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Effectiveness of physical activity interventions for improving depression, anxiety and distress: an overview of systematic reviews

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► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bjsports-2022-106195>).

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Accepted 3 February 2023

ABSTRACT

Objective To synthesise the evidence on the effects of physical activity on symptoms of depression, anxiety and psychological distress in adult populations.

Design Umbrella review.

Data sources Twelve electronic databases were searched for eligible studies published from inception to 1 January 2022.

Eligibility criteria for selecting studies Systematic reviews with meta-analyses of randomised controlled trials designed to increase physical activity in an adult population and that assessed depression, anxiety or psychological distress were eligible. Study selection was undertaken in duplicate by two independent reviewers.

Results Ninety-seven reviews (1039 trials and 128 119 participants) were included. Populations included healthy adults, people with mental health disorders and people with various chronic diseases. Most reviews (n=77) had a critically low A MeaSurement Tool to Assess systematic Reviews score. Physical activity had medium effects on depression (median effect size=-0.43, IQR=-0.66 to -0.27), anxiety (median effect size=-0.42, IQR=-0.66 to -0.26) and psychological distress (effect size=-0.60, 95% CI -0.78 to -0.42), compared with usual care across all populations. The largest benefits were seen in people with depression, HIV and kidney disease, in pregnant and postpartum women, and in healthy individuals. Higher intensity physical activity was associated with greater improvements in symptoms. Effectiveness of physical activity interventions diminished with longer duration interventions.

Conclusion and relevance Physical activity is highly beneficial for improving symptoms of depression, anxiety and distress across a wide range of adult populations, including the general population, people with diagnosed mental health disorders and people with chronic disease. Physical activity should be a mainstay approach in the management of depression, anxiety and psychological distress.

PROSPERO registration number CRD42021292710.

INTRODUCTION

Mental health disorders are among the leading causes of the global health-related burden, with substantial individual and societal costs.^{1,2} In 2019, one in eight people (970 million) worldwide were affected by a mental health disorder³ and almost one in two (44%) will experience a mental health disorder in their lifetime.⁴ The annual global costs of mental health disorders have been estimated at \$2.5 trillion (USD),

which is projected to increase to \$6 trillion (USD) by 2030.⁵ Depression is the leading cause of mental health-related disease burden,⁶ while anxiety is the most prevalent mental health disorder.³ Additionally, the COVID-19 pandemic has been associated with increased rates of psychological distress, with prevalence ranging between 35% and 38% worldwide.⁷⁻⁹

The role of lifestyle management approaches, such as exercise, sleep hygiene and a healthy diet, varies between clinical practice guidelines in different countries. In US clinical guidelines,¹⁰ psychotherapy or pharmacotherapy is recommended as the initial treatment approaches, with lifestyle approaches considered as 'complementary alternative treatments' where psychotherapy and pharmacotherapy are 'ineffective or unacceptable'. In other countries such as Australia, lifestyle management is recommended as the first-line treatment approach,^{11,12} though in practice, pharmacotherapy is often provided first.

There have been hundreds of research trials examining the effects of physical activity (PA) on depression, anxiety and psychological distress, many of which suggest that PA may have similar effects to psychotherapy and pharmacotherapy (and with numerous advantages over psychotherapy and pharmacotherapy, in terms of cost, side-effects and ancillary health benefits).¹³⁻¹⁸ Despite the evidence for the benefits of PA, it has not been widely adopted therapeutically. Patient resistance, the difficulty of prescribing and monitoring PA in clinical settings, as well as the huge volume of largely incommensurable studies, have probably impeded a wider take-up in practice.^{13,14,17}

Meta-reviews are systematic reviews of systematic reviews, offering a way of synthesising a vast evidence base. While there have been several meta-reviews of PA for depression, anxiety and psychological distress,^{17,19-24} they have focused on specific population subgroups, particular conditions (eg, depression only) or on particular forms of PA. We set out to undertake the most comprehensive synthesis to date of evidence regarding the effects of all modes of PA on symptoms of depression, anxiety and psychological distress in adult populations.

METHODS

Protocol and registration

The protocol for this systematic umbrella review was prospectively registered on PROSPERO and results are reported according to Preferred



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To cite: Singh B, Olds T, Curtis R, et al. *Br J Sports Med* Epub ahead of print: [please include Day Month Year]. doi:10.1136/bjsports-2022-106195

Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)²⁵ guidelines.

Selection criteria and search strategy

The population, intervention, comparison, outcomes and study type (PICOS) framework was used to develop the inclusion criteria as follows: population: any adult population (aged ≥ 18 years); intervention: interventions designed to increase PA. The following definition of PA was used: ‘any bodily movement produced by the contraction of skeletal muscles that results in a substantial increase in caloric requirements over resting energy expenditure’.²⁶ Reviews were eligible irrespective of PA modality, supervision, delivery (eg, in-person or online) or dose (frequency, intensity and duration). Reviews were ineligible if they included any randomised control trials (RCTs) of non-PA interventions, if PA was combined with another intervention (eg, diet) or if they evaluated single bouts of acute exercise. Comparator: reviews were eligible if $\geq 75\%$ of the included RCTs involved either usual care, waitlist, nothing an equal attention intervention or a lower/lesser PA intervention (eg, a supervised exercise intervention vs printed PA materials). During study selection, it became apparent that the comparator inclusion/exclusion criteria needed elaboration. After careful consideration and discussion, we decided to exclude reviews where $>25\%$ of component RCTs compared PA to pharmaceutical interventions or compared two types of equal dose exercise (eg, resistance vs aerobic exercise) without a non-PA comparison, since the inclusion of such reviews would limit our ability to evaluate the effectiveness of PA per se. Outcomes: any self-report or clinician-rated assessment of depression, anxiety or psychological distress symptoms. Study type: systematic reviews with meta-analyses of RCTs only, which included meta-analyses of the outcomes of interest.

Twelve databases were searched (CINAHL, Cochrane, Embase, MEDLINE, Emcare, ProQuest Health and Medical Complete, ProQuest Nursing and Allied Health Source, PsycINFO, Scopus, Sport Discus, EBSCOhost and Web of Science) using subject heading, keyword and Medical Subject Headings (MeSH) term searches for ‘systematic review’, ‘meta-analysis’, ‘physical activity’, ‘exercise’, ‘anxiety’, ‘depression’ and ‘psychological distress’ (see online supplemental eTable 1 for the full search strategy). Database searches were limited to peer-reviewed journal articles published in English language from inception to 1 January 2022.

Data management and extraction

Search results were imported into EndNote V.x9 (Clarivate, Philadelphia) where duplicates were removed, then exported into Covidence (Veritas Health Innovation, Melbourne, Australia). Title/abstract and full-text screening, data extraction and risk of bias scoring were completed in duplicate by two independent reviewers (BS and AM, AW, CEMS, DD, EE, EO, KS, RC, RV or TF), with disagreements resolved by team discussion.

Data were extracted in duplicate by two independent reviewers (BS and AM, AW, CEMS, DD, EE, EO, KS, RC, RV or TF) using a standardised extraction form,^{27 28} and discrepancies were resolved by team discussion. The risk of bias of the included reviews was assessed by two independent reviewers (BS and AM, AW, CEMS, DD, EE, EO, KS, RC, RV or TF) in duplicate using the A MeaSurement Tool to Assess systematic Reviews (AMSTAR-2) tool.²⁹ The AMSTAR-2 tool involves 16 items, with each item scored as yes, partial yes or no. Seven items are considered ‘critical’ and nine ‘non-critical’.²⁹ The critical domains are protocol registration, adequacy of search strategy,

justification for excluding individual studies, risk of bias assessment, appropriateness of meta-analysis methods, use of risk of bias during interpretation and assessment of publication bias. Reviews were rated as ‘high confidence’ (0 critical weakness and <3 non-critical weaknesses), ‘moderate’ (one critical weakness and <3 non-critical weaknesses), ‘low’ (>1 critical weakness and <3 non-critical weaknesses) or ‘critically low’ (>1 critical weakness and ≥ 3 non-critical weaknesses).²⁹

Umbrella review synthesis methods

The overlap in component RCTs that were included across all eligible reviews was assessed using the Corrected Covered Area (CCA) method.³⁰ A CCA of 100% indicates that every review included in our umbrella review comprised the same component RCTs, while a CCA of 0% indicates that every review in our umbrella review included entirely unique RCTs. The following cut-offs were used to quantify the CCA: 0%–5% = ‘slight overlap’; 6%–10% = ‘moderate’; 11%–15% = ‘high’ and $>15\%$ = ‘very high’ overlap.³⁰ Publication bias was assessed by creating a funnel plot and observing the presence of asymmetries or missing sections.³¹

Meta-analysis results from each review were presented using forest plots. Separate forest plots were created for meta-analyses reporting standardised (eg, standardised mean difference, SMD) and unstandardised effect sizes (eg, mean difference). For meta-analyses that reported standardised effect sizes, we undertook subgroup analyses for clinical status and intervention characteristics. Meta-analysis results were summarised using medians and IQRs

The Oxford Centre for Evidence-Based Medicine levels of evidence and grades for recommendations³² were used to classify the overall level of evidence as grade A: consistent level 1 studies (ie, systematic reviews of RCTs or individual RCTs); B: consistent level 2 (ie, systematic reviews of cohort studies or individual cohort studies) or level 3 studies (ie, systematic reviews of case-control studies or individual case-control studies) or extrapolations from level 1 studies; C: level 4 studies (ie, case series) or extrapolations from level 2 or 3 studies or D: level 5 (ie, expert opinion without explicit critical appraisal) evidence or troublingly inconsistent or inconclusive studies of any level.³²

RESULTS

Of the 1280 records identified, 97 were eligible. They included 1039 unique (component) RCTs and the CCA was 0.6%, indicating slight overlap (see online supplemental eFigure 1 for PRISMA flowchart, including reasons for exclusions). Evaluation of funnel plots indicated no evidence of publication bias (online supplemental eFigure 2).

An overview of all reviews’ characteristics is shown in online supplemental eTable 2. There was a total of $>128\ 119$ participants ($n=133$ did not report the number of participants). Mean participant age ranged from 29 to 86 (median=55) years, and most reviews ($n=83$, 86%) involved female and male participants. An overview of all populations and PA modalities is shown in table 1. Fifteen reviews specifically involved individuals with depression^{33–41} and three involved individuals with anxiety.^{42–44} Most reviews involved various PA modes ($n=70$) and most ($n=77$) had a critically low AMSTAR-2 score (low: $n=10$; high: $n=10$, online supplemental eTable 3).

Meta-analysis results: depression

Results from 72 meta-analyses based on SMD ($n=875$ component RCTs, $>62\ 040$ participants) showed a medium effect in

favour of PA for reducing depression and depressive symptoms (median SMD = -0.43, IQR = -0.66 to -0.27, figure 1).

MD effect size for each instrument was: profile of mood states: -7.68 (1 review), Beck Depression Inventory: -5.53 (IQR = -6.24 to -4.81), The Edinburgh Postnatal Depression Scale: -2.97 (IQR = -3.49 to -2.44), self-rating scale: -3.99 (one review), Brief Symptom Inventory 18: -3.02 (one review), Centre for Epidemiological Studies Depression: -0.36 (IQR = -1.25 to 0.02), Montgomery-Asberg Depression Rating Scale: -1.80 and Hospital Anxiety and Depression Scale: -1.26 (IQR = -1.41 to -1.18, online supplemental eFigure 3 and online supplemental eTable 4).

Grade of recommendation: (A) Consistent level 1 studies.

Anxiety

Results from 28 meta-analyses using SMD (171 component RCTs, >10 952 participants) showed a medium effect of PA for reducing anxiety (median SMD = -0.42, IQR = -0.66 to -0.26, figure 2).

Table 1 Overview of all populations, conditions and physical activity modes of the included reviews

Population or condition	Number of reviews
Cancer	n=27 ^{45-62 98-106}
Adults with depression	n=11 ^{63 64 66-73 75}
Dementia	n=5 ¹⁰⁷⁻¹¹¹
Older adults	n=5 ³³⁻³⁷
Chronic obstructive pulmonary disease	n=4 ^{78 112-114}
Multiple sclerosis	n=4 ¹¹⁵⁻¹¹⁷
Pregnant or postnatal or post-partum women	n=4 ³⁸⁻⁴¹
Adults with various chronic diseases	n=3 ¹¹⁸⁻¹²⁰
Apparently healthy adults	n=3 ⁴²⁻⁴⁴
Anxiety disorders	n=3 ^{84 85 121}
Cardiovascular disease	n=3 ^{80 122 123}
Older adults with depression	n=4 ^{63 65 74 124}
Renal disease	n=3 ^{86 125 126}
Stroke	n=3 ^{21 127 128}
Arthritis and rheumatic diseases	n=2 ^{82 129 130}
Cognitive impairment	n=2 ^{77 131}
HIV/AIDS	n=2 ^{76 132}
Post-traumatic stress disorder	n=2 ^{133 134}
Various mental health disorders	n=2 ^{83 135}
Fatigue	n=1 ¹³⁶
Knee osteoarthritis	n=1 ¹²⁹
Neurological disorders	n=1 ¹³⁷
Schizophrenia	n=1 ¹³⁸
Substance use disorder	n=1 ⁷⁹
Physical activity modality	Number of reviews
Mixed-mode exercise, not including mind-body exercise (eg, Yoga, Tai Chi or Qigong)	n=37 ^{13 21 38 41 47 50 52-55 58 59 66-70 73-75 81 84 86 100 101 103 106 108-110 112 121 123 125 126 132 133}
Mixed-mode exercise, including mind-body exercises (eg, Yoga, Tai Chi or Qigong)	n=33 ^{33-37 40 42 49 51 56 57 60 61 63 72 76-80 98 99 102 104 107 115-117 124 129 130 134 137}
Yoga	n=7 ^{39 45 46 62 127 135 138}
Aerobic exercise	n=6 ^{43 71 82 83 85 122}
Tai Chi	n=6 ^{65 113 118 128 131 136}
Qigong	n=3 ^{104 114 120}
Resistance exercise	n=3 ^{64 111 119}
Dance	n=2 ^{44 48}

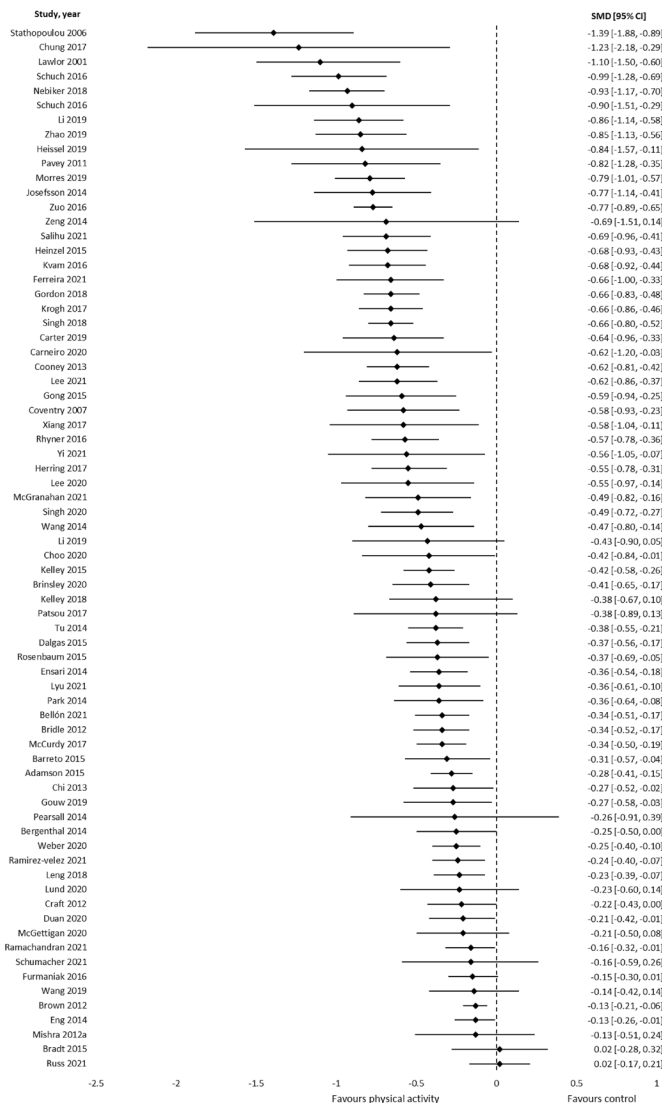


Figure 1 Results of meta-analyses that assessed symptoms of depression using standardised mean differences (negative values represent a reduction in symptoms).

MD effect sizes for each instrument were: The State-Trait Anxiety Inventory: -3.61 (IQR = -6.01 to -1.66), Brief Symptom Inventory-18: -5.45 (1 review), Self-rating scale: -4.57 (1 review), Hospital Anxiety and Depression Scale: -1.26 (IQR = -1.26 to -0.79, online supplemental eTable 4 and online supplemental eFigure 5).

Grade of recommendation: (A) Consistent level 1 studies.

Psychological distress

One systematic review⁴⁵ reported SMD results for psychological distress (six component RCTs, 508 participants), while another systematic review⁴⁶ reported MD results (one component RCT, 39 participants). Results showed a medium effect in favour of PA, compared with usual care (SMD = -0.60, 95% CI -0.78 to -0.42). For MD, findings showed no significant effect (MD = -0.30, 95% CI -5.55, 4.95, one review, one component RCT, 39 participants).

Grade of recommendation: (B) Consistent level 2 or 3 studies or extrapolations from level 1 studies.

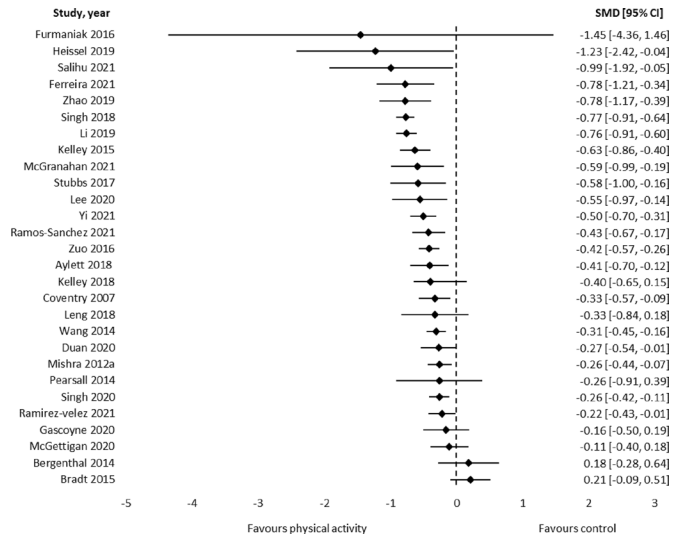


Figure 2 Results of meta-analyses that assessed symptoms of anxiety using standardised mean differences (negative values represent a reduction in symptoms).

Subgroup analyses: clinical status

Depression

Seventeen reviews provided data on patients with cancer,^{45 47–62} and 16 on people with depression or depressive symptoms.^{10 33 39 63–75} PA was effective in reducing depressive symptoms across all conditions (median SMD range: -0.85 (kidney disease), -0.16 (cardiovascular disease)). The largest effects were found in kidney disease, HIV, chronic obstructive pulmonary disease, generally healthy adults and individuals diagnosed with depression (table 2).

Anxiety

PA was generally effective for reducing anxiety across disease conditions, with median SMDs ranging from -1.23 (HIV) to -0.16 (multiple sclerosis). However, the evidence base was limited except for cancer and anxiety disorders (table 3).

Exercise mode

Depression

Eighteen reviews^{33 34 37 39 42 51 57 58 60 61 72–74 76–80} provided analyses by exercise mode (310 component RCTs, >14 496 participants, online supplemental eFigure 6). All modes were effective, and median effect sizes (SMDs) were similar across modes: -0.64 (IQR= -0.86 to -0.19) for strength-based interventions (nine reviews); -0.47 (IQR= -0.64 to -0.29) for mixed-mode interventions (12 reviews); -0.46 (IQR= -0.77 to -0.33) for stretching, yoga and other mind-body modalities (11 reviews) and -0.45 (IQR= -0.79 to -0.37) for aerobic exercise (15 reviews).

Anxiety

Fifteen reviews^{44 45 48 51 58 60 61 78 79 81–86} reported analyses by exercise mode (115 component RCTs, >5451 participants, online supplemental eFigure 7). All modes were effective, with median SMDs of -0.23 (IQR= -0.37 to -0.08) for strength-based interventions (two reviews); -0.35 (IQR= -0.86 to -0.23) for mixed modes (four reviews); -0.42 (IQR= -0.78 to -0.16) for stretching, yoga, and other mind-body modalities (seven reviews) and -0.29 (IQR= -0.54 , -0.16) for aerobic exercise (six reviews).

Exercise intensity

Depression

Five reviews^{21 42 58 73 74} reported analyses by exercise intensity (63 component RCTs, >2776 participants, online supplemental eFigure 8). Low, moderate and high-intensity exercise interventions had a median SMD of -0.22 (IQR= -0.50 to -0.12), -0.56 (IQR= -1.03 to -0.33) and -0.70 (IQR= -1.25 to -0.24), respectively.

Anxiety

Two reviews^{58 84} reported analyses by exercise intensity (23 component RCTs, online supplemental eFigure 9). All intensities were effective. The single review for low-intensity exercise had a median SMD of -0.26 ; the one for moderate-intensity exercise -0.47 , and the two for high-intensity exercise -0.44 (IQR= -0.49 to -0.13).

Intervention duration

Depression

Twelve reviews^{38 42 56 57 60 61 65 68 69 78 80} reported analyses by intervention duration (166 component RCTs, 15 669 participants, online supplemental eFigure 10). All durations were effective, but effectiveness declined as intervention duration increased. The median SMDs for short (≤ 12 weeks, 12 reviews), medium (12–23 weeks, 11 reviews) and long duration (≥ 24 weeks, 4 reviews) interventions were -0.84 (IQR= -1.50 to -0.48), -0.46 (IQR= -0.53 to -0.25) and -0.28 (IQR= -1.15 to -0.17), respectively.

Anxiety

Four reviews^{56 60 61 78} reported analyses by intervention duration (38 component RCTs, 2325 participants, online supplemental eFigure 11). Median SMDs for short (12 weeks) and median-duration (12–23 weeks) interventions were -0.55 (IQR= -0.83 to -0.27) and -0.47 (IQR= -0.72 to -0.08), respectively. The single review reporting on longer interventions (≥ 24 weeks) reported a median SMD of -0.15 .

Weekly duration

Depression

Four reviews^{42 44 57 58} presented analyses by weekly session duration (68 component RCTs, >5016 participants, online supplemental eFigure 12). The median SMD for ≤ 150 min/week and >150 min/week was -0.58 (IQR= -0.77 to -0.30) and -0.29 (IQR= -0.40 to -0.07), respectively.

Anxiety

One review⁵⁸ provided analyses by weekly session duration (17 component RCTs, online supplemental eFigure 13). The median SMDs for <150 min/week and ≥ 150 min/week were -1.23 and -0.99 , respectively.

Session frequency

Depression

Three reviews^{42 76 78} (36 component RCTs, >232 participants) reported on session frequency. High-frequency (5–7 sessions per week), moderate-frequency (4–5 per week) and low-frequency (<4 per week) interventions had a median SMD of -0.76 (IQR= -1.20 to -0.32), -1.12 (-1.39 to -0.85) and -0.47 (IQR= -0.59 to -0.35), respectively (online supplemental eFigure 14).

