle interventions have small effects on health behaviours and mental health, however, the effect on physical health was not statistically significant (low quality evidence).

The findings showed that within a short timeframe (<6 months), co-created lifestyle interventions aimed at modifying lifestyle risk factors have a significant impact on lifestyle behaviour (e.g., physical activity, nutrition and medication adherence), which in turn has an impact on mental and physical health outcomes such as depression, anxiety, quality of life and overall well-being in individuals with NCDs. However, the presence of a significant small-study effect for mental health necessitated an adjustment using the trim and fill method, which reduced the effect size slightly, reinforcing the need for more robust large-scale trials. The review findings are consistent with the findings of a similar systematic review[13] which reported that co-created interventions had small-to-moderate effects in improving various health outcomes in the short term, including physical health, health-promoting behaviour, accessibility of health services and self-efficacy. Existing literature has demonstrated that co-created interventions can improve engagement, adherence, and empowerment among participants, which are critical components for effective lifestyle modifications.[44] Furthermore, co-creation facilitates a deeper understanding of the social and environmental contexts that influence health behaviours, thereby enabling more tailored and context-sensitive solutions, which could explain the reported effectiveness.[45]

At medium-to long-term (≥6 months), co-created lifestyle interventions continued to show small but significant effects on health behaviour and mental health. However, the effect on physical health was not statistically significant. These findings suggest that while co-created interventions lead to sustained health behaviour changes and

Table 1
Characteristics of included RCTs.

Study	Study design (Country)	NCD type	Intervention group	Comparison group	Duration	Broad outcome(s)
Alsubaie et al., 2020	RCT (UK)	Depression and Cardiovascular Disorders	Adapted mindfulness-based cognitive therapy (MBCT) plus treatment as usual	Treatment as usual alone	8 Weeks	Mental and Physical Health
Angell et al., 2003	RCT (USA)	Breast cancer	Community-based Workbook-Journal (WBJ) plus educational materials (Usual care)	Educational materials alone (usual care)	3 months	Mental and Physical Health
Carlyle et al., 2019	Mixed-method RCT (UK)	Opioid Use Disorder	Compassion focused therapy (CFT)	Waitlist control group	3 weeks	Mental Health
English et al., 2024	Pilot RCT (Australia)	Stroke	Physical activity intervention and Diet	Usual care	6 months	Health Behaviour, Mental and Physical Health
Hassouneh et al., 2013	RCT (USA)	Physical Disabilities and Depression	Cognitive behavioural group therapy	Waitlist Control	14 weeks	Health Behaviour, and Mental Health
Karasz et al., 2021	RCT (Bangladesh)	Depression	Asset-based intervention	No treatment	12 months	Mental Health
Li et al., 2019	RCT (Hong Kong)	Acute myocardial infarction	An eight-week modelling-based narrative intervention	Didactic education	8 weeks	Health Behaviour
Linden et al., 2017	RCT (Sweden)	Type-1 DM	Standard care plus web-based support	Standard care	Between 5 and 9 months	Mental and Physical Health
Livingston et al., 2018	RCT (UK)	Dementia	Cognitive-behavioural interventions	Treatment as usual for mental health problems	6 weeks	Physical Health
Mullan et al., 2009	RCT (USA)	Diabetes	Decision aid tools for use in consultation between patient and physician	Usual care	<1 day (a single consultation)	Health Behaviour and Physical Health
Nápoles et al., 2015	RCT (USA)	Breast cancer	Community-Based, Peer-Delivered Stress Management Intervention	Usual care	8 weeks	Mental and Physical Health
Nápoles et al., 2020	RCT (USA)	Breast cancer	Community-Based, Peer-Delivered Stress Management Intervention	Usual care	10 weeks	Mental and Physical Health
Rüsch et al., 2019	RCT (Germany)	Psychological distress	Peer-led group intervention program	Usual care	6 weeks	Health Behaviour, Mental and Physical Health
Simmich et al., 2021	RCT (Australia)	COPD	Mobile game AVG app + Fitbit activity tracker & App	Fitbit activity tracker and App	22 weeks	Health Behaviour
Singleton et al., 2023	RCT (Australia)	Breast cancer	Lifestyle-focused text message intervention (EMPOWER-SMS)	Usual care	1 year	Health Behaviour, Mental and Physical Health
Wells et al., 2013	RCT (USA)	Depression	Communi-ty Engagement and Planning (CEP) and Resources for Services (RS)	Usual care	1 year	Health Behaviour, and Mental Health