Table 2 Summary data on the effects of physical activity interventions on depression for a range of clinical conditions, including the number of reviews, studies and participants covered; and the 25th percentile, median and 75th percentile for standardised mean differences

Condition	Reviews	RCTs*	Participants†	Standardised mean difference		
				25th percentile	Median	75th percentile
Arthritis	4	55	3713	-0.73	-0.40	-0.31
Cancer	17	196	>14 616	-0.46	-0.22	-0.15
Blood	2	5	315	-0.25	-0.24	-0.22
Breast	8	84	7113	-0.61	-0.47	-0.17
Colorectal	3	8	575	-0.23	-0.21	-0.11
Lung	1	6	695		-0.49	
Lymphoma	1	2	161		-0.35	
Non-specific	5	85	>5543	-0.22	-0.21	-0.13
Prostate	2	4	214	-0.20	-0.18	-0.16
Chronic disease	3	18	>994	-0.38	-0.27	-0.27
Chronic obstructive pulmonary disease	2	16	1175	-0.86	-0.72	-0.58
Cardiovascular disease	5	54	6681	-0.37	-0.16	-0.14
Stroke	2	19	1580	-0.36	-0.25	-0.13
Heart disease	3	26	4435	-0.33	-0.16	-0.15
Dementia	4	37	>3470	-0.37	-0.27	-0.11
Diagnosed	3	16	>881	-0.41	-0.31	-0.06
Cognitive impairment	1	21	2589		-0.23	
Depression	15	299	>13 318	-0.82	-0.62	-0.33
Diagnosed	14	273	>12 953	-0.96	-0.66	-0.38
Symptoms	3	26	>365	-0.74	-0.56	-0.34
General population	9	208	>14 145	-0.69	-0.62	-0.35
Adults	6	99	>9016	-0.82	-0.69	-0.66
Older adults	3	75	>4862	-0.52	-0.36	-0.28
HIV/AIDS	1	9	395		-0.84	
Kidney disease	3	11	567	-1.14	-0.85	-0.71
Mental health disorders	6	39	2083	-0.49	-0.44	-0.37
Fatigue	1	7	415		-0.58	
Non-specific	1	13	362		-0.41	
Post-traumatic stress disorder	2	7	332	-0.49	-0.43	-0.37
Schizophrenia	1	3	94		-0.26	
Substance abuse	1	9	610		-0.47	
Neurological disease	4	62	2901	-0.46	-0.37	-0.32
Multiple sclerosis	3	39	1577	-0.51	-0.37	-0.36
Non-specific	1	23	1324		-0.28	
Pregnancy/postpartum	3	43	3364	-0.63	-0.59	-0.40
Pregnant	1	10	609		-0.59	
Postpartum	2	33	2755	-0.69	-0.49	-0.34

*Reviews may have included overlapping randomised controlled trials.
†Randomised controlled trials may have included overlapping participants.
RCTs, randomised controlled trials.

Anxiety

One review⁷⁸ compared session frequency, with SMDs of -0.50, -0.96 and -0.52 for 2–3, 4–5 and 6–7 session per week, respectively (online supplemental eFigure 13).

Session duration

Depression

Three reviews^{42 50 78} presented analyses on session duration (online supplemental content 17). Long (≥ 60 min, SMD=-0.57, IQR -0.85 to -0.35) and medium (30–60 min, SMD=-0.60, IQR -0.78 to -0.41) session durations had similar benefits. The sole study of short sessions (<30 min) had a SMD of 0.01 (online supplemental eFigure 15).

Anxiety

One review⁷⁸ reported on the effects of session duration (online supplemental content 16). There was no difference between long (SMD=-0.63) and short (SMD=-0.83) sessions (online supplemental eFigure 13).

DISCUSSION

This is the first ever study to compile the extensive base of evidence regarding the effects of PA on depression, anxiety and psychological distress. We identified 97 systematic reviews, reporting the findings of 1039 unique RCTs, involving 128 119 participants. Findings suggest that PA interventions are effective in improving symptoms of depression and anxiety. Improvements were observed across all clinical populations, though the

Table 3 Summary data on the effects of physical activity interventions on anxiety for a range of clinical conditions, including the number of reviews, studies and participants covered; and the 25th percentile, median and 75th percentile for standardised mean differences

Condition	Reviews	RCTs*	Participants†	Standardised mean difference		
				25th percentile	Median	75th percentile
Arthritis	2	29	1859	-0.63	-0.52	-0.40
Cancer	12	72	4955	-0.50	-0.24	0.06
Blood	1	3	249		0.18	
Breast	7	46	2862	-0.72	-0.53	0.44
Colorectal	1	4	98		-0.11	
Lung	1	6	695		-0.26	
Non-specific	2	13	951	-0.21	-0.05	0.17
Chronic obstructive pulmonary disease	2	14	1067	-0.76	-0.55	-0.33
General population	2	7	2781	-0.99	-0.85	-0.70
HIV/AIDS	1	5	185		-1.23	
Kidney disease	2	4	246	-0.78	-0.78	-0.78
Mental disorders	6	40	>2133	-0.59	-0.43	-0.34
Anxiety	3	25	>1197	-0.54	-0.43	-0.41
Cognitive impairment	1	3	210		-0.33	
Post-traumatic stress disorder	2	9	>101	-0.59	-0.44	-0.30
Schizophrenia	1	3	94		-0.26	
Substance abuse disorder	1	7	741		-0.31	
Multiple sclerosis	1	4	133		-0.16	

*Reviews may have included overlapping randomised controlled trials.
†Randomised controlled trials may have included overlapping participants.
RCTs, randomised controlled trials.

magnitude of effect varied across different clinical populations. The greatest benefits were seen in people with depression, pregnant and postpartum women, apparently healthy individuals and individuals diagnosed with HIV or kidney disease. All PA modes were effective, and higher intensity exercise was associated with greater improvements for depression and anxiety. Longer duration interventions had smaller effects compared with short and mid-duration, though the longest duration interventions still had positive effects.

PA was effective at reducing depression and anxiety across all clinical conditions, though the magnitude of the benefit varied between clinical groups. The larger effect sizes observed in clinical populations may reflect that these populations experience above-average symptoms of depression and anxiety and have low PA levels, and, therefore, have a greater scope for improvement compared with non-clinical populations.¹⁷

All PA modes were beneficial, including aerobic, resistance, mixed-mode exercise and yoga. It is likely that the beneficial effects of PA on depression and anxiety are due to a combination of various psychological, neurophysiological and social mechanisms.⁸⁷ Different modes of PA stimulate different physiological⁸⁸ and psychosocial effects,^{88–90} and this was supported by our findings (eg, resistance exercise had the largest effects on depression, while Yoga and other mind–body exercises were most effective for reducing anxiety). Furthermore, our findings showed that moderate-intensity and high-intensity PA modes were more effective than lower intensities. PA improves depression through various neuromolecular mechanisms including increased expression of neurotrophic factors, increased availability of serotonin and norepinephrine, regulation of hypothalamic–pituitary–adrenal axis activity and reduced systemic inflammation.^{91–92} Therefore, low-intensity PA may be insufficient for stimulating the neurological and hormonal changes that are associated with larger improvements in depression and anxiety.⁸⁷ Overall, our

findings add further support to public health guidelines, which recommend multimodal, moderate and vigorous intensity PA.

Our findings that longer duration interventions were less effective than shorter interventions may seem counter intuitive. It is possible that this finding reflects a decline in adherence with longer interventions. Furthermore, due to a lack of blinding of participants in PA trials, participants may have expected to have improved symptoms. It is possible that after experiencing short-term improvements in depression or anxiety, the expectancy effect may diminish over longer periods of time. An alternative explanation is that the longer interventions might not provide sufficient progression of PA dose, leading to a reduction in their effectiveness. Furthermore, it was somewhat surprising that smaller weekly duration interventions demonstrated larger effects than higher weekly duration. This is the opposite to the dose–benefit relationship observed for exercise and physical health outcomes.⁹³ It is possible that shorter duration interventions are easier for participants to comply with, whereas longer weekly duration interventions are more burdensome and that may be impacting the psychological benefits. It is a useful message that interventions do not need to provide high doses of PA for improvements in depression.

The key strength of this study was that it is the first umbrella review to evaluate the effects of all types of PA on depression, anxiety and psychological distress in all adult populations. We included only the highest level of evidence: meta-analyses of RCTs and applied stringent criteria regarding the design of the component RCTs to ensure that effects could be confidently attributed to PA rather than other intervention components. Additionally, there was only slight overlap in the component RCTs, increasing our confidence in the findings.

A limitation of the review is that most evidence focused on mild-to-moderate depression, with fewer reviews addressing anxiety and psychological distress, preventing us from reaching

firm conclusions in the subgroup analyses for these outcomes. Furthermore, most (n=77) of the included reviews were rated as 'critically low', based on the AMSTAR-2 quality rating.

Clinical implications

PA is effective for managing symptoms of depression and anxiety across numerous populations, including the general population, people with mental illnesses and various other clinical populations. While the benefit of exercise for depression and anxiety is generally recognised, it is often overlooked in the management of these conditions. Furthermore, many people with depression and anxiety have comorbidities, and PA is beneficial for their mental health and disease management. This underscores the need for PA to be a mainstay approach for managing depression and anxiety.

All modes of PA are effective, with moderate-to-high intensities more effective than low intensity. Larger benefits are achieved from shorter interventions, which has health service delivery cost implications—suggesting that benefits can be obtained following short-term interventions, and intensive long-term interventions are not necessarily required to achieve therapeutic benefit. The effect size reductions in symptoms of depression (−0.43) and anxiety (−0.42) are comparable to or slightly greater than the effects observed for psychotherapy and pharmacotherapy (SMD range=−0.22 to −0.37).^{94–97} Future research to understand the relative effectiveness of PA compared with (and in combination with) other treatments is needed to confirm these findings.

In conclusion, PA is effective for improving depression and anxiety across a very wide range of populations. All PA modes are effective, and higher intensity is associated with greater benefit. The findings from this umbrella review underscore the need for PA, including structured exercise interventions, as a mainstay approach for managing depression and anxiety.

What is already known

- ⇒ Previous research trials suggest that physical activity may have similar effects to psychotherapy and pharmacotherapy for patients with depression, anxiety or psychological distress.
- ⇒ Studies have evaluated different forms of physical activity, in varying dosages, in different population subgroups, and using different comparator groups, making it difficult for clinicians to understand the body of evidence for physical activity in the management of mental health disorders.

What are the new findings

- ⇒ Results showed that physical activity is effective for reducing mild-to-moderate symptoms of depression, anxiety and psychological distress (median effect size range=−0.42 to −0.60), compared with usual care across all populations.
- ⇒ Our findings underscore the important role of physical activity in the management of mild-to-moderate symptoms of depression, anxiety and psychological distress.

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Contributors BS, TO and CM conceived the idea for the review. BS, RC, DD, RV, AW, KS, EOC, TF, EE, AM and CEMS conducted search, study selection, data extraction and quality assessment. BS, TO and CM drafted the initial manuscript. RC, DD, RV, AW, KS, EOC, TF, EE, AM and CEMS contributed to writing the manuscript. All authors reviewed and approved the final manuscript.

Funding DD is supported by the Australian National Health and Medical Research Council (NHMRC) Early Career Fellowship APP1162166 and by the Centre of

Research Excellence in Driving Global Investment in Adolescent Health funded by NHMRC APP1171981. AM is supported by the Centre of Research Excellence in Driving Global Investment in Adolescent Health funded by NHMRC APP1171981. Dr Maher is supported by a Medical Research Future Fund Emerging Leader Grant (GNT1193862).

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

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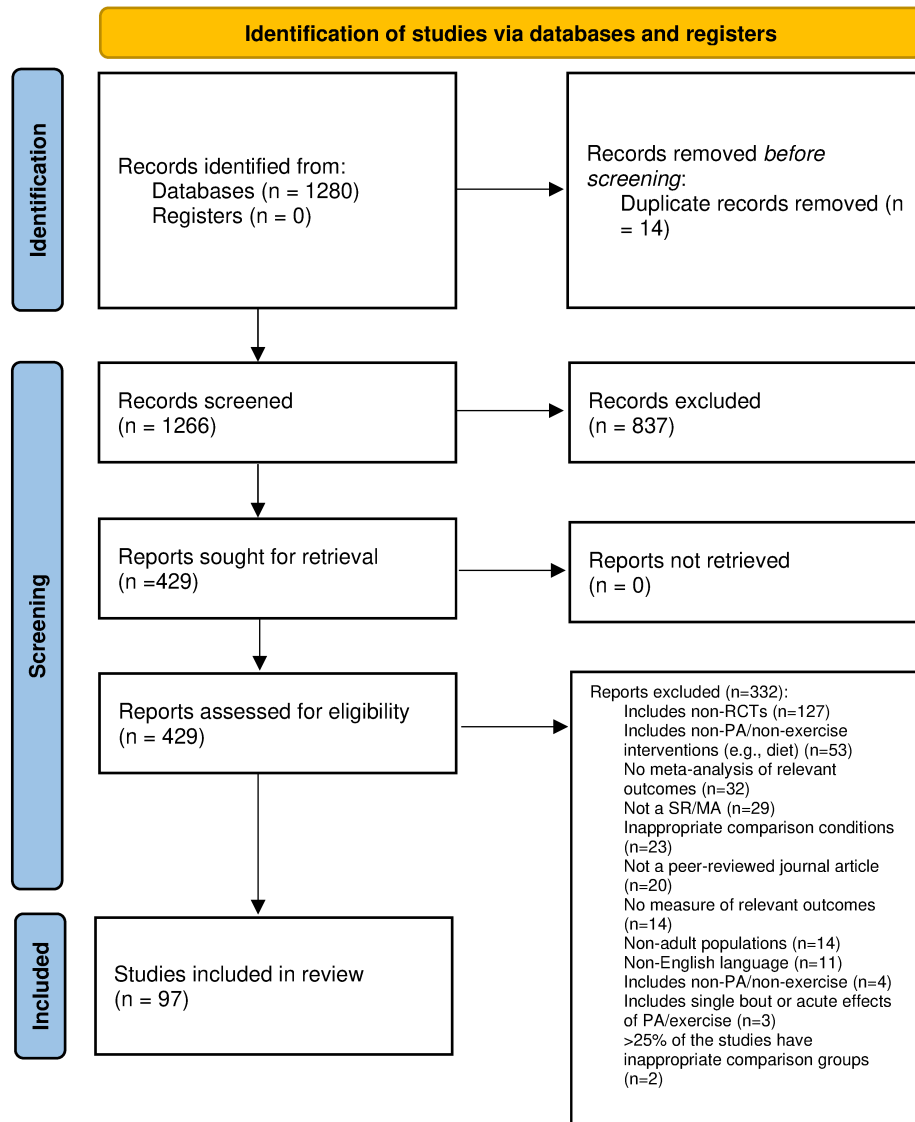
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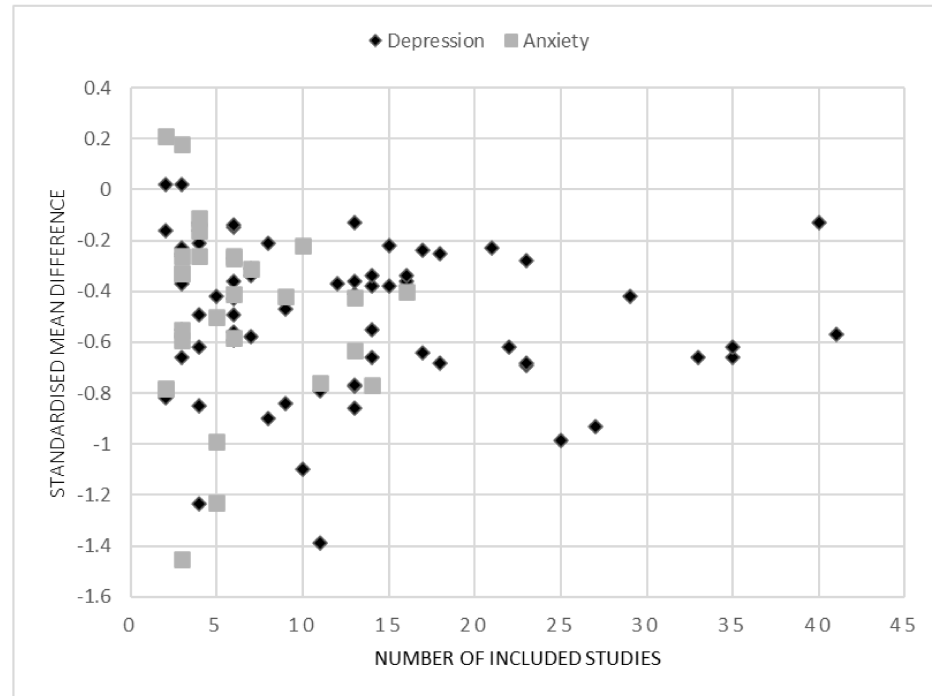
eTable 1. Medline search strategy and terms

MEDLINE(R) ALL <1946 to November 12, 2021> Ovid MEDLINE(R) ALL <1946 to November 19, 2021>	
1 Meta-Analysis as Topic/ 2 meta analy\$.tw. 3 metaanaly\$.tw. 4 Meta-Analysis/ 5 Systematic Review/ [addition] 6 Systematic Reviews as Topic/ [addition] 7 (systematic adj (review\$1 or overview\$1)).tw. 8 exp Review Literature as Topic/ 9 or/1-8 10 cochrane.ab. 11 embase.ab. 12 (psychlit or psyclit).ab. 13 (psychinfo or psycinfo).ab. 14 (cinahl or cinhal).ab. 15 science citation index.ab. 16 bids.ab. 17 cancerlit.ab. 18 or/10-17 19 reference list\$.ab. 20 bibliograph\$.ab. 21 hand-search\$.ab. 22 relevant journals.ab. 23 manual search\$.ab. 24 or/19-23 25 selection criteria.ab. 26 data extraction.ab. 27 25 or 26 28 Review/ 29 27 and 28 30 Comment/ 31 Letter/ 32 Editorial/ 33 animal/	34 human/ 35 33 not (33 and 34) 36 or/30-32,35 37 9 or 18 or 24 or 29 38 37 not 36 39 exp exercise/ 40 exp exercise therapy/ 41 exp sports/ 42 Physical Fitness/ 43 (physical* adj5 (fit* or train* or activ* or endur* or exer*)).ti,ab. 44 (exercis* adj5 (train* or physical* or activ*)).ti,ab. 45 sport*.ti,ab. 46 walk*.ti,ab. 47 swim*.ti,ab. 48 pilates.ti,ab. 49 step*.ti,ab. 50 HIIT.ti,ab. 51 (tai ji or tai chi or tai-ji or tai-chi).ti,ab. 52 (resistance adj3 train*).ti,ab. 53 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 54 38 and 53 55 depress*.ti,ab. 56 anxiety.ti,ab. 57 distress.ti,ab. 58 55 or 56 or 57 59 54 and 58 60 food.ti,ab. 61 diet*.ti,ab. 62 nutriti*.ti,ab. 63 59 not (60 or 61 or 62)

eFigure 1. PRISMA flow diagram.



eFigure 2. Funnel plot showing the relationship between systematic review-level standardised mean differences and the number of studies included in each meta-analysis for depression and anxiety.



eTable 2. Overview of all included studies.

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Adamson 2015	26	1324	Neurological disorders; males and females; mean±SD and range NR	AE, RE, Yoga, Tai Chi, Qigong, gymnastics; various intensities; 4w-52w	1) Depression (BDI, BDI-II, CES-D, CESD-10, CSDD, GDS, HADS, IDS-SR, Levine-Pilowsky depression questionnaire, MADRS, MDI, POMS)	Critically low
Aylett 2018	15	675	Anxiety; males and females; mean±SD and range NR	AE, RE; various intensities; 2w-10w	1) Anxiety (PSWQ, Liebowitz Social scale, Anxiety Sensitivity Index, BAI, STAI)	Critically low
Barreto 2015	20	1627	Dementia; males and females; mean±SD and range NR	AE, RE, Tai Chi, dance; various intensities; 6w-1y	1) Depression (GDS-15, GDS-30, MADRS, GSDD)	Critically low
Bellón 2021	14	1737	Adults without depression; males and females; 44.7±18.6	AE, RE, Yoga; various intensities; 4w-2y	1) Depression (HADS, PHQ-9, BDI, SCID-I, EPDS, POMS, CES-D, BDI-FS, GDS, BDI-II)	Critically low
Bergenthal 2014	9	818	Haematological cancer; males and females; 50.7±2.4	AE, RE; various intensities; 10d-36w	1) Depression (not specified) 2) Anxiety (not specified)	High
Bradt 2015	3	207	Breast cancer; females; 55.4±4.8	Dance; various intensities; 3w-12w	1) Depression (POMS, HADS) 2) Anxiety (HADS, Symptom Checklist 90-Revised)	High
Bridle 2012	9	667	Older adults with depression; males and females; 75.7±6.8	AE, RE, Tai Chi, Qigong; various intensities; 12w-1y	1) Depression (PHQ-9, GDS, HSCL-20, CES-D, HRSD, BDI, CSDD)	Low
Brinsley 2020	19	1080	Mental disorders; males and females; 38.5±9.4	Yoga; various intensities; 5w-12w	1) Depression (PANSS, HDRS, CES-D, HAD-C, FBGL, DASS-21, CDS, BDI, CAPS, HAM-D-21, QIDS)	Critically low
Broderick 2015	8	457	Schizophrenia; males and females; mean±SD and range NR	Yoga; various intensities; 4w-16w	1) Depression (Calgary Depression Scale)	Low
Brown 2012	40	2929	Cancer; males and females; 51.3±6.5	AE, RE, Yoga; various intensities; 3w-1y	1) CES-D, Center for Epidemiologic Studies Depression scale; POMS, Profile of Mood States; BDI, Beck Depression Inventory; HADS, Hospital Anxiety and Depression Scale; Symptom Assessment Scale.	Critically low
Carneiro 2020	4	295	Depression; males and females; 61.1±14.4	RE; various intensities; 10w-16w	1) Depression (HAM-D, CES-D, GDS, BDI)	Low
Carter 2019	18	1428	Postnatal women; females; 29.3±2.9	AE, RE; various intensities; 6w-14m	1) Depression (DASS, EPDS, GHQ12, HDRS, IDAS, PHQ, SCID, SF-36, HAM-D, SCID-PN diagnosis, SF-36v2, CES-D, PHQ-9, SCID-I)	Low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Chi 2013	4	253	Older adults with depressive symptoms; males and females; mean±SD NR; age range=52-82	Tai Chi; low-intensity; 12w-24w	1) Depression (DASS-21, CES-D)	Critically low
Choo 2020	13	869	Chronic diseases; males and females; 67.2±3.5	Tai Chi; low-intensity; 10w-24w	1) Depression (CES-D, Zung depression scale, Depression, Anxiety, and Stress Scales)	Low
Chung 2017	17	651	End Stage Renal Disease; males and females; mean±SD and range NR	AE, RE; various intensities; 8w-48w	1) Depression (Zung depression scale, BDI, SF-36)	Critically low
Cooney 2013	39	2326	Depression; males and females; 52.7±19.3	AE, RE; various intensities; 10d-16w	1) Depression (Hamilton Rating Scale for Depression, BDI, BDI-II, Lubin's Depression Adjective List, Zung Depression Scale, MADRS, HAM-D, Global Assessment Scale, CES-D, POMS, Cornell Scale for Depression in Dementia, GDS)	High
Coventry 2007	6	545	COPD; males and females; 65.3±2.9	AE, RE; various intensities; 5w-1y	1) Depression (HADS, Lorr-McNair Mood Questionnaire, CES-D, SCL-90-R) 2) Anxiety (HADS, STAI-State Anxiety, SCL-90-R)	Critically low
Craft 2012	15	1371	Cancer; males and females; 55.1±7.8	AE, RE; various intensities; 6w-6m	1) Depression (CES-D Short Form, CES-D, BDI-II, HADS)	Critically low
Dalgas 2015	15	591	Multiple sclerosis; males and females; 46.7±6.3	AE, RE, water aerobics, yoga, sports climbing; various intensities; 3w-26w	1) Depression (BDI-I, BDI-II HADS-D, MDI, CES-D, IDS-SR30, POMS)	Critically low
deAlmeida 2020	16	1129	Dementia; males and females; 77.3±7.3	AE, RE; various intensities; 6w-2y	1) Depression (Cornell Scale for Depression in Dementia, NPI Depression, GDS – Short Form) 2) Anxiety (Generalized Anxiety Disorder 7-item, NPI Anxiety)	Critically low
Duan 2020	15	1461	Cancer; males and females; 54.6±6.6	Yoga, Qigong, Tai Chi, Dance; various intensities; 3w-24w	1) Depression (HADS, BDI, CES-D, PHQ-9) 2) Anxiety (FACT-B, FACT-C, SF-12, FACT-G) 3) Distress (Perceived Stress Scale General Quality of Life: FACT-G, FACT-B, EORTC-QLQ-C-30)	Critically low
Eng 2014	13	1022	Stroke; males and females; mean±SD NR; age range=21-93	AE, RE; various intensities; 4-12w	1) Depression (HADS, GDS, BDI, CES-D)	Critically low
Ensari 2014	13	477	Multiple sclerosis; males and females; 45.1±5.8	AE, RE, water aerobics, yoga; various intensities; 4-26w	1) Depression (BFI, IFD, MDI, BDI-II, HADS, CES-D, POMS, POMS-SF)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Felbel 2014	1	39	Haematological cancer; males and females; 51	Yoga; low intensity; 7w	1) Depression (CES-D) 2) Anxiety (STAI) 3) Distress (Impact of Events Scale)	High
Ferreira 2021	8	376	Kidney disease; males and females; 51.7±8.6	AE, RE, Pilates, intradialytic exercise; various intensities; 4w-48w	1) Depression (HADS, DASS, BDI, General Health Dimensions - depression subscale) 2) Anxiety (HADS, DASS)	Critically low
Fong 2012	34	4113	Cancer; males and females; 55.7±5.8	AE, RE, Yoga; various intensities; 3w-60w	1) Depression (HADS, BDI) 2) Anxiety (HADS)	Critically low
Forbes 2008	4	280	Dementia; males and females; mean±SD and range NR	AE, RE; various intensities; 2w-1y	1) Depression (MADRS)	Low
Furmaniak 2016	32	2626	Breast cancer; females; mean±SD and range NR	AE, RE; various intensities; 6w-1y	1) Depression (BDI, CES-D, HADS) 2) Anxiety (STAI, HADS)	High
Gascoyne 2020	4	133	Multiple sclerosis; males and females; 43.9±7.6	AE, RE; various intensities; 8w-26w	1) Anxiety (POMS, HADS, STAI, BAI)	Critically low
Gong 2015	6	375	Pregnant women; females only; mean±SD NR; range = 18-40	Yoga; various intensities; 12w-16w	1) Depression (CES-D, HADS, EPDS)	Critically low
Gordon 2018	33	1877	Adults with or without chronic conditions; males and females; 52±18	RE; various intensities; 6w-1y	1) Depression (BDI, GDS, CES-D, MDI, MHFI, DACL, HRSD, BRUMS-D, HADS, POMS, SCL-90-D, DSM, DASS-21)	Critically low
Gouw 2019	13	1340	Older adults with chronic disease; males and females; 70.4±6.2	Qigong; low intensity; 8w-26w	1) Depression (GDS, HADS, HRSD, Self-rating scale)	Critically low
Guo 2020	16	1096	COPD, males and females; 67.4±4.9	Tai Chi; various intensities; 2w-1y	1) Depression (HADS, Self-rating scale) 2) Anxiety (HADS, Self-rating scale)	Critically low
Hall 2021	17	1456	Knee osteoarthritis; males and females; 65.9±4.6	AE, RE, Yoga, Tai chi, Qigong; various intensities; 6w-1y	1) Depression (HADS, CES-D) 2) Anxiety (HADS)	Critically low
Heinzel 2015	18	1063	Older adults; males and females; 71.9±6.0	AE, RE, Tai chi, Qigong; various intensities; 6w-26w	1) Depression (HADS, HDG, HAM-D, PHQ-9, BDI, DSM-IV diagnostic criteria)	Critically low
Heissel 2019	10	479	HIV; males and females; mean±SD and range NR	AE, RE, Yoga; various intensities; 4w-12w	1) Depression (BDI, GHQ-28, POMS, HADS) 2) Anxiety (GHQ-28, POMS, HADS, STAI)	High