Key: SAQ: The Seattle Angina Questionnaire, HROoL: Health-related Quality of Life, COPD: Chronic obstructive pulmonary disease, NCD: Non-communicable disease.

mental health improvements over time, their impact on physical health may diminish over time. However, it is important to note that only few of the included studies evaluated and reported the long-term effects of the co-created interventions, which may have influenced the magnitude of effect observed for the physical health outcomes. No other review has reported on the medium-to long-term effects of co-created lifestyle interventions due to the paucity of studies reporting long-term impact, hence, there was no existing review to compare our findings with. This demonstrates the need for more robust primary studies on the medium-to long-term effects of co-created interventions, as investigating long-term effects is essential to determine if positive changes in outcomes can be maintained over time. In addition, a lot of existing studies related to intervention co-creation in the literature are not quantitatively evaluated, which limits the establishment of causal effects. Hence, we recommend that future studies exploring co-created interventions should, as a minimum, collect baseline data.

4.1. Study limitations

Despite the promising findings, several limitations should be considered. Firstly, non-English language studies and studies involving children (<18 years) were excluded from the systematic review, which could have potentially led to exclusion of relevant studies and limits the generalisability of the study findings to only adult populations with NCDs. Secondly, the heterogeneity observed in the meta-analysis, particularly in the short-term (<6 months) evaluation for mental health outcomes, suggests variability in intervention designs, population characteristics, and outcome measures. This limits the generalisability of findings. Thirdly, the presence of a small-study effect in the mental health outcomes at <6 months, although adjusted using the trim and fill method, indicates potential publication bias, which should be considered while interpreting the results. Fourthly, while co-created lifestyle interventions appear effective in the short term, the sustainability of these effects remains unclear, especially for physical health outcomes beyond six months. More long-term studies are needed to understand the sustainability of the identified effects. Fifthly, many different outcomes measures were assessed in a broad classification scheme, meaning we had to group outcomes assessing similar concepts for meta-analysis. Although grouped outcomes measure similar broad concepts, they may reflect different aspects of that concept (e.g., anxiety and depression) and reflect different levels of importance to individuals. Also, some studies were added more than once, which could give them too much weight. Hence, we conducted separate analysis for anxiety and depression including studies only once to further validate the analysis. Finally, it is challenging to determine whether the observed effects are solely attributable to co-creation or influenced by other contextual factors such as available resources and intervention components. Hence, future studies should focus on comparative evaluations where co-creation is the only differentiating factor between intervention and comparison groups to better isolate its specific effects. Furthermore, future studies should adopt standardised definitions and reporting frameworks for co-creation to facilitate comparisons and ensure consistency.[46] The five co-creation dimensions identified by Messiha et al.,[47] the planning guidance in the PRODUCES framework,[44] and the A-CRIC