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Herring 2017	14	624	Multiple Sclerosis; males and females; 44±6.6	AE, RE, Yoga; various intensities; 3w-26w	1) Depression (BDI, CES-D, HADS, IDS-SR, POMS, MDI)	Critically low
Josefsson 2014	15	880	Depression; males and females; 46.3±13	AE, RE; various intensities; 4w-16w	1) Depression (HRSD, BDI, MARDS, PHQ-9, MMPI)	Critically low
Kelley 2018	14	926	Arthritis and rheumatic diseases; males and females; 54.5±8.9	AE; RE; various intensities; 8w-32w	1) Depression (AIMS, BDI, CES-D, DASS-21, FIQ, HADs, MHI, VAS) 2) Anxiety (STAI, AIMS, HADS, DASS-21, MHI, FIQ, VAS)	High
Kelley 2015	29	2449	Arthritis; males and females; 52.3±9.7	AE, RE, Tai chi, Qigong; various intensities; 4w-32w	1) Depression (BDI, CES-D, DASS-21, MIH, FIQ, AIMS, POMS, HADS, VAS)	High
Krogh 2017	35	2498	Depression; males and females; 44±12.8	AE, RE; various intensities; 2w-32w	1) Depression (HAM-D17, SCL-D, BDI, MADRS, PHQ-9)	Low
Kvam 2016	23	977	Depression; males and females; 36.9±14.4	AE, RE; various intensities; 1w-8m	1) Depression (HAMD-17, MDD, BDI, BDI-II, SCL-90)	Critically low
Lawlor 2001	14	479	Depression; males and females; 44.7±17	AE, RE; various intensities; 4w-12w	1) Depression (BDI, Depression symptom checklist)	Critically low
Lawrence 2017	2	72	Stroke; males and females; 59.5±4.6	Yoga; various intensities; 8w-10w	1) Depression (GDS15) 2) Anxiety (STAI, STAI-Y1, STAI-Y2, Stroke Impact Scale version 3)	Critically low
Lee 2021	22	1025	Depression; males and females; 48.5±12.6	AE, RE; various intensities; 10d-24w	1) Depression (BDI-II, HAM-D, BDI, MADRS, MARDS-S, BRMS, GDS)	Critically low
Lee 2020	29	2989	Breast cancer; females; 50±7.7	AE, RE; Yoga; various intensities; 4w-26w	1) Depression (HADS, CES-D) 2) Anxiety (HADS, Spielberger State-Anxiety Inventory)	Critically low
Leng 2018	21	2589	Cognitive impairment; males and females; 76.3±5.9	AE, RE, Tai Chi, Yoga; various intensities; 6w-1y	1) Depression (CSDD, GDS, Depression Rating Scale, BDI, HAMD)	Critically low
Liu 2019	6	429	Lymphoma; males and females; 53.6±6.4	AE, Yoga, Qigong; various intensities; 3w-36w	1) Depression (CES-D)	Critically low
Li 2019	13	906	COPD; males and females; 63.9±6.9	Yoga, Qigong, Tai chi, various intensities; 8w-48w	1) Depression (CES-D, SSAI, HADS, BDI, Self-rating scale, HAMD) 2) Anxiety (HADS, STAI, Self-rating scale, HAMA)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Li 2019	20	2051	Dementia; males and females; 80.9±5.1	AE, RE, dance; various intensities; 6w-18m	1) Depression (HAMD-17, GDS, CSDD, MADRS)	Critically low
Lund 2020	8	552	Colorectal cancer; males and females; 58±4.6	AE, RE; various intensities; 6w-24w	1) Depression (HADS, BDI)	Critically low
Lyu 2021	11	732	Stroke patients with mental or sleep disorders; males and females; 62.2±6.6	Tai Chi; low intensity; 6w-24w	1) Depression (CES-D, HAM-D, BDI) 2) Anxiety (HAMA)	Critically low
McCurdy 2017	16	1327	Postpartum women, females; 29.6±2.8	AE, RE, Yoga; various intensities; 6w-1y	1) Depression (EPDS, CES-D, HAMD)	Critically low
McGettigan 2020	16	992	Colorectal cancer; males and females; 59.5±4.6	AE, RE; various intensities; 6w-1y	1) Depression (HADS, CES-D) 2) Anxiety (HADS, STAI)	Low
McGranahan 2021	4	149	PTSD; males and females; 44.7±16.3	AE, RE; various intensities; 3w-12w	1) Depression (CES-D, DASS, PHD) 2) Anxiety (STAI, DASS)	Critically low
Miller 2020	69	5379	Older adults; males and females; 73.4±5.6	AE, RE, Yoga, Tai Chi, Qigong; various intensities; 4w-15m	1) Depression (BDI, CESD-20, POMS-D, GDS-15, GDS-30, BDI-II, MADRS, GADS-D, CSDD, TDQ, HADS-D, HRSD, DASS-D, IDS-C, GDS-5, POMS-SF-D, CESD-10, PROMIS-EDD SF-8a, CESD-6)	Low
Miller 2020	15	596	Older adults with depression; males and females; 73.9±5.9	AE, RE, Yoga, Tai Chi, Qigong, dance; various intensities; 4w-16w	1) Depression (GDS-15, CESD-20, GDS-30, HRSD, BDI, CSDD)	Low
Mishra 2012	40	3694	Cancer; males and females; 53.3±5.4	AE, RE, Yoga, Tai Chi, Qigong; various intensities; 3w-1y	1) Depression (CES-D, HADS, BDI, VAS, POMS) 2) Anxiety (HADS, STAI, VAS, POMS)	High
Morres 2019	11	455	Depression; males and females; Mean (SD) = 37 (9.4); range = 20.9-49.1	AE; various intensities; 10d-32w	1) Depression (HAMD-17, BDI, CIS, MADRS)	Critically low
Nebiker 2018	27	1452	Depression; males and females; 49.5±16.0	AE, RE, Yoga, Tai Chi; various intensities; 10d-32w	1) Depression (BDI, BDI-II, HRSD, CES-D, GDS-15, GDS, HAM-D, MADRS, PHQ-9)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Nixon 2005	10	276	HIV/AIDS; males and females; mean±SD NR; age range=18-58	AE, RE; various intensities; 5w-24w	1) Depression (POMS)	Critically low
Park 2014	18	3297	Older adults; males and females; mean±SD and range NR	AE, RE, Yoga, Tai Chi, dance; various intensities; 4w-2y	1) Depression (GDS, GDS-15, HADS, Zung Self-rating depression scale, CES-D)	Critically low
Patsou 2017	14	1701	Breast cancer; females; 52.1±2.9	AE, RE, Yoga; various intensities; 6-1y	1) Depression (HADS, BDI-II, CES-D, POMS)	Critically low
Pavey 2011	8	5109	Adults; males and females; 59±7	AE; various intensities 8w-52w	1) Depression (not specified)	Critically low
Pearsall 2014	8	374	Schizophrenia; males and females; mean±SD NR; range = 27-52	AE; various intensities 10w-24w	1) Depression (BSI, WHOQOL-BREF-TR, BDI, MHI, CGI-Severity) 2) Anxiety (BSI, WHOQOL-BREF-TR, MHI, CGI-Severity)	Critically low
Peddle-McIntyre6 2019	6	221	Lung cancer; males and female; 60.9±5.3	AE, RE; various intensities; 4w-12w	1) Depression (GHQ-12, HADS) 2) Anxiety (GHQ-12, HADS)	Critically low
Pentland 2021	5	242	Postpartum women; females; 30±3.5	AE, RE; various intensities; 12w-6m	1) Depression (EPDS)	Critically low
Ramachandran 2021	14	2869	Heart disease; males and females; 59.4±5.7	AE; various intensities; 6w-6m	1) Depression (Patient Health Questionnaire, CES-D, DASS)	Critically low
Ramirez-velez 2021	57	6988	Breast cancer; females; 52.3±3.3	AE, RE; various intensities; 5w-1y	1) Depression (HADS, FACT-B Depression, BDI, Finnish version of modified BDI, CES-D) 2) Anxiety (HADS, FACT-B Anxiety, Social Physique Anxiety Scale-7, SSAI, State-Trait Anxiety Inventory (STAI))	Critically low
Ramos-Sanchez 2021	13	731	Anxiety disorder; males and females; 39.2±11.7	AE, RE; various intensities; 3w-20w	1) Anxiety (Hamilton Scale for Anxiety, Penn State Worry Questionnaire, Anxiety stress scale, Chinese Mandarin version STAI)	High
Rhyner 2016	41	NR	Older adults; males and females; 73.9±5.2	AE, RE, Yoga, Tai Chi, Qigong; various intensities; 3w-144w	1) Depression (GSD, CES-D, GSD-15, BDI, Taiwanese Depression Questionnaire, HSCL-20, DASS, HDRS, Cornell Scale for Depression in Dementia, MADRS)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Rosenbaum 2015	4	200	PTSD; males and females; 43.7±6.7	AE, RE, Yoga; various intensities; 6w-12w	1) Depression (PSS-I, PCL-C, CAPS)	Critically low
Russ 2021	9	456	Dementia; males and females; 85.5±1	RE; various intensities; 12w-7m	1) Depression (GDS, CCSD, MADRS)	Critically low
Salihu 2021	28	2249	Adults; males and females; 65.3±16	Dance; various intensities; 10d-1y	1) Depression (BDI, GDS, POMS, CESD, HADS, DASS-21) 2) Anxiety (Test Anxiety Inventory, DASS-21, HADS, STAI)	Critically low
Schuch 2016	8	267	Older adults with depression or depressive symptoms; males and females; 69.5±0.71	AE, RE; various intensities; 6w-16w	1) Depression (HAM-D, GDS-15, BDI, GDS, PHQ-9, CES-D, CSDD)	Critically low
Schuch 2016	25	1487	Depression or depressive symptoms; males and females; 50.9±17.1	AE, RE; various intensities; 4w-32w	1) Depression (HAM-D, BDI, BDI-II, MARSD, GDS-15, CES-D, PHQ-9, DACL, MMPI, CSDD)	Critically low
Schumacher 2021	7	391	Prostate cancer, males; 67.9±1.5	AE, RE; various intensities; 4w-24w	1) Depression (CES-D, BDI)	Critically low
Singh 2018	61	5200	Breast cancer; females; 53±3.6	AE, RE, Yoga; various intensities; 6w-1y	1) Depression (POMs, HADs, CES-D, Greene Climacteric Scale, NDI, Functional Living Index of Cancer) 2) Anxiety (POMs, HADs, STAI, FACT-Amemia, Greene Climacteric Scale, SSAI, Social Physique Anxiety Scale, Functional Living Index of Cancer)	Critically low
Singh 2020	31	2109	Lung cancer; males and females; 64±3	AE, RE, Yoga; various intensities; 1w-20w	1) Depression (HADs, GHQ) 2) Anxiety (HADs, GHQ)	Critically low
Stathopoulou 2006	11	513	Depression; males and females; mean±SD and range NR	AE, RE; various intensities; 4w-16w	1) Depression (HRSD, EPSD, BDI, Self-rating scale, Depression - Symptom Checklist 90)	Critically low
Stubbs 2017	6	262	Anxiety or stress disorder; males and females; 34.7±9.6	AE; various intensities; 6w-12w	1) Anxiety (HAM-A, Penn State Worry Questionnaire, PSWQ, DASS21, PTSD symptom scale, PSSI, PTSD checklist-civilian version)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Tu 2014	19	3447	Heart failure; males and females; 63.7±7.8	AE, RE, Tai Chi; various intensities; 6w-76w	1) Depression (Depression - Symptom Checklist 90, HADS, BDI, BDI-II, MADRS, Multiple Affect Adjective Checklist, GDS, HAM-D, Cognitive Behavioural Assessment Hospital form, CES-D, Psychological General Well-being Index, Hare-Davis Cardiac Depression Scale, POMS)	Critically low
vanHaren 2013	11	734	Cancer; males and females; mean±SD and range NR	RE, AE; various intensities; 4w-24w	1) Depression (POMS, HADS) 2) Anxiety (POMS, HADS) 3) Distress (Self-perception scale of physical and emotional well-being)	Critically low
Vashistha 2016	13	1057	Prostate cancer; males; 69.2±2.3	AE, RE, Qigong; various intensities; 4w-6m	1) Depression (BSI-18) 2) Anxiety (BSI-18)	Critically low
Wang 2014	22	2894	Substance use disorder; males and females; 38.9±5.8	AE, RE, Yoga, Tai Chi, sports; various intensities; 10d-6m	1) Depression (BDI, CES-D, Self-rating depression scale, HADS) 2) Anxiety (Self-rating scale, Hamilton Anxiety Scores, Mood and Physical Symptoms Scale-anxiety, STAI)	Critically low
Wang 2019	12	516	Heart failure; males and females; mean±SD NR; range = 43-74	AE, RE; various intensities; 8w-48w	1) Depression (not specified)	Critically low
Weber 2020	37	3224	Older adults; males and females; 72.2±7.3	Tai Chi, Qigong, Yoga, Pilates; various intensities; 4w-1y	1) Depression (GDS, GDS-SF, HADS, BDI, BDI-II, CES-D, DASS-21, MHI-18, POMS, POMS-SF, Taiwanese Depression Questionnaire, Warwick-Edinburgh Mental Well-being Scale)	Critically low
Wu 2019	6	415	COPD; males and females; 66.3±4.6	Qigong; various intensities; 4w-24w	1) Depression (Self-rating scale) 2) Anxiety (Self-rating scale)	Critically low
Xiang 2017	10	689	Fatigue; males and females; mean±SD NR; range=18-88	Tai Chi; various intensities; 4w-6m	1) Depression (POMS, POMS-SF, IDS-C, CES-D, BDI, BDI-II)	Critically low
Yi 2021	7	693	Breast cancer; females; 50.4±3.5	Yoga; various intensities; 8w-16w	1) Depression (BDI, POMS, HADS, Self-rating scale, CES-D) 2) Anxiety (POMS, HADs, Self-rating scale)	Critically low
Zeng 2019	12	915	Cancer; males and females; 62.2±4.3	Qigong; various intensities; 6w-12w	1) Depression (DASS, HADS) 2) Anxiety (DASS, HADS) 3) Stress (BSI, FACT-G)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Zeng 2014	13	592	Cancer; males and females; mean±SD and range NR	Tai Chi; various intensities; 6w-24w	1) Depression (BDI, CES-D) 2) Anxiety (BAI)	Critically low
Zeng 2019	10	838	Cancer; males and females; 52.5±4.1	AE, RE; various intensities; 8w-96w	1) Depression (Not specified)	Critically low
Zhang 2019	5	803	Older adults with mild cognitive impairment; males and females; 74.8±5.7	Tai Chi; various intensities; 12w-1y	1) Depression (CDS)	Critically low
Zhao 2019	13	614	End-stage renal disease; males and females; 54.58±11.68	AR, RE, Yoga; various intensities; 8w-1y	1) Depression (BDI, HADS) 2) Anxiety (HADS)	Critically low
Zhou 2021	8	570	Lung cancer; males and females; 64.4±2.1	AR, RE, Tai Chi; various intensities; 6w-12w	1) Depression (HADS, GHQ-12) 2) Anxiety (HADS, GHD)	Critically low
Zuo 2016	21	1762	Breast cancer; females; 42.6±4.7	Yoga; various intensities; 2w-24w	1) Depression (HADS, BDI, CES-D, DMI, Self-rating scale) 2) Anxiety (HADS, STAI, Self-rating scale) 3) Distress (Positive and Negative Affect Schedule, Subjective Symptom Checklist, The Rotterdam Symptom Checklist)	Critically low
Abbreviations: AE: Aerobic exercise; RE: Resistance exercise; NR: Not reported						

eTable 3. AMSTAR 2 quality appraisal of reviews.

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Adamson 2015	Y	N	Y	PY	Y	Y	N	N	Y	N	Y	N	N	Y	N	N	Critically low
Aylett 2018	Y	N	Y	N	Y	Y	Y	Y	Y	N	N	N	N	Y	N	Y	Critically low
Barreto 2015	Y	N	Y	PY	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Bellón 2021	Y	N	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Bergenthal 2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Bradt 2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Bridle 2012	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Low
Brinsley 2020	Y	PY	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	N	Y	Y	Critically low
Broderick 2015	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Low
Brown 2012	Y	N	Y	N	N	Y	N	PY	Y	Y	Y	Y	Y	N	Y	Y	Critically low
Carneiro 2020	Y	PY	Y	Y	Y	N	Y	PY	Y	Y	Y	Y	Y	Y	N	Y	Low
Carter 2019	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Low
Chi 2013	Y	PY	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Critically low
Choo 2020	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Low
Chung 2017	Y	N	Y	N	Y	Y	N	N	Y	N	N	Y	Y	Y	Y	Y	Critically low
Cooney 2013	Y	PY	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Coventry 2007	Y	N	Y	PY	N	Y	N	Y	PY	N	Y	Y	Y	Y	N	Y	Critically low
Craft 2012	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y	Y	Critically low
Dalgas 2015	Y	N	Y	N	N	N	N	Y	Y	N	Y	N	N	Y	N	Y	Critically low
deAlmeida 2020	Y	PY	Y	N	Y	N	N	Y	Y	N	Y	N	N	Y	N	Y	Critically low
Duan 2020	Y	N	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Eng 2014	Y	N	Y	PY	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Ensari 2014	Y	N	Y	PY	N	N	N	N	Y	N	Y	N	Y	Y	Y	Y	Critically low
Felbel 2014	Y	Y	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Ferreira 2021	Y	Y	Y	PY	Y	N	N	N	Y	N	Y	N	Y	Y	N	Y	Critically low
Fong 2012	N	N	N	N	Y	Y	N	PY	N	N	Y	Y	Y	Y	Y	Y	Critically low
Forbes 2008	Y	PY	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	Low
Furmaniak 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Gascoyne 2020	Y	Y	Y	Y	Y	Y	N	PY	N	N	Y	N	N	Y	N	Y	Critically low
Gong 2015	Y	N	Y	PY	N	Y	N	PY	PY	N	Y	N	N	Y	N	Y	Critically low
Gordon 2018	Y	N	Y	N	N	Y	N	PY	Y	N	Y	N	Y	Y	Y	Y	Critically low
Gouw 2019	Y	N	Y	Y	Y	Y	N	PY	Y	N	Y	N	N	N	N	Y	Critically low
Guo 2020	Y	Y	N	N	Y	Y	N	PY	Y	N	Y	Y	N	Y	N	Y	Critically low

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Hall 2021	Y	N	Y	PY	Y	Y	N	PY	Y	N	N	N	N	N	Y	Y	Critically low
Heinzel 2015	Y	N	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	Y	N	Y	Critically low
Heissel 2019	Y	PY	Y	PY	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High
Herring 2017	Y	N	Y	PY	Y	Y	N	Y	Y	N	Y	Y	N	N	Y	Y	Critically low
Josefsson 2014	Y	N	Y	PY	N	N	N	PY	PY	N	Y	Y	Y	Y	N	N	Critically low
Kelley 2018	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Kelley 2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Krogh 2017	Y	Y	Y	PY	N	Y	N	PY	Y	Y	Y	Y	Y	Y	Y	Y	Low
Kvam 2016	Y	N	Y	Y	Y	Y	Y	Y	Y	PY	N	N	Y	Y	N	Y	Critically low
Lawlor 2001	Y	N	Y	Y	Y	Y	Y	Y	Y	PY	N	Y	N	N	Y	N	Critically low
Lawrence 2017	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	N	Y	Critically low
Lee 2021	Y	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y	Y	Y	N	Y	Critically low
Lee 2020	N	N	Y	N	Y	N	N	PY	N	N	N	N	N	N	N	Y	Critically low
Leng 2018	Y	N	Y	PY	Y	Y	N	PY	Y	N	Y	N	N	N	Y	Y	Critically low
Liu 2019	Y	N	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	Critically low
Li 2019	Y	N	Y	PY	Y	Y	N	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Li 2019	Y	N	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	Y	Y	Y	Critically low

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Lund 2020	N	Y	Y	PY	Y	N	N	N	Y	N	N	Y	Y	N	N	Y	Critically low
Lyu 2021	Y	Y	Y	PY	Y	Y	N	PY	Y	N	N	N	N	N	N	Y	Critically low
McCurdy 2017	Y	N	Y	PY	Y	Y	N	PY	Y	N	Y	Y	Y	Y	N	Y	Critically low
McGettigan 2020	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Low
McGranahan 2021	N	N	N	N	N	N	N	PY	N	N	Y	Y	Y	Y	Y	Y	Critically low
Miller 2020	Y	Y	Y	PY	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Low
Miller 2020	Y	Y	Y	PY	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Low
Mishra 2012	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Morres 2019	Y	N	Y	PY	Y	Y	N	PY	Y	N	Y	Y	Y	Y	Y	N	Critically low
Nebiker 2018	Y	N	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	N	Y	Y	Critically low
Nixon 2005	Y	Y	Y	Y	Y	Y	Y	PY	PY	N	Y	N	N	N	N	Y	Critically low
Park 2014	Y	N	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	N	Y	N	Critically low
Patsou 2017	Y	N	Y	N	N	N	N	Y	Y	N	Y	N	N	N	Y	Y	Critically low
Pavey 2011	Y	N	Y	N	Y	N	Y	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Pearsall 2014	Y	N	Y	N	N	N	N	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Peddle-McIntyre 2019	Y	Y	Y	Y	Y	Y	Y	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Pentland	Y	PY	Y	N	Y	Y	N	PY	Y	N	Y	N	N	Y	Y	Y	Critically low

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Ramachandran 2021	Y	N	Y	PY	Y	Y	Y	PY	Y	Y	Y	N	N	Y	N	Y	Critically low
Ramirez-velez 2021	Y	PY	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Ramos-Sanchez 2021	Y	Y	Y	PY	Y	Y	PY	PY	Y	Y	Y	N	Y	Y	Y	Y	High
Rhyner 2016	Y	N	Y	PY	N	N	N	PY	N	N	Y	N	N	N	Y	N	Critically low
Rosenbaum 2015	Y	N	Y	Y	Y	Y	N	PY	PY	N	Y	N	N	Y	Y	N	Critically low
Russ 2021	Y	N	Y	N	Y	N	N	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Salihu 2021	Y	Y	Y	N	Y	N	N	Y	Y	N	Y	Y	Y	Y	N	Y	Critically low
Schuch 2016	Y	N	Y	PY	Y	Y	N	N	Y	N	Y	Y	N	N	Y	Y	Critically low
Schuch 2016	Y	N	Y	PY	Y	Y	N	N	Y	N	Y	Y	Y	N	Y	Y	Critically low
Schumacher 2021	Y	PY	Y	PY	Y	Y	N	N	Y	N	N	N	N	Y	N	N	Critically low
Singh 2018	Y	N	N	Y	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Singh 2020	Y	N	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	N	N	Y	Critically low
Stathopoulos 2006	N	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	Y	N	Critically low
Stubbs 2017	Y	N	Y	Y	Y	Y	N	Y	Y	N	Y	N	N	Y	Y	Y	Critically low
Tu 2014	Y	N	Y	N	N	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Critically low
vanHaren 2013	N	N	Y	N	N	N	N	N	Y	N	Y	Y	N	N	N	N	Critically low
Vashistha 2016	Y	PY	Y	N	Y	Y	N	PY	Y	N	Y	N	N	N	N	Y	Critically low

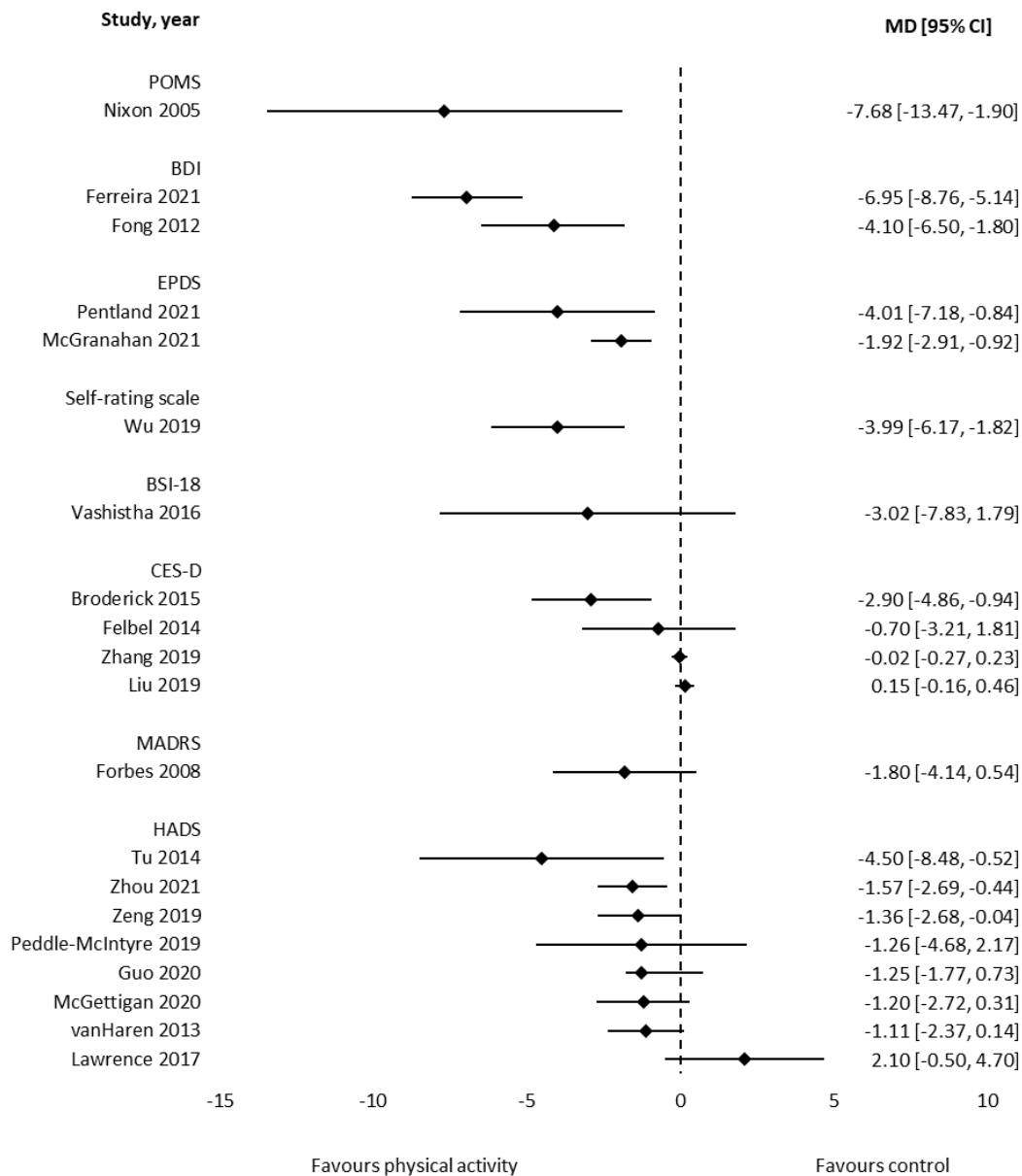
Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Wang 2014	N	N	Y	N	Y	Y	N	PY	PY	N	N	N	N	Y	Y	Y	Critically low
Wang 2019	Y	N	Y	N	Y	Y	N	N	Y	N	N	N	N	N	N	N	Critically low
Weber 2020	Y	N	N	N	N	Y	N	PY	Y	N	N	N	N	N	Y	Y	Critically low
Wu 2019	Y	N	Y	N	Y	Y	N	PY	Y	N	N	N	N	N	N	Y	Critically low
Xiang 2017	Y	Y	Y	N	Y	N	N	PY	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Yi 2021	Y	N	N	N	Y	Y	N	PY	Y	N	N	N	N	Y	Y	Y	Critically low
Zeng 2019	Y	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	Y	Critically low
Zeng 2014	Y	N	N	Y	Y	Y	N	PY	Y	N	N	N	N	N	N	Y	Critically low
Zeng 2019	Y	N	N	Y	N	Y	N	PY	Y	N	Y	Y	Y	Y	N	Y	Critically low
Zhang 2019	Y	N	N	Y	Y	Y	N	PY	Y	N	N	Y	N	Y	N	Y	Critically low
Zhao 2019	Y	N	N	N	Y	Y	N	PY	Y	N	N	N	N	N	Y	Y	Critically low
Zhou 2021	Y	N	N	N	Y	Y	N	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Zuo 2016	Y	N	N	N	Y	Y	N	PY	Y	N	N	N	N	N	Y	N	Critically low

Note: Y=yes; N=no; Partial Y=meets criteria for partial yes; N/A=not applicable as no meta-analysis conducted

Legend: AMSTAR 2 Items: 1) The Participant, Intervention, Comparator and Outcome (PICO) components included in the review research question and inclusion criteria; 2) Explicit statement included that review methods were established prior to conduct and significant deviations justified; 3) Selection of included study designs explained; 4) Comprehensive search strategy used; 5) Study selection performed in duplicate; 6) Data extraction performed in duplicate; 7) List of excluded studies with justification provided; 8) Included studies described in adequate detail; 9) Satisfactory technique used for assessing risk of bias in included studies; 10) Sources of funding for included studies reported; 11) Appropriate methods for statistical combination of results used if meta-analysis performed; 12) Potential impact of risk of bias of individual studies assessed if meta-analysis performed; 13) Risk of bias of individual studies accounted for in discussion of the review results; 14) Any heterogeneity observed in the review

results was explained and discussed; 15) Publication bias investigated and discussed if meta-analysis performed; 16) Authors reported any potential sources of conflict of interest.

eFigure 3. Results of meta-analyses that assessed depression using mean differences.



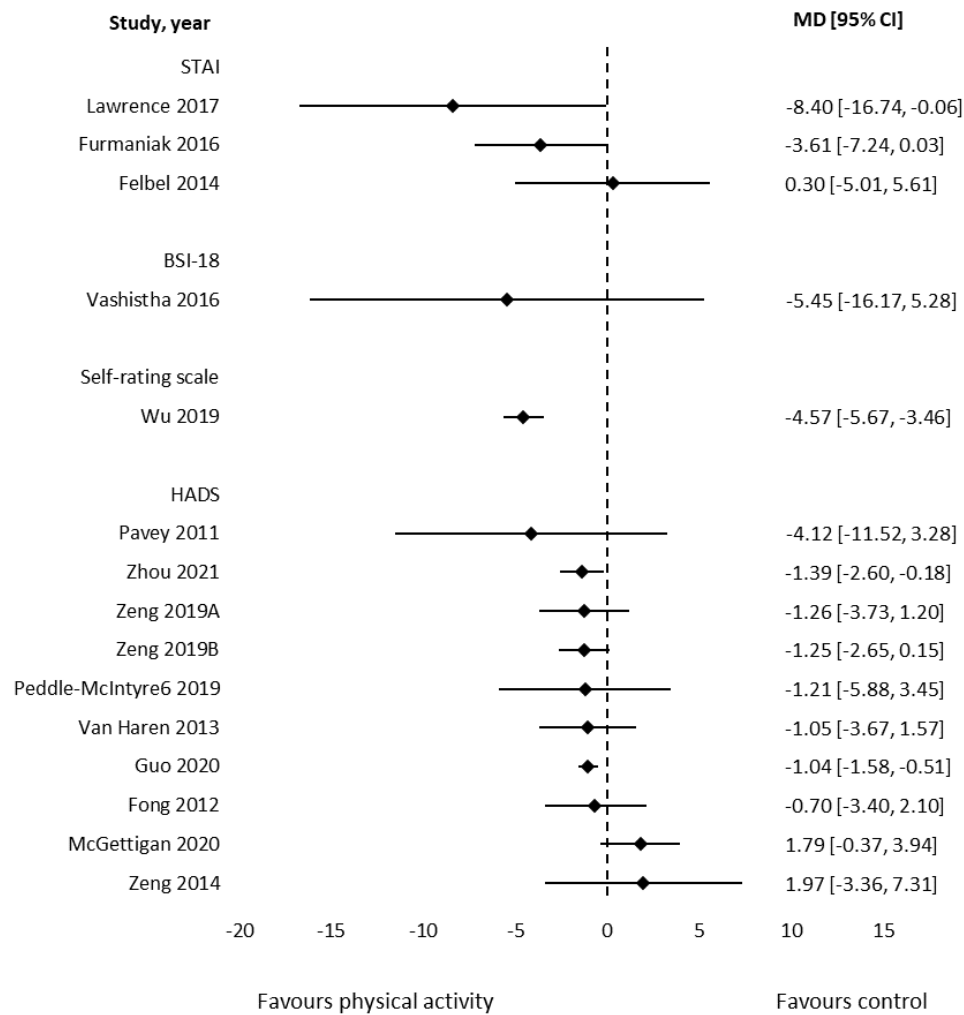
BDI: Beck Depression Inventory; CES-D: Center for Epidemiological Studies Depression; EPDS: The Edinburgh Postnatal Depression Scale; HADS: Hospital Anxiety and Depression Scale; MADRS: Montgomery-Asberg Depression Rating Scale; POMS: Profile of Mood States.

eTable 4. Overview of results of meta-analyses using mean differences for anxiety and depression.

	Reviews	Studies	Participants	Mean difference			Standardised mean difference (95% CI)
				25%ile	Median	75%ile	
Depression (instrument)							
Profile of Mood States	1	2	65		-7.68		-0.96 (-1.47, -0.44)
Beck Depression Inventory	2	7	>134	-6.24	-5.53	-4.81	-0.69 (-1.04, -0.34)
The Edinburgh Postnatal Depression Scale	2	19	1110	-3.49	-2.97	-2.44	-0.74 (-0.86, -0.62)
Self-rating scale	1	6	415		-3.99		-0.79 (-0.99, -0.59)
Brief Symptom Inventory 18	1	2	92		-3.02		
Center for Epidemiological Studies Depression	4	6	847	-1.25	-0.36	0.02	-0.72 (-0.85, -0.58)
Montgomery-Asberg Depression Rating Scale	1	1	117		-1.80		-0.33 (-0.74, -0.07)
Hospital Anxiety and Depression Scale	8	15	622	-1.41	-1.26	-1.18	-0.18 (-0.33, -0.02)
Anxiety (Instrument)							
The State-Trait Anxiety Inventory	3	4	262	-6.01	-3.61	-1.66	-0.51 (-0.76, -0.27)
Brief Symptom Inventory-18	1	2	92		-5.45		-0.49 (-0.91, -0.08)
Self-rating scale	1	6	415		-4.57		-0.41 (-0.61, -0.22)
Hospital Anxiety and	10	22	3360	-1.13	-1.26	-0.79	-0.21 (-0.27, -0.14)

Depression Scale							

eFigure 5. Results of meta-analyses that assessed anxiety using mean differences.



BSI-18: Brief Symptom Inventory-18; HADS: Hospital Anxiety and Depression Scale; STAI: The State-Trait Anxiety Inventory.

Figure 6. Results of subgroup meta-analyses for depression based on physical activity mode.

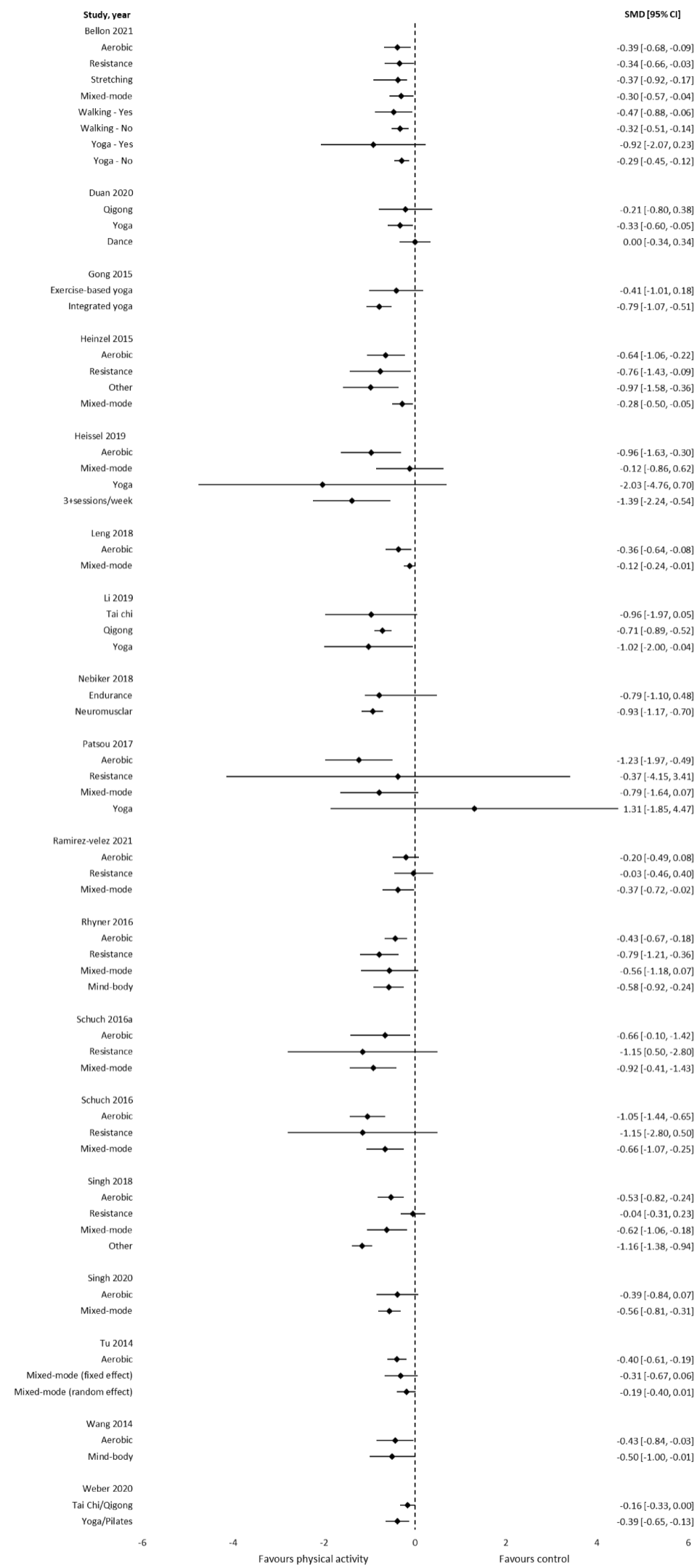
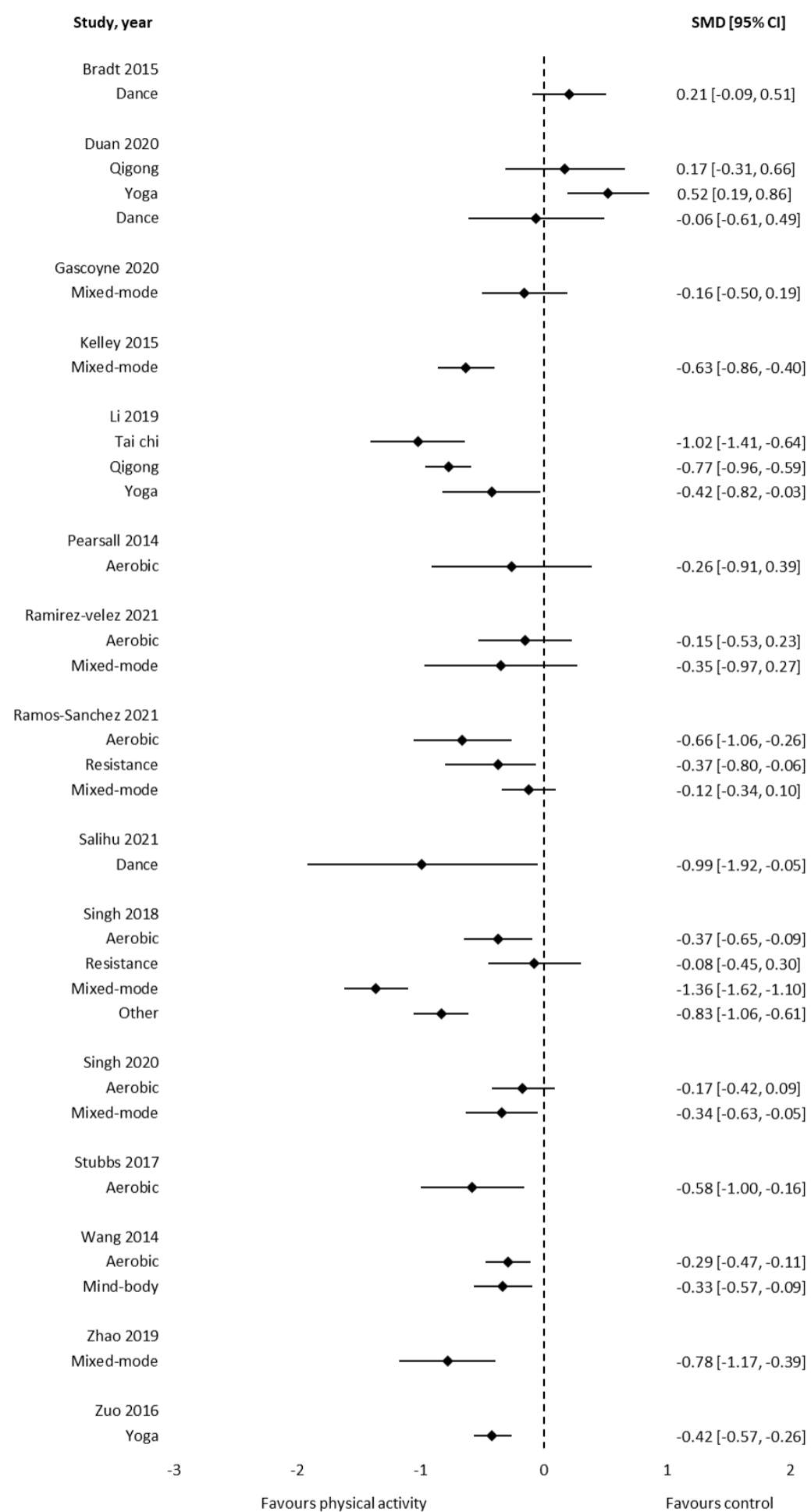


Figure 7. Results of subgroup meta-analyses for anxiety based on physical activity mode.



eFigure 8. Results of subgroup meta-analyses for depression based on physical activity intensity.

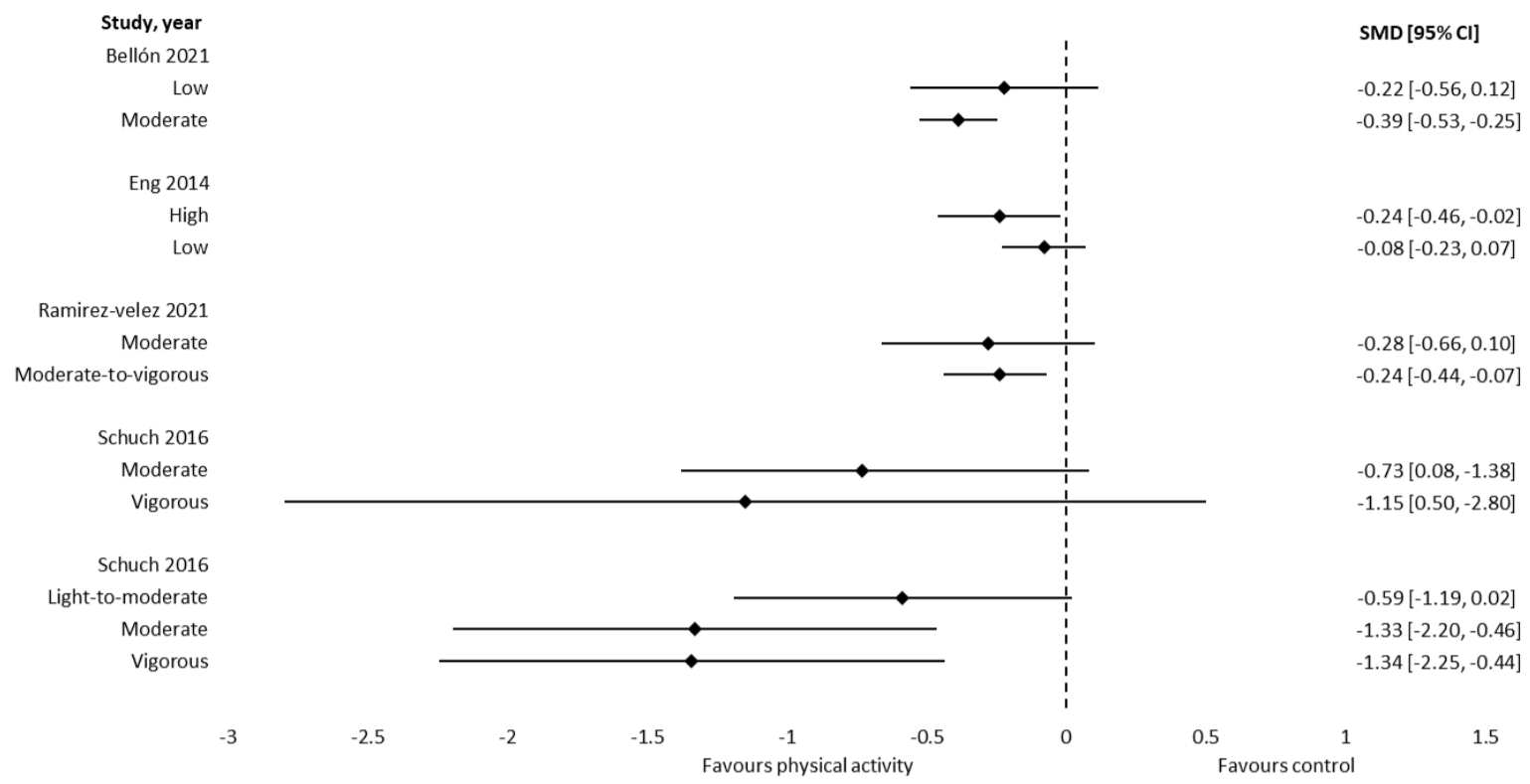


Figure 9: Results of subgroup meta-analyses for anxiety based on physical activity intensity.