Group by Main outcome measures	Study name	Std diff in means	Lower limit	Upper limit	Z-Value	p-Value
Health Behaviour	English et al 2024 (Diet-ARFS)	0.46	-0.43	1.35	1.02	0.31
Health Behaviour	English et al 2024 (Diet-MDS)	1.17	0.22	2.12	2.42	0.02
Health Behaviour	English et al 2024 (Physical activity)	0.69	-0.22	1.59	1.49	0.14
Health Behaviour	Hassouneh et al 2013 (Interpersonal relation)	0.59	0.11	1.08	2.42	0.02
Health Behaviour	Hassouneh et al 2013 (Stress management)	0.55	0.07	1.03	2.26	0.02
Health Behaviour	Hassouneh et al 2013 (Substance abuse)	0.33	-0.14	0.80	1.36	0.17
Health Behaviour	Li et al 2019 (Care seeking attitude)	0.63	0.14	1.12	2.53	0.01
Health Behaviour	Mullan et al 2009 (Changed medication)	0.33	-0.22	0.87	1.18	0.24
Health Behaviour	Nápoles et al 2020 (Stress management)	0.49	0.17	0.82	3.02	0.00
Health Behaviour	Rüsch et al 2019 (Help-seeking intensions)	0.30	-0.31	0.91	0.96	0.34
Health Behaviour	Simmich et al 2021 (Physical activity-MVPA)	0.16	-0.76	1.09	0.34	0.73
Health Behaviour	Simmich et al 2021 (Physical activity-Steps/Day)	0.27	-0.65	1.20	0.58	0.56
Health Behaviour		0.49	0.33	0.65	5.97	0.00
Mental Health	Alsubaie et al 2020 (Anxiety)	1.22	0.31	2.13	2.63	0.01
Mental Health	Alsubaie et al 2020 (Depression)	1.53	0.58	2.48	3.16	0.00
Mental Health	Alsubaie et al 2020 (Negative effect)	-0.15	-0.99	0.69	-0.36	0.72
Mental Health	Alsubaie et al 2020 (Positive effect)	-0.05	-0.88	0.79	-0.11	0.91
Mental Health	Alsubaie et al 2020 (QoL-Mental)	0.62	-0.23	1.48	1.43	0.15
Mental Health	Angell et al 2003 (Behavioural disengagement)	-0.07	-0.46	0.33	-0.33	0.74
Mental Health	Angell et al 2003 (Fatalism)	0.00	-0.39	0.39	0.00	1.00
Mental Health	Angell et al 2003 (Fighting spirit)	-0.14	-0.54	0.25	-0.70	0.49
Mental Health	Angell et al 2003 (Hopelessness)	0.08	-0.31	0.48	0.41	0.68
Mental Health	Angell et al 2003 (Mood)	-0.09	-0.49	0.30	-0.45	0.65
Mental Health	Angell et al 2003 (PTSD)	-0.13	-0.52	0.27	-0.62	0.53
Mental Health	Carlyle et al 2019 (Anxiety)	-0.06	-0.84	0.71	-0.16	0.87
Mental Health	Carlyle et al 2019 (Depression)	0.53	-0.26	1.32	1.31	0.19
Mental Health	Carlyle et al 2019 (Stress)	0.04	-0.74	0.82	0.11	0.92
Mental Health	English et al 2024 (Anxiety)	-0.14	-1.02	0.73	-0.32	0.75
Mental Health	English et al 2024 (Depression)	0.00	-0.88	0.88	0.00	1.00
Mental Health	English et al 2024 (Stress)	-0.28	-1.16	0.60	-0.62	0.53
Mental Health	Hassouneh et al 2013 (Depression)	0.66	0.17	1.14	2.66	0.01
Mental Health	Hassouneh et al 2013 (Self esteem)	0.47	-0.00	0.95	1.95	0.05