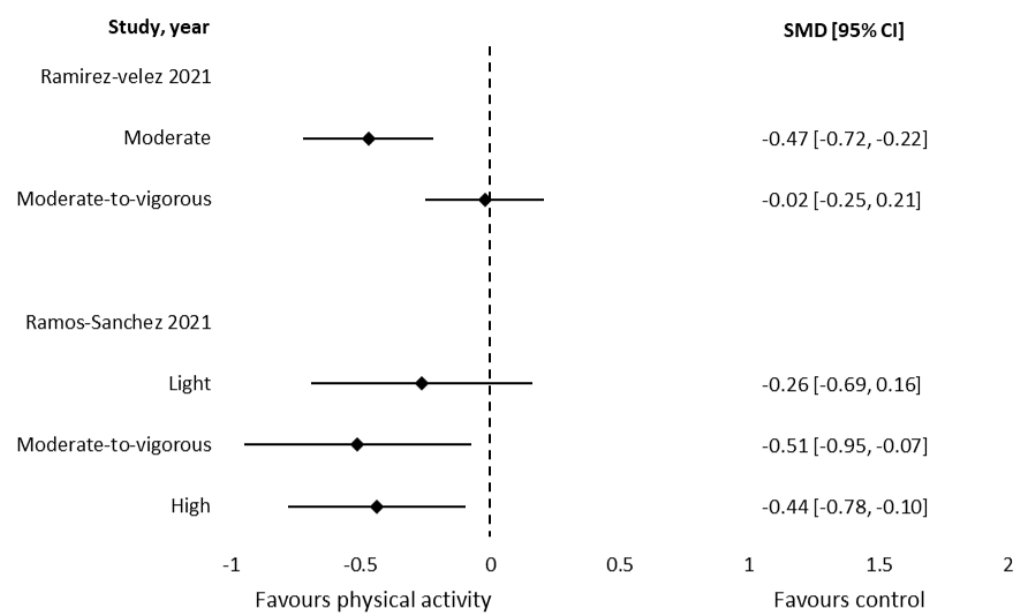


Figure 10: Results of subgroup meta-analyses for depression based on intervention duration.

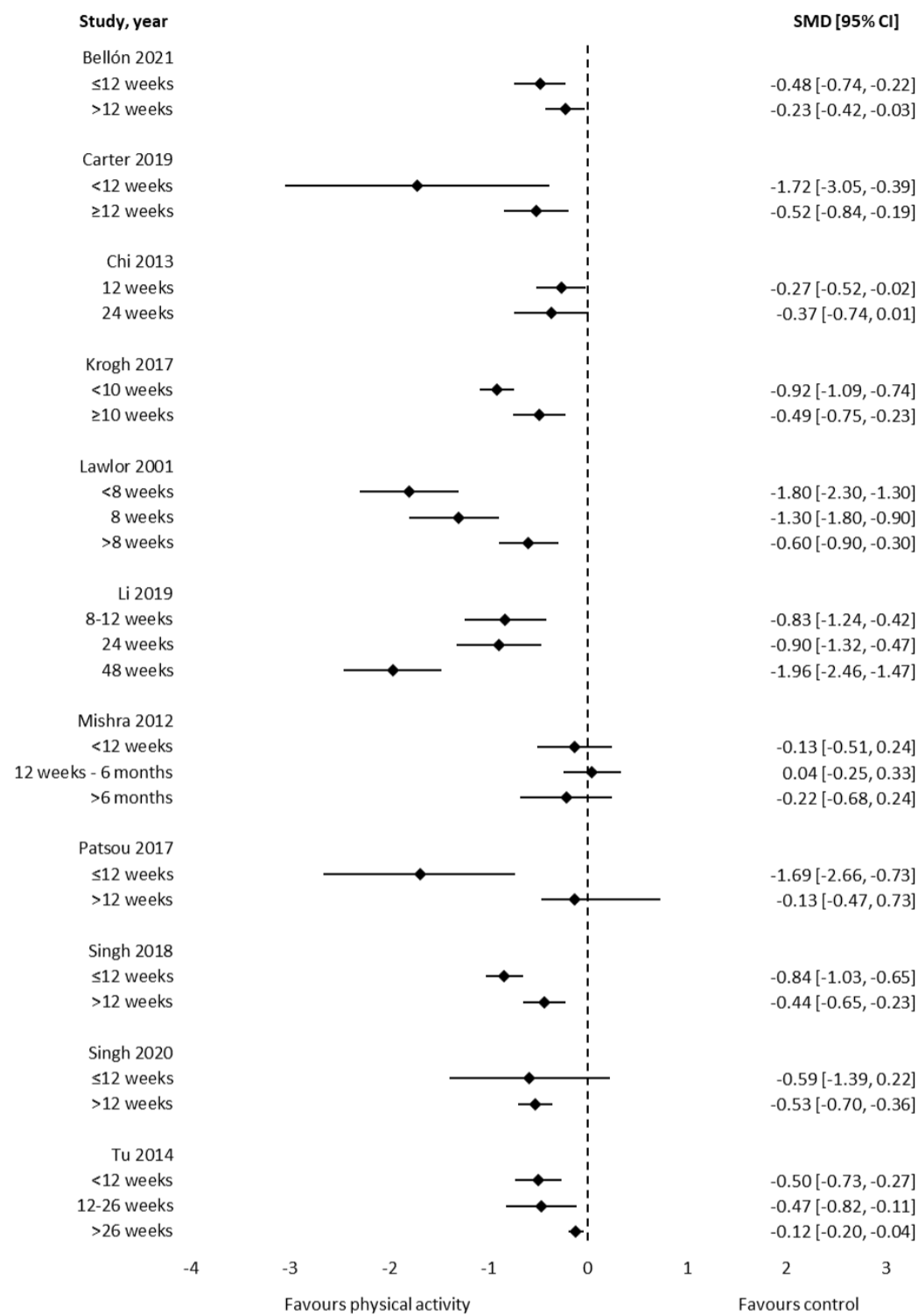


Figure 11: Results of subgroup meta-analyses for anxiety based on intervention duration.

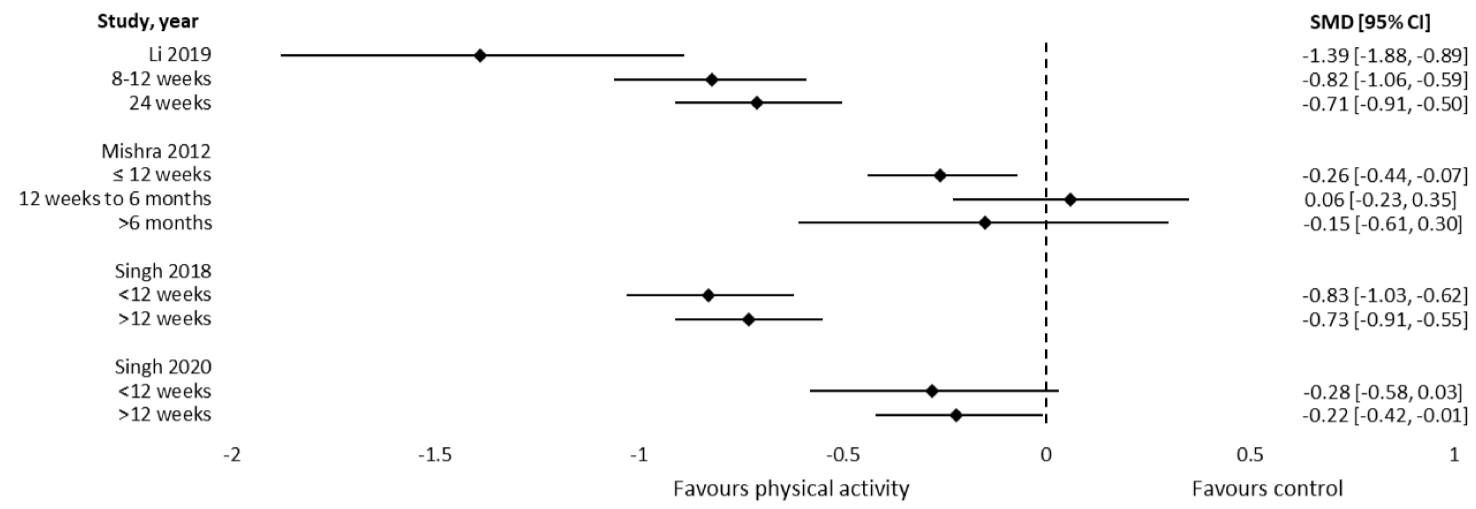


Figure 12: Results of subgroup meta-analyses for depression based on weekly duration.

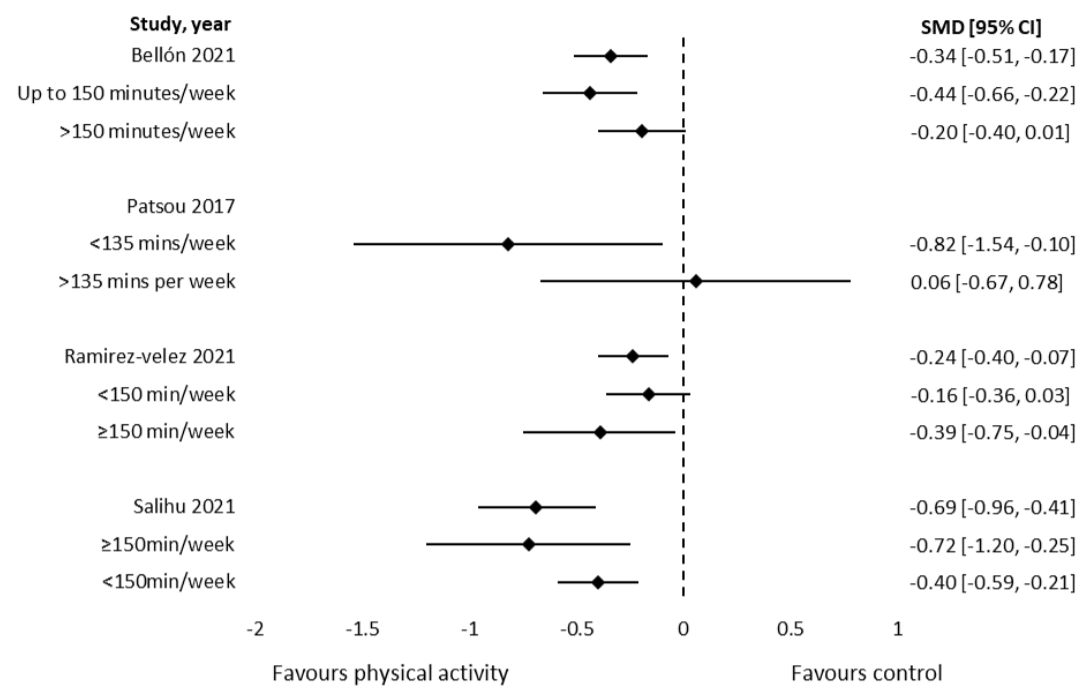
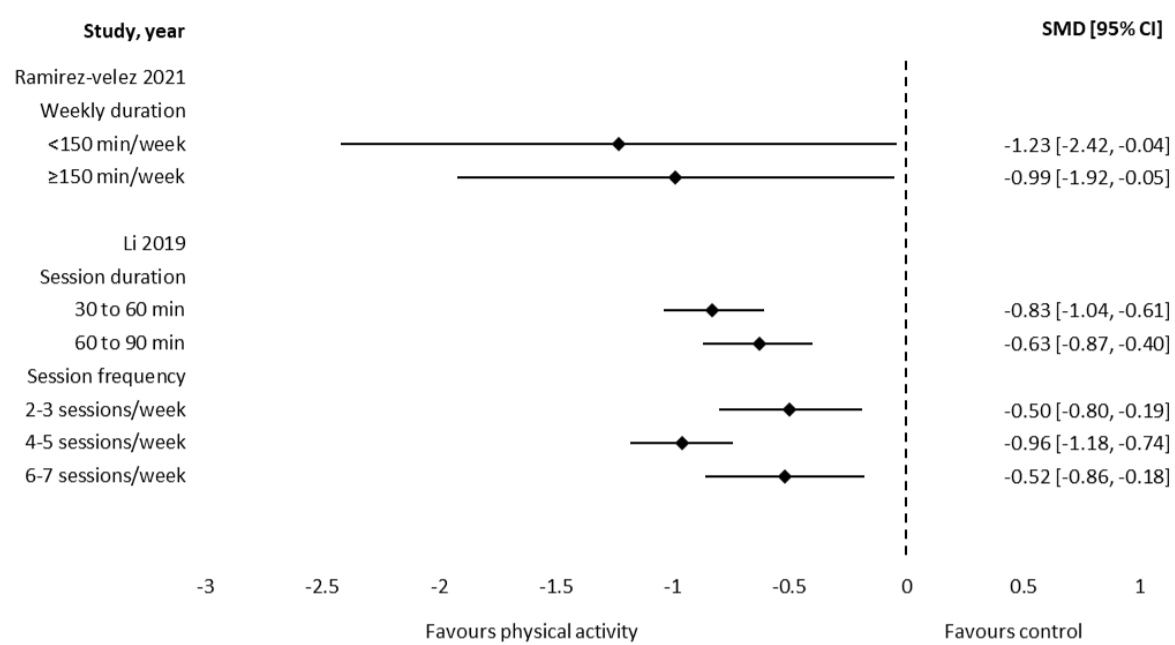
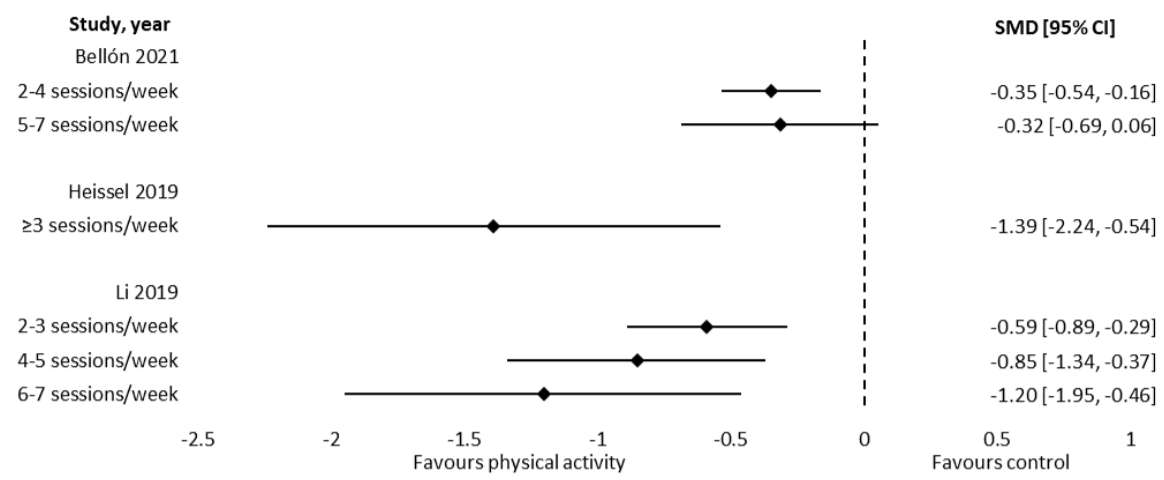


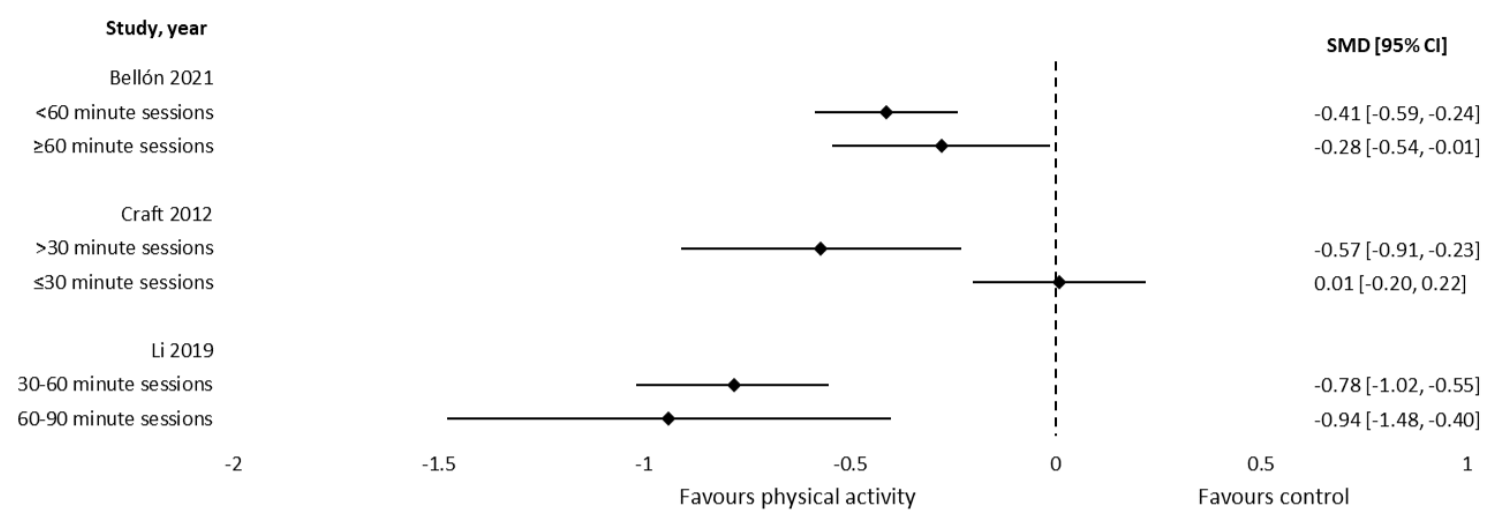
Figure 13: Results of subgroup meta-analyses for anxiety based on weekly duration, session duration and session frequency.



eFigure 14: Results of subgroup meta-analyses for depression based on session frequency.



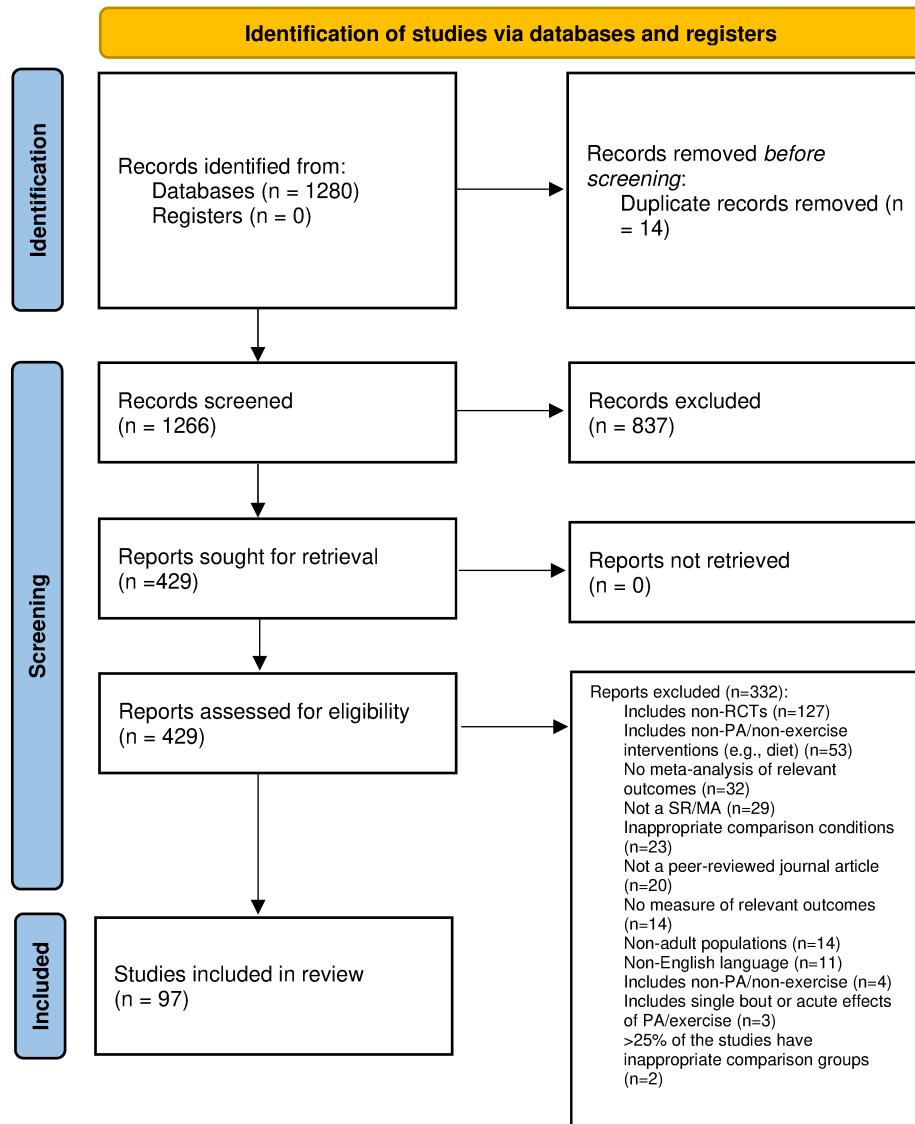
eFigure 15: Results of subgroup meta-analyses for depression based on session duration.



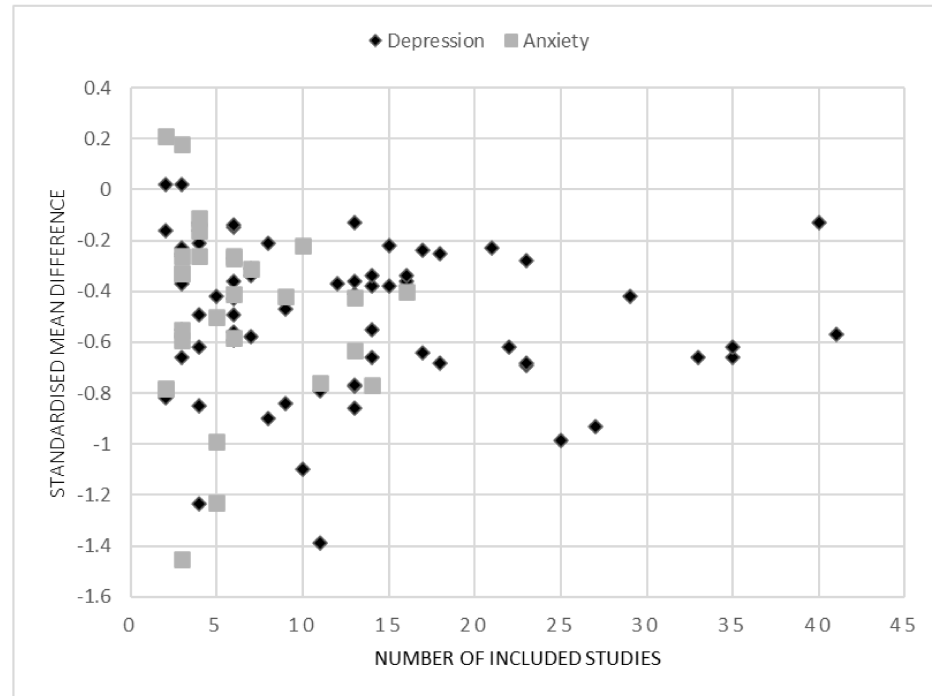
eTable 1. Medline search strategy and terms

MEDLINE(R) ALL <1946 to November 12, 2021> Ovid MEDLINE(R) ALL <1946 to November 19, 2021>	
1 Meta-Analysis as Topic/ 2 meta analy\$.tw. 3 metaanaly\$.tw. 4 Meta-Analysis/ 5 Systematic Review/ [addition] 6 Systematic Reviews as Topic/ [addition] 7 (systematic adj (review\$1 or overview\$1)).tw. 8 exp Review Literature as Topic/ 9 or/1-8 10 cochrane.ab. 11 embase.ab. 12 (psychlit or psyclit).ab. 13 (psychinfo or psycinfo).ab. 14 (cinahl or cinhal).ab. 15 science citation index.ab. 16 bids.ab. 17 cancerlit.ab. 18 or/10-17 19 reference list\$.ab. 20 bibliograph\$.ab. 21 hand-search\$.ab. 22 relevant journals.ab. 23 manual search\$.ab. 24 or/19-23 25 selection criteria.ab. 26 data extraction.ab. 27 25 or 26 28 Review/ 29 27 and 28 30 Comment/ 31 Letter/ 32 Editorial/ 33 animal/	34 human/ 35 33 not (33 and 34) 36 or/30-32,35 37 9 or 18 or 24 or 29 38 37 not 36 39 exp exercise/ 40 exp exercise therapy/ 41 exp sports/ 42 Physical Fitness/ 43 (physical* adj5 (fit* or train* or activ* or endur* or exer*)).ti,ab. 44 (exercis* adj5 (train* or physical* or activ*)).ti,ab. 45 sport*.ti,ab. 46 walk*.ti,ab. 47 swim*.ti,ab. 48 pilates.ti,ab. 49 step*.ti,ab. 50 HIIT.ti,ab. 51 (tai ji or tai chi or tai-ji or tai-chi).ti,ab. 52 (resistance adj3 train*).ti,ab. 53 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 54 38 and 53 55 depress*.ti,ab. 56 anxiety.ti,ab. 57 distress.ti,ab. 58 55 or 56 or 57 59 54 and 58 60 food.ti,ab. 61 diet*.ti,ab. 62 nutriti*.ti,ab. 63 59 not (60 or 61 or 62)

eFigure 1. PRISMA flow diagram.



eFigure 2. Funnel plot showing the relationship between systematic review-level standardised mean differences and the number of studies included in each meta-analysis for depression and anxiety.



eTable 2. Overview of all included studies.

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Adamson 2015	26	1324	Neurological disorders; males and females; mean±SD and range NR	AE, RE, Yoga, Tai Chi, Qigong, gymnastics; various intensities; 4w-52w	1) Depression (BDI, BDI-II, CES-D, CESD-10, CSDD, GDS, HADS, IDS-SR, Levine-Pilowsky depression questionnaire, MADRS, MDI, POMS)	Critically low
Aylett 2018	15	675	Anxiety; males and females; mean±SD and range NR	AE, RE; various intensities; 2w-10w	1) Anxiety (PSWQ, Liebowitz Social scale, Anxiety Sensitivity Index, BAI, STAI)	Critically low
Barreto 2015	20	1627	Dementia; males and females; mean±SD and range NR	AE, RE, Tai Chi, dance; various intensities; 6w-1y	1) Depression (GDS-15, GDS-30, MADRS, GSDD)	Critically low
Bellón 2021	14	1737	Adults without depression; males and females; 44.7±18.6	AE, RE, Yoga; various intensities; 4w-2y	1) Depression (HADS, PHQ-9, BDI, SCID-I, EPDS, POMS, CES-D, BDI-FS, GDS, BDI-II)	Critically low
Bergenthal 2014	9	818	Haematological cancer; males and females; 50.7±2.4	AE, RE; various intensities; 10d-36w	1) Depression (not specified) 2) Anxiety (not specified)	High
Bradt 2015	3	207	Breast cancer; females; 55.4±4.8	Dance; various intensities; 3w-12w	1) Depression (POMS, HADS) 2) Anxiety (HADS, Symptom Checklist 90-Revised)	High
Bridle 2012	9	667	Older adults with depression; males and females; 75.7±6.8	AE, RE, Tai Chi, Qigong; various intensities; 12w-1y	1) Depression (PHQ-9, GDS, HSCL-20, CES-D, HRSD, BDI, CSDD)	Low
Brinsley 2020	19	1080	Mental disorders; males and females; 38.5±9.4	Yoga; various intensities; 5w-12w	1) Depression (PANSS, HDRS, CES-D, HAD-C, FBGL, DASS-21, CDS, BDI, CAPS, HAM-D-21, QIDS)	Critically low
Broderick 2015	8	457	Schizophrenia; males and females; mean±SD and range NR	Yoga; various intensities; 4w-16w	1) Depression (Calgary Depression Scale)	Low
Brown 2012	40	2929	Cancer; males and females; 51.3±6.5	AE, RE, Yoga; various intensities; 3w-1y	1) CES-D, Center for Epidemiologic Studies Depression scale; POMS, Profile of Mood States; BDI, Beck Depression Inventory; HADS, Hospital Anxiety and Depression Scale; Symptom Assessment Scale.	Critically low
Carneiro 2020	4	295	Depression; males and females; 61.1±14.4	RE; various intensities; 10w-16w	1) Depression (HAM-D, CES-D, GDS, BDI)	Low
Carter 2019	18	1428	Postnatal women; females; 29.3±2.9	AE, RE; various intensities; 6w-14m	1) Depression (DASS, EPDS, GHQ12, HDRS, IDAS, PHQ, SCID, SF-36, HAM-D, SCID-PN diagnosis, SF-36v2, CES-D, PHQ-9, SCID-I)	Low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Chi 2013	4	253	Older adults with depressive symptoms; males and females; mean±SD NR; age range=52-82	Tai Chi; low-intensity; 12w-24w	1) Depression (DASS-21, CES-D)	Critically low
Choo 2020	13	869	Chronic diseases; males and females; 67.2±3.5	Tai Chi; low-intensity; 10w-24w	1) Depression (CES-D, Zung depression scale, Depression, Anxiety, and Stress Scales)	Low
Chung 2017	17	651	End Stage Renal Disease; males and females; mean±SD and range NR	AE, RE; various intensities; 8w-48w	1) Depression (Zung depression scale, BDI, SF-36)	Critically low
Cooney 2013	39	2326	Depression; males and females; 52.7±19.3	AE, RE; various intensities; 10d-16w	1) Depression (Hamilton Rating Scale for Depression, BDI, BDI-II, Lubin's Depression Adjective List, Zung Depression Scale, MADRS, HAM-D, Global Assessment Scale, CES-D, POMS, Cornell Scale for Depression in Dementia, GDS)	High
Coventry 2007	6	545	COPD; males and females; 65.3±2.9	AE, RE; various intensities; 5w-1y	1) Depression (HADS, Lorr-McNair Mood Questionnaire, CES-D, SCL-90-R) 2) Anxiety (HADS, STAI-State Anxiety, SCL-90-R)	Critically low
Craft 2012	15	1371	Cancer; males and females; 55.1±7.8	AE, RE; various intensities; 6w-6m	1) Depression (CES-D Short Form, CES-D, BDI-II, HADS)	Critically low
Dalgas 2015	15	591	Multiple sclerosis; males and females; 46.7±6.3	AE, RE, water aerobics, yoga, sports climbing; various intensities; 3w-26w	1) Depression (BDI-I, BDI-II HADS-D, MDI, CES-D, IDS-SR30, POMS)	Critically low
deAlmeida 2020	16	1129	Dementia; males and females; 77.3±7.3	AE, RE; various intensities; 6w-2y	1) Depression (Cornell Scale for Depression in Dementia, NPI Depression, GDS – Short Form) 2) Anxiety (Generalized Anxiety Disorder 7-item, NPI Anxiety)	Critically low
Duan 2020	15	1461	Cancer; males and females; 54.6±6.6	Yoga, Qigong, Tai Chi, Dance; various intensities; 3w-24w	1) Depression (HADS, BDI, CES-D, PHQ-9) 2) Anxiety (FACT-B, FACT-C, SF-12, FACT-G) 3) Distress (Perceived Stress Scale General Quality of Life: FACT-G, FACT-B, EORTC-QLQ-C-30)	Critically low
Eng 2014	13	1022	Stroke; males and females; mean±SD NR; age range=21-93	AE, RE; various intensities; 4-12w	1) Depression (HADS, GDS, BDI, CES-D)	Critically low
Ensari 2014	13	477	Multiple sclerosis; males and females; 45.1±5.8	AE, RE, water aerobics, yoga; various intensities; 4-26w	1) Depression (BFI, IFD, MDI, BDI-II, HADS, CES-D, POMS, POMS-SF)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Felbel 2014	1	39	Haematological cancer; males and females; 51	Yoga; low intensity; 7w	1) Depression (CES-D) 2) Anxiety (STAI) 3) Distress (Impact of Events Scale)	High
Ferreira 2021	8	376	Kidney disease; males and females; 51.7±8.6	AE, RE, Pilates, intradialytic exercise; various intensities; 4w-48w	1) Depression (HADS, DASS, BDI, General Health Dimensions - depression subscale) 2) Anxiety (HADS, DASS)	Critically low
Fong 2012	34	4113	Cancer; males and females; 55.7±5.8	AE, RE, Yoga; various intensities; 3w-60w	1) Depression (HADS, BDI) 2) Anxiety (HADS)	Critically low
Forbes 2008	4	280	Dementia; males and females; mean±SD and range NR	AE, RE; various intensities; 2w-1y	1) Depression (MADRS)	Low
Furmaniak 2016	32	2626	Breast cancer; females; mean±SD and range NR	AE, RE; various intensities; 6w-1y	1) Depression (BDI, CES-D, HADS) 2) Anxiety (STAI, HADS)	High
Gascoyne 2020	4	133	Multiple sclerosis; males and females; 43.9±7.6	AE, RE; various intensities; 8w-26w	1) Anxiety (POMS, HADS, STAI, BAI)	Critically low
Gong 2015	6	375	Pregnant women; females only; mean±SD NR; range = 18-40	Yoga; various intensities; 12w-16w	1) Depression (CES-D, HADS, EPDS)	Critically low
Gordon 2018	33	1877	Adults with or without chronic conditions; males and females; 52±18	RE; various intensities; 6w-1y	1) Depression (BDI, GDS, CES-D, MDI, MHFI, DACL, HRSD, BRUMS-D, HADS, POMS, SCL-90-D, DSM, DASS-21)	Critically low
Gouw 2019	13	1340	Older adults with chronic disease; males and females; 70.4±6.2	Qigong; low intensity; 8w-26w	1) Depression (GDS, HADS, HRSD, Self-rating scale)	Critically low
Guo 2020	16	1096	COPD, males and females; 67.4±4.9	Tai Chi; various intensities; 2w-1y	1) Depression (HADS, Self-rating scale) 2) Anxiety (HADS, Self-rating scale)	Critically low
Hall 2021	17	1456	Knee osteoarthritis; males and females; 65.9±4.6	AE, RE, Yoga, Tai chi, Qigong; various intensities; 6w-1y	1) Depression (HADS, CES-D) 2) Anxiety (HADS)	Critically low
Heinzel 2015	18	1063	Older adults; males and females; 71.9±6.0	AE, RE, Tai chi, Qigong; various intensities; 6w-26w	1) Depression (HADS, HDG, HAM-D, PHQ-9, BDI, DSM-IV diagnostic criteria)	Critically low
Heissel 2019	10	479	HIV; males and females; mean±SD and range NR	AE, RE, Yoga; various intensities; 4w-12w	1) Depression (BDI, GHQ-28, POMS, HADS) 2) Anxiety (GHQ-28, POMS, HADS, STAI)	High

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Herring 2017	14	624	Multiple Sclerosis; males and females; 44±6.6	AE, RE, Yoga; various intensities; 3w-26w	1) Depression (BDI, CES-D, HADS, IDS-SR, POMS, MDI)	Critically low
Josefsson 2014	15	880	Depression; males and females; 46.3±13	AE, RE; various intensities; 4w-16w	1) Depression (HRSD, BDI, MARDS, PHQ-9, MMPI)	Critically low
Kelley 2018	14	926	Arthritis and rheumatic diseases; males and females; 54.5±8.9	AE; RE; various intensities; 8w-32w	1) Depression (AIMS, BDI, CES-D, DASS-21, FIQ, HADs, MHI, VAS) 2) Anxiety (STAI, AIMS, HADS, DASS-21, MHI, FIQ, VAS)	High
Kelley 2015	29	2449	Arthritis; males and females; 52.3±9.7	AE, RE, Tai chi, Qigong; various intensities; 4w-32w	1) Depression (BDI, CES-D, DASS-21, MIH, FIQ, AIMS, POMS, HADS, VAS)	High
Krogh 2017	35	2498	Depression; males and females; 44±12.8	AE, RE; various intensities; 2w-32w	1) Depression (HAM-D17, SCL-D, BDI, MADRS, PHQ-9)	Low
Kvam 2016	23	977	Depression; males and females; 36.9±14.4	AE, RE; various intensities; 1w-8m	1) Depression (HAMD-17, MDD, BDI, BDI-II, SCL-90)	Critically low
Lawlor 2001	14	479	Depression; males and females; 44.7±17	AE, RE; various intensities; 4w-12w	1) Depression (BDI, Depression symptom checklist)	Critically low
Lawrence 2017	2	72	Stroke; males and females; 59.5±4.6	Yoga; various intensities; 8w-10w	1) Depression (GDS15) 2) Anxiety (STAI, STAI-Y1, STAI-Y2, Stroke Impact Scale version 3)	Critically low
Lee 2021	22	1025	Depression; males and females; 48.5±12.6	AE, RE; various intensities; 10d-24w	1) Depression (BDI-II, HAM-D, BDI, MADRS, MARDS-S, BRMS, GDS)	Critically low
Lee 2020	29	2989	Breast cancer; females; 50±7.7	AE, RE; Yoga; various intensities; 4w-26w	1) Depression (HADS, CES-D) 2) Anxiety (HADS, Spielberger State-Anxiety Inventory)	Critically low
Leng 2018	21	2589	Cognitive impairment; males and females; 76.3±5.9	AE, RE, Tai Chi, Yoga; various intensities; 6w-1y	1) Depression (CSDD, GDS, Depression Rating Scale, BDI, HAMD)	Critically low
Liu 2019	6	429	Lymphoma; males and females; 53.6±6.4	AE, Yoga, Qigong; various intensities; 3w-36w	1) Depression (CES-D)	Critically low
Li 2019	13	906	COPD; males and females; 63.9±6.9	Yoga, Qigong, Tai chi, various intensities; 8w-48w	1) Depression (CES-D, SSAI, HADS, BDI, Self-rating scale, HAMD) 2) Anxiety (HADS, STAI, Self-rating scale, HAMA)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Li 2019	20	2051	Dementia; males and females; 80.9±5.1	AE, RE, dance; various intensities; 6w-18m	1) Depression (HAMD-17, GDS, CSDD, MADRS)	Critically low
Lund 2020	8	552	Colorectal cancer; males and females; 58±4.6	AE, RE; various intensities; 6w-24w	1) Depression (HADS, BDI)	Critically low
Lyu 2021	11	732	Stroke patients with mental or sleep disorders; males and females; 62.2±6.6	Tai Chi; low intensity; 6w-24w	1) Depression (CES-D, HAM-D, BDI) 2) Anxiety (HAMA)	Critically low
McCurdy 2017	16	1327	Postpartum women, females; 29.6±2.8	AE, RE, Yoga; various intensities; 6w-1y	1) Depression (EPDS, CES-D, HAMD)	Critically low
McGettigan 2020	16	992	Colorectal cancer; males and females; 59.5±4.6	AE, RE; various intensities; 6w-1y	1) Depression (HADS, CES-D) 2) Anxiety (HADS, STAI)	Low
McGranahan 2021	4	149	PTSD; males and females; 44.7±16.3	AE, RE; various intensities; 3w-12w	1) Depression (CES-D, DASS, PHD) 2) Anxiety (STAI, DASS)	Critically low
Miller 2020	69	5379	Older adults; males and females; 73.4±5.6	AE, RE, Yoga, Tai Chi, Qigong; various intensities; 4w-15m	1) Depression (BDI, CESD-20, POMS-D, GDS-15, GDS-30, BDI-II, MADRS, GADS-D, CSDD, TDQ, HADS-D, HRSD, DASS-D, IDS-C, GDS-5, POMS-SF-D, CESD-10, PROMIS-EDD SF-8a, CESD-6)	Low
Miller 2020	15	596	Older adults with depression; males and females; 73.9±5.9	AE, RE, Yoga, Tai Chi, Qigong, dance; various intensities; 4w-16w	1) Depression (GDS-15, CESD-20, GDS-30, HRSD, BDI, CSDD)	Low
Mishra 2012	40	3694	Cancer; males and females; 53.3±5.4	AE, RE, Yoga, Tai Chi, Qigong; various intensities; 3w-1y	1) Depression (CES-D, HADS, BDI, VAS, POMS) 2) Anxiety (HADS, STAI, VAS, POMS)	High
Morres 2019	11	455	Depression; males and females; Mean (SD) = 37 (9.4); range = 20.9-49.1	AE; various intensities; 10d-32w	1) Depression (HAMD-17, BDI, CIS, MADRS)	Critically low
Nebiker 2018	27	1452	Depression; males and females; 49.5±16.0	AE, RE, Yoga, Tai Chi; various intensities; 10d-32w	1) Depression (BDI, BDI-II, HRSD, CES-D, GDS-15, GDS, HAM-D, MADRS, PHQ-9)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Nixon 2005	10	276	HIV/AIDS; males and females; mean±SD NR; age range=18-58	AE, RE; various intensities; 5w-24w	1) Depression (POMS)	Critically low
Park 2014	18	3297	Older adults; males and females; mean±SD and range NR	AE, RE, Yoga, Tai Chi, dance; various intensities; 4w-2y	1) Depression (GDS, GDS-15, HADS, Zung Self-rating depression scale, CES-D)	Critically low
Patsou 2017	14	1701	Breast cancer; females; 52.1±2.9	AE, RE, Yoga; various intensities; 6-1y	1) Depression (HADS, BDI-II, CES-D, POMS)	Critically low
Pavey 2011	8	5109	Adults; males and females; 59±7	AE; various intensities 8w-52w	1) Depression (not specified)	Critically low
Pearsall 2014	8	374	Schizophrenia; males and females; mean±SD NR; range = 27-52	AE; various intensities 10w-24w	1) Depression (BSI, WHOQOL-BREF-TR, BDI, MHI, CGI-Severity) 2) Anxiety (BSI, WHOQOL-BREF-TR, MHI, CGI-Severity)	Critically low
Peddle-McIntyre6 2019	6	221	Lung cancer; males and female; 60.9±5.3	AE, RE; various intensities; 4w-12w	1) Depression (GHQ-12, HADS) 2) Anxiety (GHQ-12, HADS)	Critically low
Pentland 2021	5	242	Postpartum women; females; 30±3.5	AE, RE; various intensities; 12w-6m	1) Depression (EPDS)	Critically low
Ramachandran 2021	14	2869	Heart disease; males and females; 59.4±5.7	AE; various intensities; 6w-6m	1) Depression (Patient Health Questionnaire, CES-D, DASS)	Critically low
Ramirez-velez 2021	57	6988	Breast cancer; females; 52.3±3.3	AE, RE; various intensities; 5w-1y	1) Depression (HADS, FACT-B Depression, BDI, Finnish version of modified BDI, CES-D) 2) Anxiety (HADS, FACT-B Anxiety, Social Physique Anxiety Scale-7, SSAI, State-Trait Anxiety Inventory (STAI))	Critically low
Ramos-Sanchez 2021	13	731	Anxiety disorder; males and females; 39.2±11.7	AE, RE; various intensities; 3w-20w	1) Anxiety (Hamilton Scale for Anxiety, Penn State Worry Questionnaire, Anxiety stress scale, Chinese Mandarin version STAI)	High
Rhyner 2016	41	NR	Older adults; males and females; 73.9±5.2	AE, RE, Yoga, Tai Chi, Qigong; various intensities; 3w-144w	1) Depression (GSD, CES-D, GSD-15, BDI, Taiwanese Depression Questionnaire, HSCL-20, DASS, HDRS, Cornell Scale for Depression in Dementia, MADRS)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Rosenbaum 2015	4	200	PTSD; males and females; 43.7±6.7	AE, RE, Yoga; various intensities; 6w-12w	1) Depression (PSS-I, PCL-C, CAPS)	Critically low
Russ 2021	9	456	Dementia; males and females; 85.5±1	RE; various intensities; 12w-7m	1) Depression (GDS, CCSD, MADRS)	Critically low
Salihu 2021	28	2249	Adults; males and females; 65.3±16	Dance; various intensities; 10d-1y	1) Depression (BDI, GDS, POMS, CESD, HADS, DASS-21) 2) Anxiety (Test Anxiety Inventory, DASS-21, HADS, STAI)	Critically low
Schuch 2016	8	267	Older adults with depression or depressive symptoms; males and females; 69.5±0.71	AE, RE; various intensities; 6w-16w	1) Depression (HAM-D, GDS-15, BDI, GDS, PHQ-9, CES-D, CSDD)	Critically low
Schuch 2016	25	1487	Depression or depressive symptoms; males and females; 50.9±17.1	AE, RE; various intensities; 4w-32w	1) Depression (HAM-D, BDI, BDI-II, MARSD, GDS-15, CES-D, PHQ-9, DACL, MMPI, CSDD)	Critically low
Schumacher 2021	7	391	Prostate cancer, males; 67.9±1.5	AE, RE; various intensities; 4w-24w	1) Depression (CES-D, BDI)	Critically low
Singh 2018	61	5200	Breast cancer; females; 53±3.6	AE, RE, Yoga; various intensities; 6w-1y	1) Depression (POMs, HADs, CES-D, Greene Climacteric Scale, NDI, Functional Living Index of Cancer) 2) Anxiety (POMs, HADs, STAI, FACT-Amemia, Greene Climacteric Scale, SSAI, Social Physique Anxiety Scale, Functional Living Index of Cancer)	Critically low
Singh 2020	31	2109	Lung cancer; males and females; 64±3	AE, RE, Yoga; various intensities; 1w-20w	1) Depression (HADs, GHQ) 2) Anxiety (HADs, GHQ)	Critically low
Stathopoulou 2006	11	513	Depression; males and females; mean±SD and range NR	AE, RE; various intensities; 4w-16w	1) Depression (HRSD, EPSD, BDI, Self-rating scale, Depression - Symptom Checklist 90)	Critically low
Stubbs 2017	6	262	Anxiety or stress disorder; males and females; 34.7±9.6	AE; various intensities; 6w-12w	1) Anxiety (HAM-A, Penn State Worry Questionnaire, PSWQ, DASS21, PTSD symptom scale, PSSI, PTSD checklist-civilian version)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Tu 2014	19	3447	Heart failure; males and females; 63.7±7.8	AE, RE, Tai Chi; various intensities; 6w-76w	1) Depression (Depression - Symptom Checklist 90, HADS, BDI, BDI-II, MADRS, Multiple Affect Adjective Checklist, GDS, HAM-D, Cognitive Behavioural Assessment Hospital form, CES-D, Psychological General Well-being Index, Hare-Davis Cardiac Depression Scale, POMS)	Critically low
vanHaren 2013	11	734	Cancer; males and females; mean±SD and range NR	RE, AE; various intensities; 4w-24w	1) Depression (POMS, HADS) 2) Anxiety (POMS, HADS) 3) Distress (Self-perception scale of physical and emotional well-being)	Critically low
Vashistha 2016	13	1057	Prostate cancer; males; 69.2±2.3	AE, RE, Qigong; various intensities; 4w-6m	1) Depression (BSI-18) 2) Anxiety (BSI-18)	Critically low
Wang 2014	22	2894	Substance use disorder; males and females; 38.9±5.8	AE, RE, Yoga, Tai Chi, sports; various intensities; 10d-6m	1) Depression (BDI, CES-D, Self-rating depression scale, HADS) 2) Anxiety (Self-rating scale, Hamilton Anxiety Scores, Mood and Physical Symptoms Scale-anxiety, STAI)	Critically low
Wang 2019	12	516	Heart failure; males and females; mean±SD NR; range = 43-74	AE, RE; various intensities; 8w-48w	1) Depression (not specified)	Critically low
Weber 2020	37	3224	Older adults; males and females; 72.2±7.3	Tai Chi, Qigong, Yoga, Pilates; various intensities; 4w-1y	1) Depression (GDS, GDS-SF, HADS, BDI, BDI-II, CES-D, DASS-21, MHI-18, POMS, POMS-SF, Taiwanese Depression Questionnaire, Warwick-Edinburgh Mental Well-being Scale)	Critically low
Wu 2019	6	415	COPD; males and females; 66.3±4.6	Qigong; various intensities; 4w-24w	1) Depression (Self-rating scale) 2) Anxiety (Self-rating scale)	Critically low
Xiang 2017	10	689	Fatigue; males and females; mean±SD NR; range=18-88	Tai Chi; various intensities; 4w-6m	1) Depression (POMS, POMS-SF, IDS-C, CES-D, BDI, BDI-II)	Critically low
Yi 2021	7	693	Breast cancer; females; 50.4±3.5	Yoga; various intensities; 8w-16w	1) Depression (BDI, POMS, HADS, Self-rating scale, CES-D) 2) Anxiety (POMS, HADs, Self-rating scale)	Critically low
Zeng 2019	12	915	Cancer; males and females; 62.2±4.3	Qigong; various intensities; 6w-12w	1) Depression (DASS, HADS) 2) Anxiety (DASS, HADS) 3) Stress (BSI, FACT-G)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Zeng 2014	13	592	Cancer; males and females; mean±SD and range NR	Tai Chi; various intensities; 6w-24w	1) Depression (BDI, CES-D) 2) Anxiety (BAI)	Critically low
Zeng 2019	10	838	Cancer; males and females; 52.5±4.1	AE, RE; various intensities; 8w-96w	1) Depression (Not specified)	Critically low
Zhang 2019	5	803	Older adults with mild cognitive impairment; males and females; 74.8±5.7	Tai Chi; various intensities; 12w-1y	1) Depression (CDS)	Critically low
Zhao 2019	13	614	End-stage renal disease; males and females; 54.58±11.68	AR, RE, Yoga; various intensities; 8w-1y	1) Depression (BDI, HADS) 2) Anxiety (HADS)	Critically low
Zhou 2021	8	570	Lung cancer; males and females; 64.4±2.1	AR, RE, Tai Chi; various intensities; 6w-12w	1) Depression (HADS, GHQ-12) 2) Anxiety (HADS, GHD)	Critically low
Zuo 2016	21	1762	Breast cancer; females; 42.6±4.7	Yoga; various intensities; 2w-24w	1) Depression (HADS, BDI, CES-D, DMI, Self-rating scale) 2) Anxiety (HADS, STAI, Self-rating scale) 3) Distress (Positive and Negative Affect Schedule, Subjective Symptom Checklist, The Rotterdam Symptom Checklist)	Critically low
Abbreviations: AE: Aerobic exercise; RE: Resistance exercise; NR: Not reported						

eTable 3. AMSTAR 2 quality appraisal of reviews.