Mental Health	Karasz et al 2021 (Depression)	3.36	2.48	4.24	7.49	0.00
Mental Health	Karasz et al 2021 (Self esteem)	0.77	0.18	1.36	2.57	0.01
Mental Health	Linden et al 2018 (Sense of coherence)	0.15	-0.16	0.47	0.97	0.33
Mental Health	Nápoles et al 2015 (Anxiety)	0.29	-0.03	0.61	1.77	0.08
Mental Health	Nápoles et al 2015 (Depression)	0.14	-0.18	0.46	0.89	0.38
Mental Health	Nápoles et al 2015 (Intrusive thoughts)	0.33	0.01	0.65	2.03	0.04
Mental Health	Nápoles et al 2015 (Somatization)	0.25	-0.07	0.57	1.54	0.12
Mental Health	Nápoles et al 2020 (Anxiety)	0.31	-0.01	0.62	1.88	0.06
Mental Health	Nápoles et al 2020 (Depression)	-0.10	-0.41	0.22	-0.60	0.55
Mental Health	Nápoles et al 2020 (Somatization)	0.31	-0.01	0.63	1.91	0.06
Mental Health	Nápoles et al 2020 (Stress)	0.07	-0.25	0.39	0.44	0.66
Mental Health	Rüsch et al 2019 (Depression)	0.93	0.29	1.57	2.85	0.00
Mental Health	Rüsch et al 2019 (Hopelessness)	0.37	-0.24	0.99	1.19	0.23
Mental Health	Rüsch et al 2019 (Secrecy)	0.27	-0.34	0.88	0.86	0.39
Mental Health	Rüsch et al 2019 (Self stigma)	0.54	-0.07	1.16	1.72	0.08
Mental Health		0.29	0.14	0.43	3.87	0.00
Physical Health	Alsubaie et al 2020 (Diastolic BP)	0.36	-0.49	1.20	0.83	0.41
Physical Health	Alsubaie et al 2020 (Physical limitations)	-0.09	-0.92	0.75	-0.21	0.84
Physical Health	Alsubaie et al 2020 (QoL-Physical)	-0.12	-0.96	0.72	-0.28	0.78
Physical Health	Alsubaie et al 2020 (Systolic BP)	0.33	-0.51	1.18	0.78	0.44
Physical Health	English et al 2024 (Diastolic BP)	0.78	-0.13	1.69	1.69	0.09
Physical Health	English et al 2024 (QoL-Health Today)	0.69	-0.22	1.59	1.49	0.14
Physical Health	English et al 2024 (QoL-Mobility)	-0.37	-1.26	0.51	-0.82	0.41
Physical Health	English et al 2024 (Systolic BP)	0.57	-0.32	1.47	1.26	0.21
Physical Health	Linden et al 2018 (Blood glucose)	0.38	0.07	0.69	2.37	0.02
Physical Health	Linden et al 2018 (General wellbeing)	0.11	-0.20	0.42	0.69	0.49
Physical Health	Livingston et al 2019 (Average time in bed)	-0.09	-0.62	0.45	-0.32	0.75
Physical Health	Livingston et al 2019 (QoL-Overall)	0.64	0.09	1.18	2.29	0.02
Physical Health	Livingston et al 2019 (Sleepiness)	0.28	-0.25	0.82	1.04	0.30
Physical Health	Nápoles et al 2015 (QoL-Overall)	0.25	-0.07	0.57	1.51	0.13
Physical Health	Nápoles et al 2020 (QoL-Overall)	-0.04	-0.36	0.27	-0.27	0.79
Physical Health	Rüsch et al 2019 (Stage of recovery)	0.44	-0.18	1.05	1.40	0.16
Physical Health		0.21	0.09	0.34	3.35	0.00
Overall		0.31	0.23	0.39	7.40	0.00