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Adamson 2015	Y	N	Y	PY	Y	Y	N	N	Y	N	Y	N	N	Y	N	N	Critically low
Aylett 2018	Y	N	Y	N	Y	Y	Y	Y	Y	N	N	N	N	Y	N	Y	Critically low
Barreto 2015	Y	N	Y	PY	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Bellón 2021	Y	N	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Bergenthal 2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Bradt 2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Bridle 2012	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Low
Brinsley 2020	Y	PY	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	N	Y	Y	Critically low
Broderick 2015	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Low
Brown 2012	Y	N	Y	N	N	Y	N	PY	Y	Y	Y	Y	Y	N	Y	Y	Critically low
Carneiro 2020	Y	PY	Y	Y	Y	N	Y	PY	Y	Y	Y	Y	Y	Y	N	Y	Low
Carter 2019	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Low
Chi 2013	Y	PY	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Critically low
Choo 2020	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Low
Chung 2017	Y	N	Y	N	Y	Y	N	N	Y	N	N	Y	Y	Y	Y	Y	Critically low
Cooney 2013	Y	PY	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Coventry 2007	Y	N	Y	PY	N	Y	N	Y	PY	N	Y	Y	Y	Y	N	Y	Critically low
Craft 2012	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y	Y	Critically low
Dalgas 2015	Y	N	Y	N	N	N	N	Y	Y	N	Y	N	N	Y	N	Y	Critically low
deAlmeida 2020	Y	PY	Y	N	Y	N	N	Y	Y	N	Y	N	N	Y	N	Y	Critically low
Duan 2020	Y	N	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Eng 2014	Y	N	Y	PY	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Ensari 2014	Y	N	Y	PY	N	N	N	N	Y	N	Y	N	Y	Y	Y	Y	Critically low
Felbel 2014	Y	Y	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Ferreira 2021	Y	Y	Y	PY	Y	N	N	N	Y	N	Y	N	Y	Y	N	Y	Critically low
Fong 2012	N	N	N	N	Y	Y	N	PY	N	N	Y	Y	Y	Y	Y	Y	Critically low
Forbes 2008	Y	PY	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	Low
Furmaniak 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Gascoyne 2020	Y	Y	Y	Y	Y	Y	N	PY	N	N	Y	N	N	Y	N	Y	Critically low
Gong 2015	Y	N	Y	PY	N	Y	N	PY	PY	N	Y	N	N	Y	N	Y	Critically low
Gordon 2018	Y	N	Y	N	N	Y	N	PY	Y	N	Y	N	Y	Y	Y	Y	Critically low
Gouw 2019	Y	N	Y	Y	Y	Y	N	PY	Y	N	Y	N	N	N	N	Y	Critically low
Guo 2020	Y	Y	N	N	Y	Y	N	PY	Y	N	Y	Y	N	Y	N	Y	Critically low

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Hall 2021	Y	N	Y	PY	Y	Y	N	PY	Y	N	N	N	N	N	Y	Y	Critically low
Heinzel 2015	Y	N	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	Y	N	Y	Critically low
Heissel 2019	Y	PY	Y	PY	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High
Herring 2017	Y	N	Y	PY	Y	Y	N	Y	Y	N	Y	Y	N	N	Y	Y	Critically low
Josefsson 2014	Y	N	Y	PY	N	N	N	PY	PY	N	Y	Y	Y	Y	N	N	Critically low
Kelley 2018	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Kelley 2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Krogh 2017	Y	Y	Y	PY	N	Y	N	PY	Y	Y	Y	Y	Y	Y	Y	Y	Low
Kvam 2016	Y	N	Y	Y	Y	Y	Y	Y	Y	PY	N	N	Y	Y	N	Y	Critically low
Lawlor 2001	Y	N	Y	Y	Y	Y	Y	Y	Y	PY	N	Y	N	N	Y	N	Critically low
Lawrence 2017	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	N	Critically low
Lee 2021	Y	Y	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y	Y	Y	N	Critically low
Lee 2020	N	N	Y	N	Y	N	N	PY	N	N	N	N	N	N	N	Y	Critically low
Leng 2018	Y	N	Y	PY	Y	Y	N	PY	Y	N	Y	N	N	N	Y	Y	Critically low
Liu 2019	Y	N	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	Critically low
Li 2019	Y	N	Y	PY	Y	Y	N	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Li 2019	Y	N	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	Y	Y	Y	Critically low

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Lund 2020	N	Y	Y	PY	Y	N	N	N	Y	N	N	Y	Y	N	N	Y	Critically low
Lyu 2021	Y	Y	Y	PY	Y	Y	N	PY	Y	N	N	N	N	N	N	Y	Critically low
McCurdy 2017	Y	N	Y	PY	Y	Y	N	PY	Y	N	Y	Y	Y	Y	N	Y	Critically low
McGettigan 2020	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Low
McGranahan 2021	N	N	N	N	N	N	N	PY	N	N	Y	Y	Y	Y	Y	Y	Critically low
Miller 2020	Y	Y	Y	PY	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Low
Miller 2020	Y	Y	Y	PY	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Low
Mishra 2012	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Morres 2019	Y	N	Y	PY	Y	Y	N	PY	Y	N	Y	Y	Y	Y	Y	N	Critically low
Nebiker 2018	Y	N	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	N	Y	Y	Critically low
Nixon 2005	Y	Y	Y	Y	Y	Y	Y	PY	PY	N	Y	N	N	N	N	Y	Critically low
Park 2014	Y	N	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	N	Y	N	Critically low
Patsou 2017	Y	N	Y	N	N	N	N	Y	Y	N	Y	N	N	N	Y	Y	Critically low
Pavey 2011	Y	N	Y	N	Y	N	Y	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Pearsall 2014	Y	N	Y	N	N	N	N	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Peddle-McIntyre 2019	Y	Y	Y	Y	Y	Y	Y	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Pentland	Y	PY	Y	N	Y	Y	N	PY	Y	N	Y	N	N	Y	Y	Y	Critically low

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Ramachandran 2021	Y	N	Y	PY	Y	Y	Y	PY	Y	Y	Y	N	N	Y	N	Y	Critically low
Ramirez-velez 2021	Y	PY	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Ramos-Sanchez 2021	Y	Y	Y	PY	Y	Y	PY	PY	Y	Y	Y	N	Y	Y	Y	Y	High
Rhyner 2016	Y	N	Y	PY	N	N	N	PY	N	N	Y	N	N	N	Y	N	Critically low
Rosenbaum 2015	Y	N	Y	Y	Y	Y	N	PY	PY	N	Y	N	N	Y	Y	N	Critically low
Russ 2021	Y	N	Y	N	Y	N	N	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Salihu 2021	Y	Y	Y	N	Y	N	N	Y	Y	N	Y	Y	Y	Y	N	Y	Critically low
Schuch 2016	Y	N	Y	PY	Y	Y	N	N	Y	N	Y	Y	N	N	Y	Y	Critically low
Schuch 2016	Y	N	Y	PY	Y	Y	N	N	Y	N	Y	Y	Y	N	Y	Y	Critically low
Schumacher 2021	Y	PY	Y	PY	Y	Y	N	N	Y	N	N	N	N	Y	N	N	Critically low
Singh 2018	Y	N	N	Y	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Singh 2020	Y	N	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	N	N	Y	Critically low
Stathopoulos 2006	N	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	Y	N	Critically low
Stubbs 2017	Y	N	Y	Y	Y	Y	N	Y	Y	N	Y	N	N	Y	Y	Y	Critically low
Tu 2014	Y	N	Y	N	N	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Critically low
vanHaren 2013	N	N	Y	N	N	N	N	N	Y	N	Y	Y	N	N	N	N	Critically low
Vashistha 2016	Y	PY	Y	N	Y	Y	N	PY	Y	N	Y	N	N	N	N	Y	Critically low

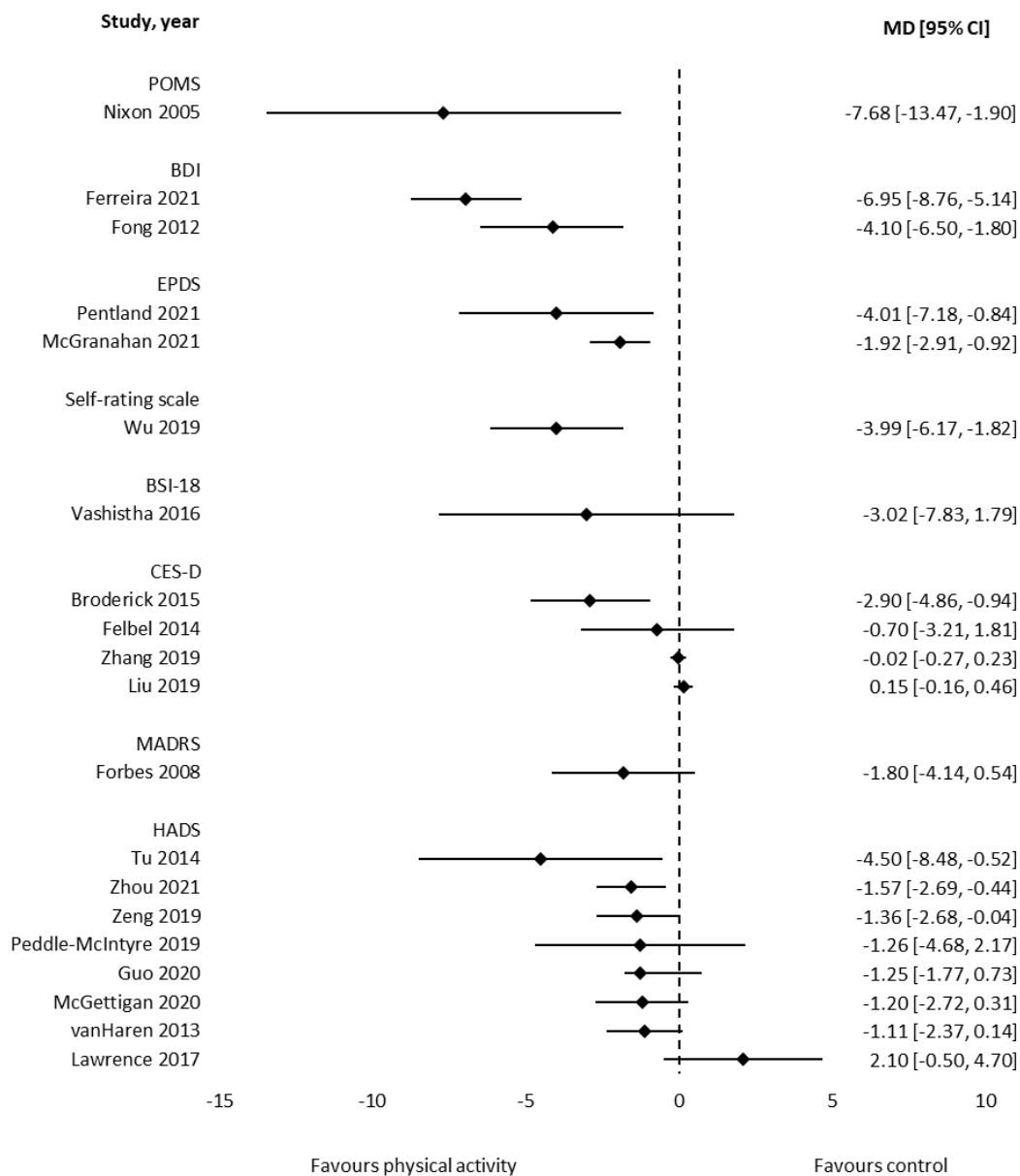
Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Wang 2014	N	N	Y	N	Y	Y	N	PY	PY	N	N	N	N	Y	Y	Y	Critically low
Wang 2019	Y	N	Y	N	Y	Y	N	N	Y	N	N	N	N	N	N	N	Critically low
Weber 2020	Y	N	N	N	N	Y	N	PY	Y	N	N	N	N	N	Y	Y	Critically low
Wu 2019	Y	N	Y	N	Y	Y	N	PY	Y	N	N	N	N	N	N	Y	Critically low
Xiang 2017	Y	Y	Y	N	Y	N	N	PY	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Yi 2021	Y	N	N	N	Y	Y	N	PY	Y	N	N	N	N	Y	Y	Y	Critically low
Zeng 2019	Y	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	Y	Critically low
Zeng 2014	Y	N	N	Y	Y	Y	N	PY	Y	N	N	N	N	N	N	Y	Critically low
Zeng 2019	Y	N	N	Y	N	Y	N	PY	Y	N	Y	Y	Y	Y	N	Y	Critically low
Zhang 2019	Y	N	N	Y	Y	Y	N	PY	Y	N	N	Y	N	Y	N	Y	Critically low
Zhao 2019	Y	N	N	N	Y	Y	N	PY	Y	N	N	N	N	N	Y	Y	Critically low
Zhou 2021	Y	N	N	N	Y	Y	N	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Zuo 2016	Y	N	N	N	Y	Y	N	PY	Y	N	N	N	N	N	Y	N	Critically low

Note: Y=yes; N=no; Partial Y=meets criteria for partial yes; N/A=not applicable as no meta-analysis conducted

Legend: AMSTAR 2 Items: 1) The Participant, Intervention, Comparator and Outcome (PICO) components included in the review research question and inclusion criteria; 2) Explicit statement included that review methods were established prior to conduct and significant deviations justified; 3) Selection of included study designs explained; 4) Comprehensive search strategy used; 5) Study selection performed in duplicate; 6) Data extraction performed in duplicate; 7) List of excluded studies with justification provided; 8) Included studies described in adequate detail; 9) Satisfactory technique used for assessing risk of bias in included studies; 10) Sources of funding for included studies reported; 11) Appropriate methods for statistical combination of results used if meta-analysis performed; 12) Potential impact of risk of bias of individual studies assessed if meta-analysis performed; 13) Risk of bias of individual studies accounted for in discussion of the review results; 14) Any heterogeneity observed in the review

results was explained and discussed; 15) Publication bias investigated and discussed if meta-analysis performed; 16) Authors reported any potential sources of conflict of interest.

eFigure 3. Results of meta-analyses that assessed depression using mean differences.



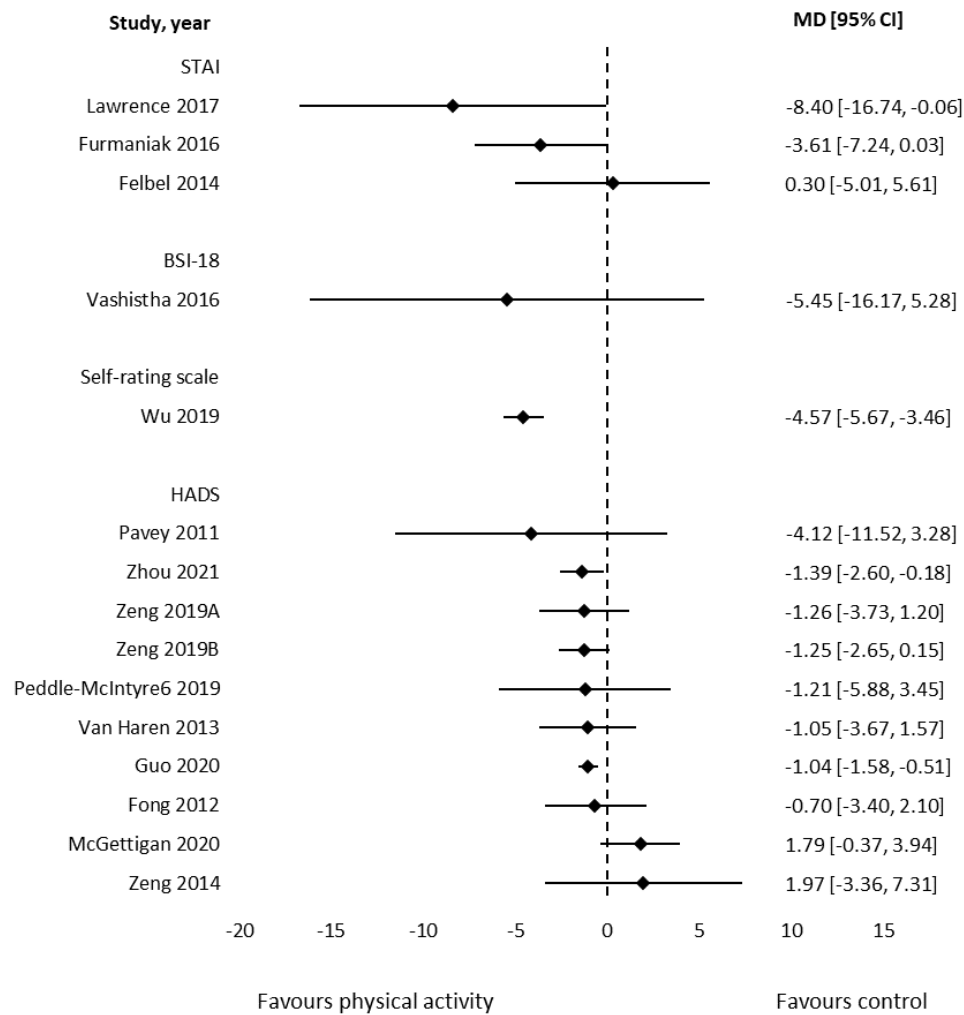
BDI: Beck Depression Inventory; CES-D: Center for Epidemiological Studies Depression; EPDS: The Edinburgh Postnatal Depression Scale; HADS: Hospital Anxiety and Depression Scale; MADRS: Montgomery-Asberg Depression Rating Scale; POMS: Profile of Mood States.

eTable 4. Overview of results of meta-analyses using mean differences for anxiety and depression.

	Reviews	Studies	Participants	Mean difference			Standardised mean difference (95% CI)
				25%ile	Median	75%ile	
Depression (instrument)							
Profile of Mood States	1	2	65		-7.68		-0.96 (-1.47, -0.44)
Beck Depression Inventory	2	7	>134	-6.24	-5.53	-4.81	-0.69 (-1.04, -0.34)
The Edinburgh Postnatal Depression Scale	2	19	1110	-3.49	-2.97	-2.44	-0.74 (-0.86, -0.62)
Self-rating scale	1	6	415		-3.99		-0.79 (-0.99, -0.59)
Brief Symptom Inventory 18	1	2	92		-3.02		
Center for Epidemiological Studies Depression	4	6	847	-1.25	-0.36	0.02	-0.72 (-0.85, -0.58)
Montgomery-Asberg Depression Rating Scale	1	1	117		-1.80		-0.33 (-0.74, -0.07)
Hospital Anxiety and Depression Scale	8	15	622	-1.41	-1.26	-1.18	-0.18 (-0.33, -0.02)
Anxiety (Instrument)							
The State-Trait Anxiety Inventory	3	4	262	-6.01	-3.61	-1.66	-0.51 (-0.76, -0.27)
Brief Symptom Inventory-18	1	2	92		-5.45		-0.49 (-0.91, -0.08)
Self-rating scale	1	6	415		-4.57		-0.41 (-0.61, -0.22)
Hospital Anxiety and	10	22	3360	-1.13	-1.26	-0.79	-0.21 (-0.27, -0.14)

Depression Scale							

eFigure 5. Results of meta-analyses that assessed anxiety using mean differences.



BSI-18: Brief Symptom Inventory-18; HADS: Hospital Anxiety and Depression Scale; STAI: The State-Trait Anxiety Inventory.

Figure 6. Results of subgroup meta-analyses for depression based on physical activity mode.

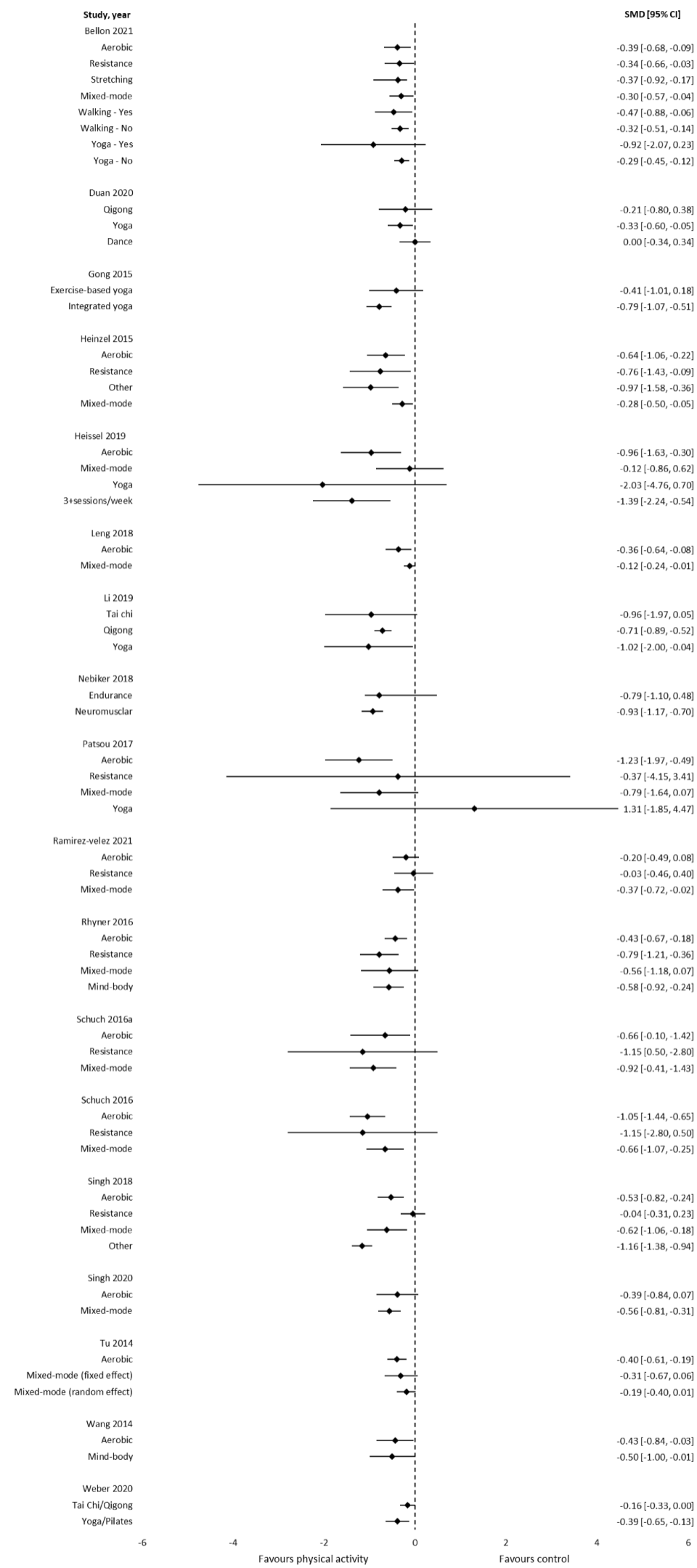
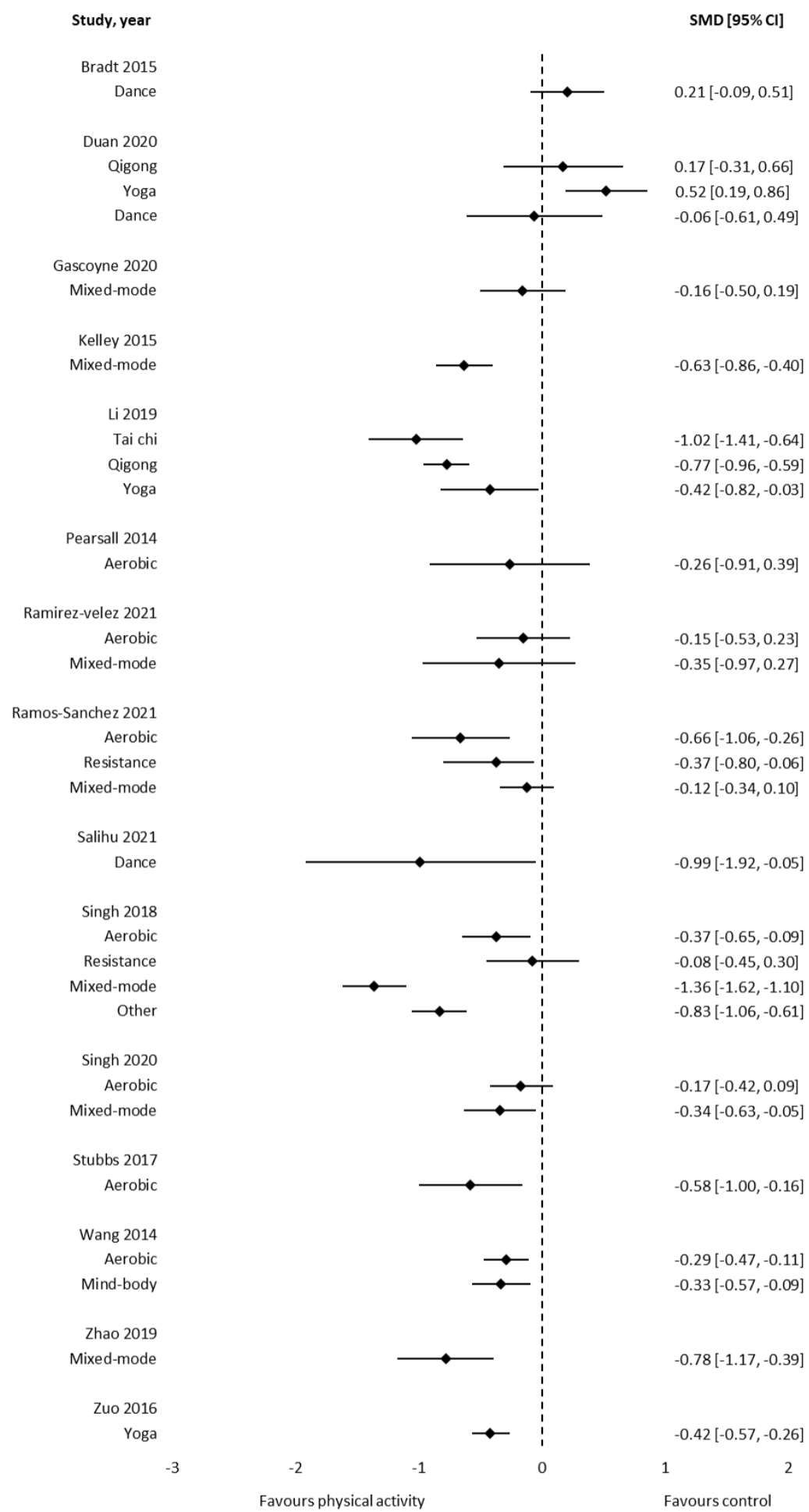


Figure 7. Results of subgroup meta-analyses for anxiety based on physical activity mode.



eFigure 8. Results of subgroup meta-analyses for depression based on physical activity intensity.