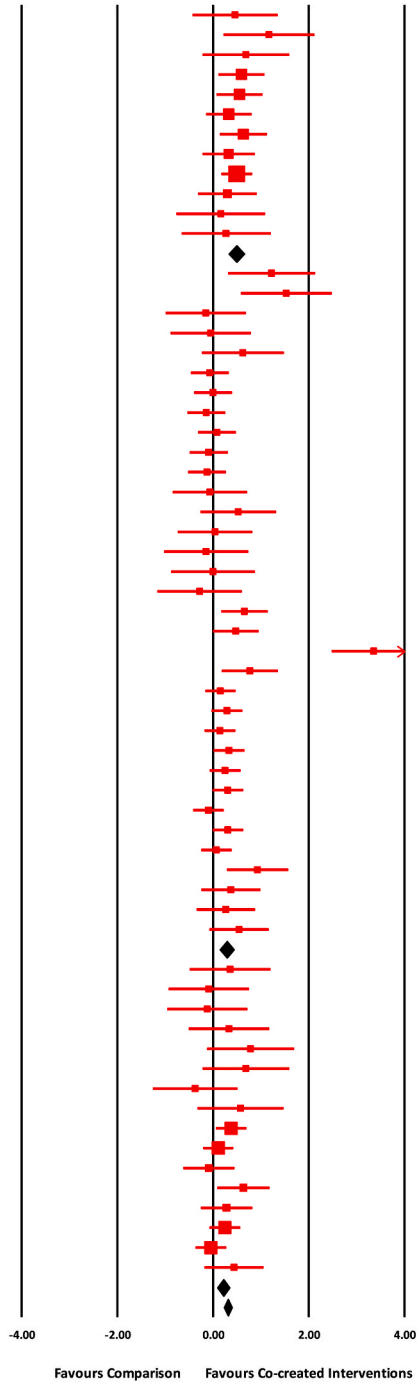

Fig. 2. Meta-analysis of RCTs on the <6 months effects of co-created interventions on health behaviour, mental health, and physical health in individuals with NCDs.

tool/checklist[15] offer a starting point. Further developments include the PRODUCES + framework which includes a reporting tool and checklist (currently in the course of publishing), and the PROSECO framework developed to support the planning and reporting of the evaluation of the co-creation process.[48]

4.2. Conclusion

Overall, this systematic review and meta-analysis demonstrate that there is moderate quality evidence that co-created lifestyle interventions for secondary prevention of NCDs have a significant positive impact on the target health behaviour (e.g., physical activity, nutrition and medication adherence), and on mental health, and physical health outcomes. While short-term effects are more pronounced, sustained benefits are observed for health behaviour and mental health over longer durations. Future studies should aim to strengthen the evidence base by addressing methodological limitations, investigating long-term effects and further exploring the role of co-creation in intervention effectiveness. Health researchers, practitioners and policymakers should consider incorporating co-creation approaches when designing

Group by Main Outcome Measures	Study	Std diff in means	Lower limit	Upper limit	Z-Value	p-Value
Health Behaviour	English et al 2024 (Diet-ARFS)	0.17	-0.70	1.05	0.39	0.70
Health Behaviour	English et al 2024 (Diet-MDS)	0.35	-0.53	1.24	0.79	0.43
Health Behaviour	English et al 2024 (Physical activity)	0.85	-0.06	1.77	1.82	0.07
Health Behaviour	Mullan et al 2009 (Adherence to medication)	-0.07	-0.57	0.43	-0.29	0.77
Health Behaviour	Rüsch et al 2019 (Help-seeking intensions)	0.27	-0.34	0.88	0.86	0.39
Health Behaviour	Wells et al 2013 (Physical activity)	0.22	0.06	0.37	2.66	0.01
Health Behaviour		0.21	0.07	0.35	2.95	0.00
Mental Health	English et al 2024 (Anxiety)	-0.49	-1.38	0.40	-1.07	0.28
Mental Health	English et al 2024 (Depression)	0.00	-0.88	0.88	0.00	1.00
Mental Health	English et al 2024 (Stress)	-0.07	-0.95	0.81	-0.16	0.87
Mental Health	Rüsch et al 2019 (Depression)	0.64	0.01	1.26	2.00	0.05
Mental Health	Rüsch et al 2019 (Hopelessness)	0.57	-0.05	1.19	1.79	0.07
Mental Health	Rüsch et al 2019 (Secrecy)	0.52	-0.10	1.14	1.65	0.10
Mental Health	Rüsch et al 2019 (Self stigma)	0.35	-0.26	0.96	1.12	0.26
Mental Health	Singleton et al 2023 (Depression)	0.05	-0.26	0.36	0.32	0.75
Mental Health	Singleton et al 2023 (Anxiety)	0.05	-0.26	0.36	0.33	0.74
Mental Health	Singleton et al 2023 (Stress)	0.08	-0.23	0.39	0.52	0.60
Mental Health	Singleton et al 2023 (Physical activity)	0.04	-0.27	0.35	0.27	0.78
Mental Health	Wells et al 2013 (Mental Health-HRQL)	0.18	0.02	0.34	2.22	0.03
Mental Health	Wells et al 2013 (Depression)	0.11	-0.05	0.28	1.35	0.18
Mental Health	Wells et al 2013 (Mental wellness)	0.26	0.09	0.42	3.10	0.00
Mental Health	Wells et al 2013 (Risk factors for homelessness)	0.27	0.10	0.43	3.13	0.00
Mental Health	Wells et al 2013 (Missed work in last 30 days)	0.29	-0.04	0.62	1.73	0.08
Mental Health		0.19	0.12	0.26	5.40	0.00
Physical Health	English et al 2024 (Diastolic BP)	0.46	-0.43	1.35	1.02	0.31
Physical Health	English et al 2024 (QoL-Health Today)	0.75	-0.16	1.65	1.62	0.11
Physical Health	English et al 2024 (QoL-Mobility)	-0.69	-1.59	0.22	-1.49	0.14
Physical Health	English et al 2024 (Systolic BP)	0.15	-0.73	1.02	0.33	0.74
Physical Health	Mullan et al 2009 (General Health)	-0.04	-0.47	0.38	-0.20	0.84
Physical Health	Mullan et al 2009 (Blood glucose)	0.06	-0.37	0.48	0.25	0.80
Physical Health	Rüsch et al 2019 (Stage of recovery)	0.51	-0.11	1.13	1.62	0.10
Physical Health	Singleton et al 2023 (Overall QoL)	0.09	-0.22	0.40	0.55	0.58
Physical Health		0.11	-0.09	0.32	1.10	0.27
Overall		0.19	0.13	0.24	6.20	0.00

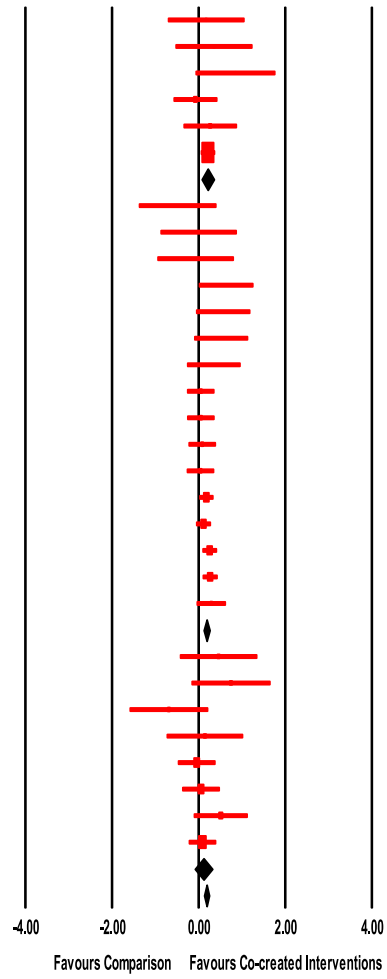

Fig. 3. Meta-analysis of RCTs on the ≥6 months effects of co-created interventions on health behaviour, mental health, and physical health in individuals with NCDs.

interventions, ensuring meaningful stakeholder engagement to enhance intervention effectiveness and sustainability.

Ethical approval

Ethical approval was not required for this study, as it is a systematic review that synthesised data from previously published studies.

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Competing interests

The authors declare no conflict of interests.

Data availability

There is no primary data linked to this manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2025.105929.

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