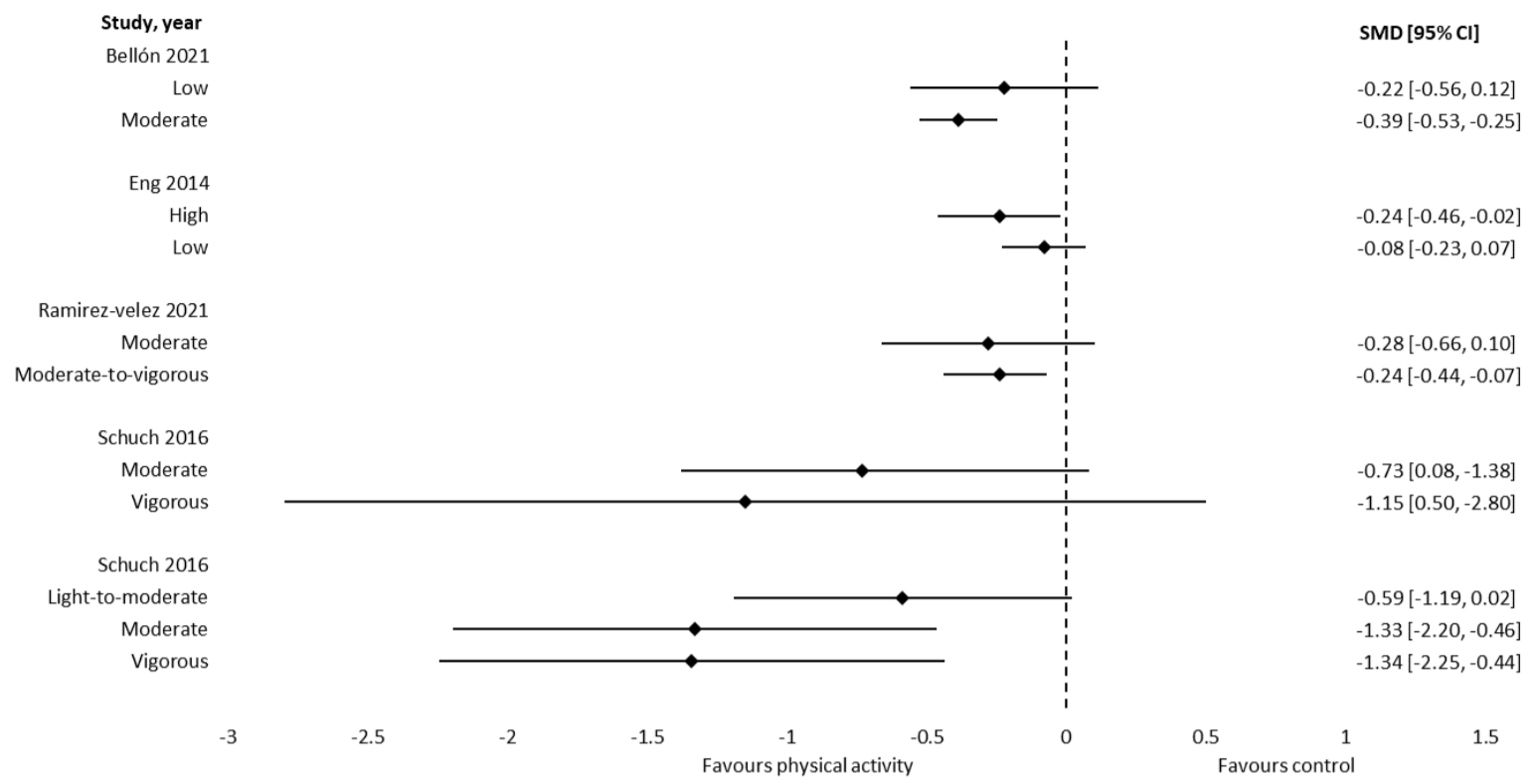


Figure 9: Results of subgroup meta-analyses for anxiety based on physical activity intensity.

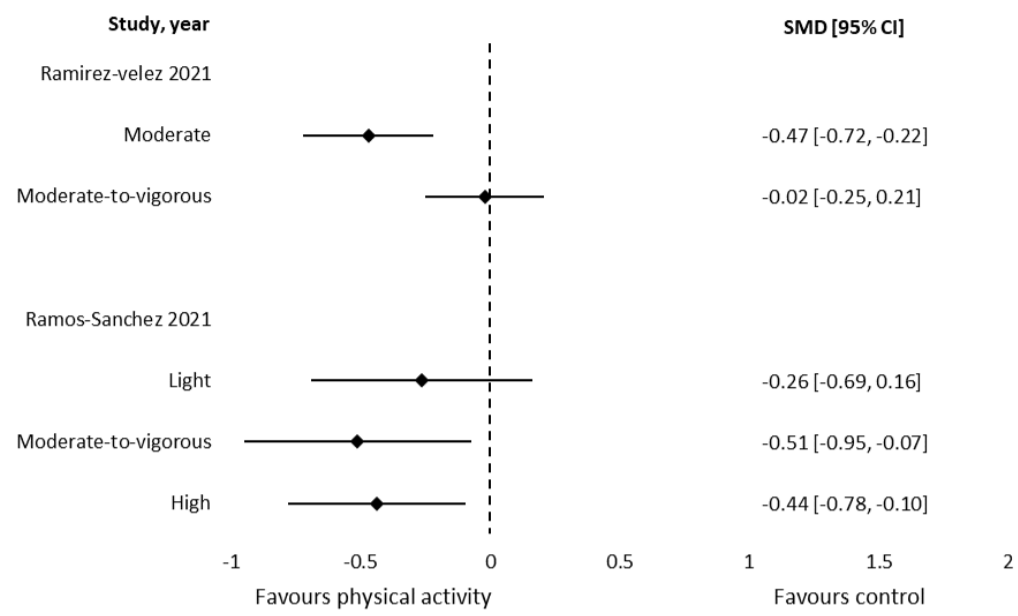


Figure 10: Results of subgroup meta-analyses for depression based on intervention duration.

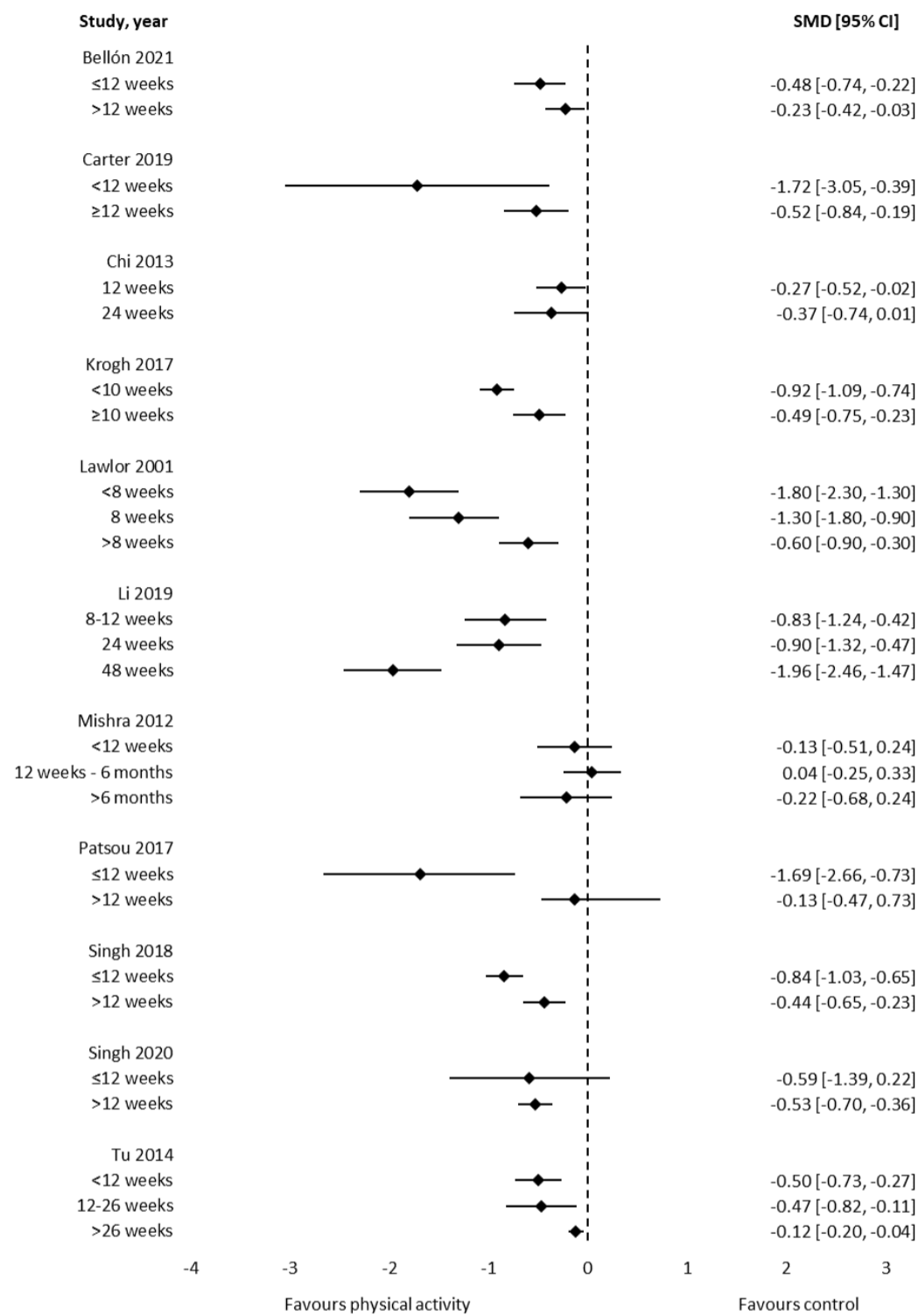


Figure 11: Results of subgroup meta-analyses for anxiety based on intervention duration.

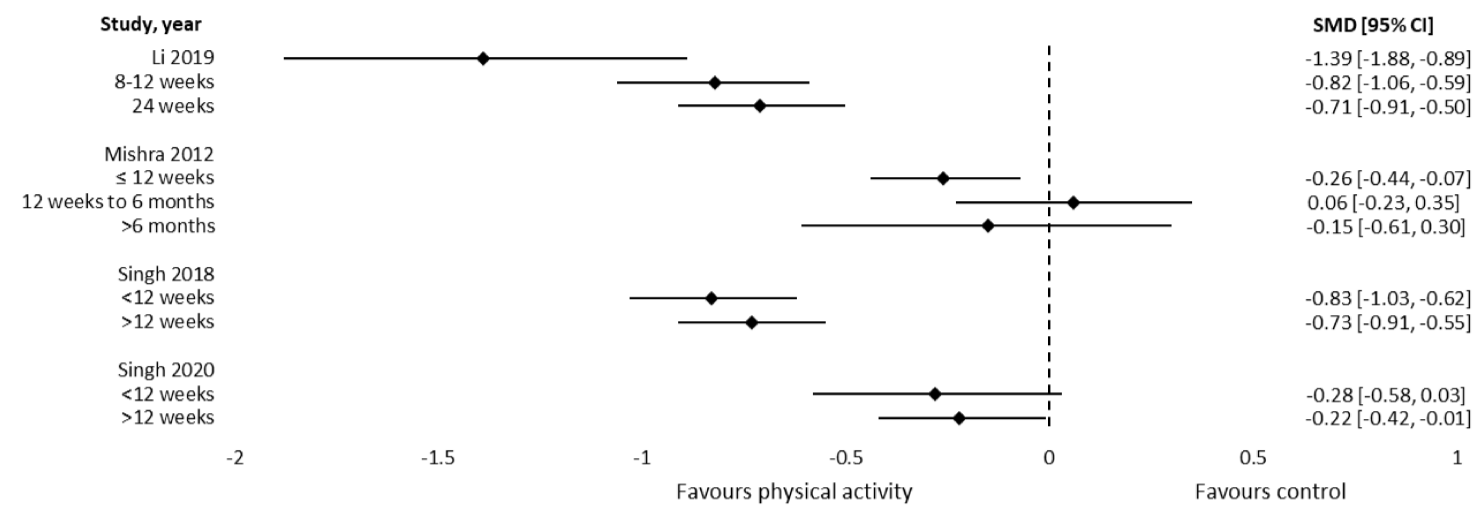


Figure 12: Results of subgroup meta-analyses for depression based on weekly duration.

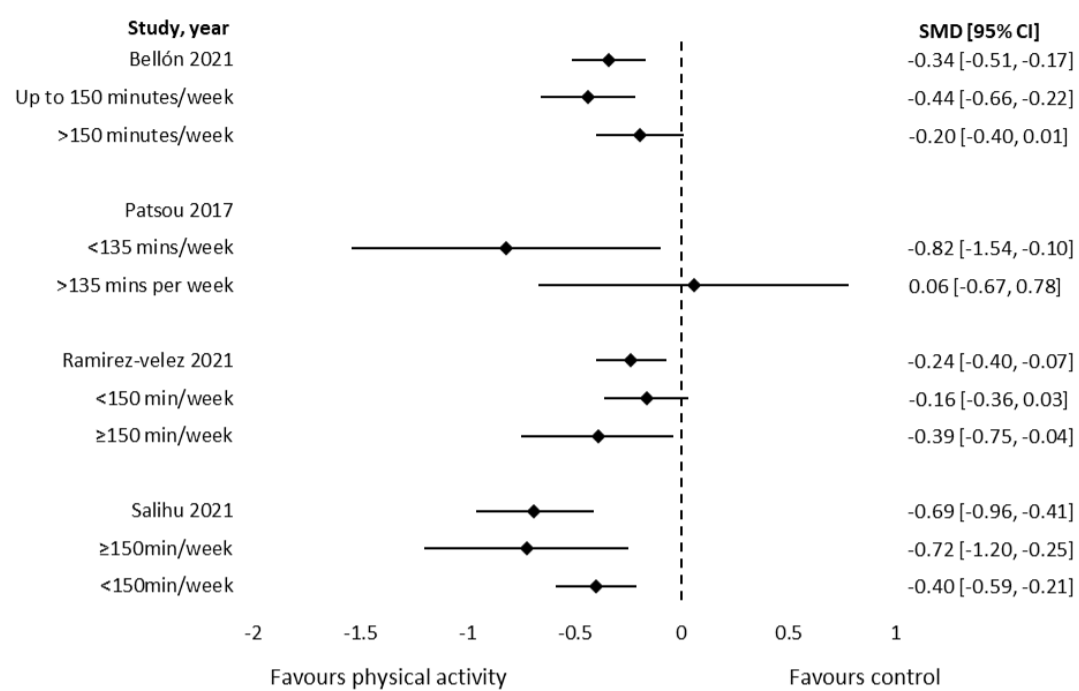
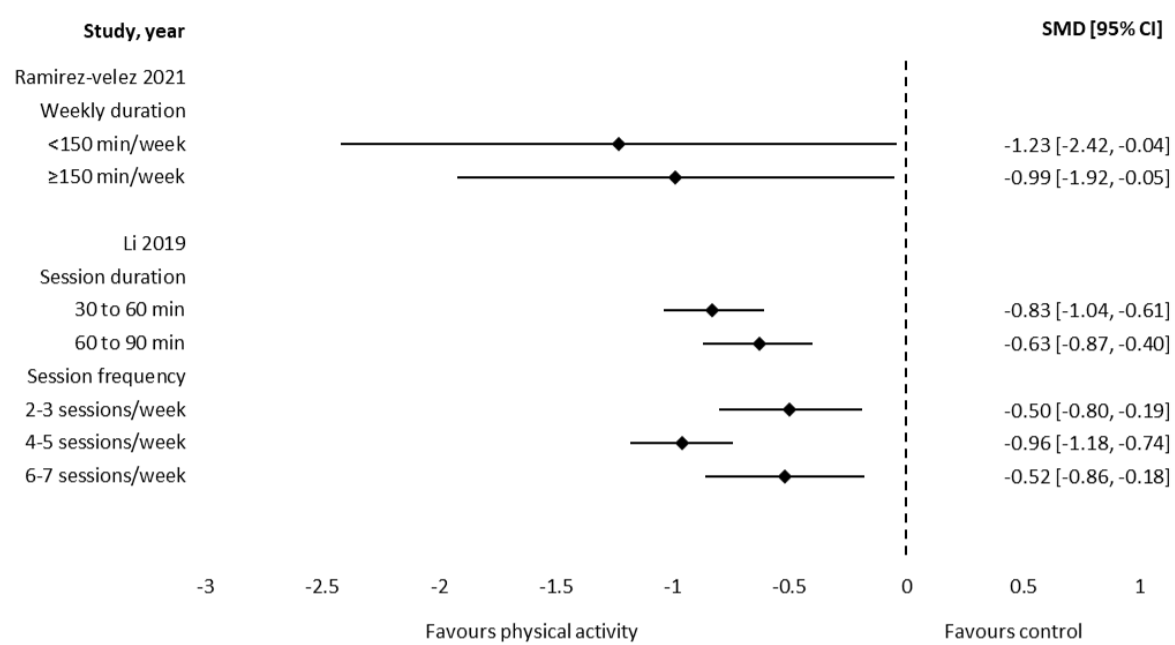
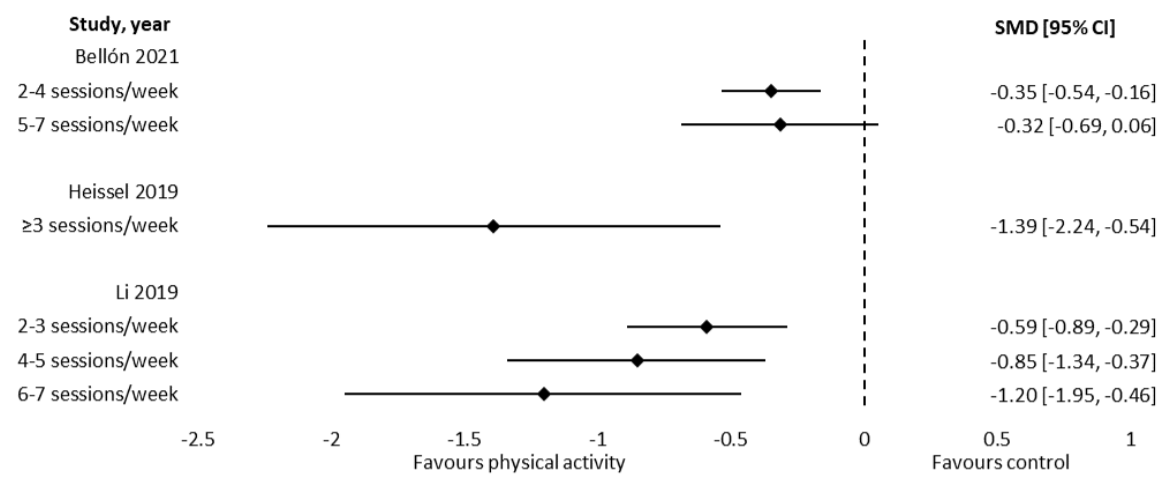


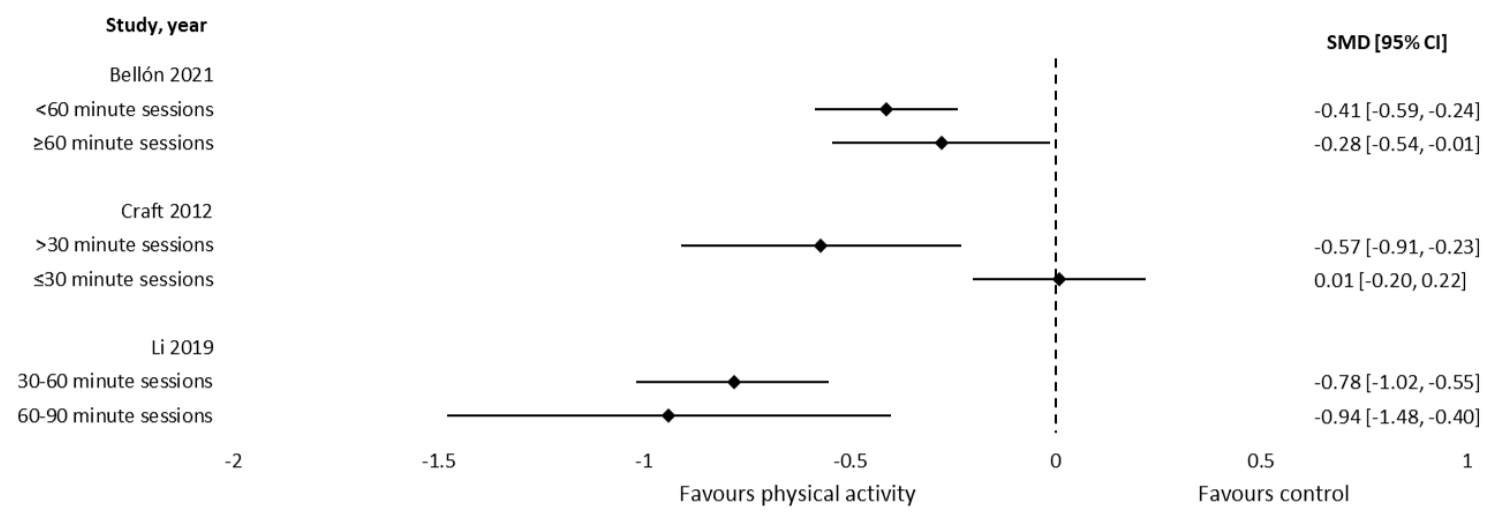
Figure 13: Results of subgroup meta-analyses for anxiety based on weekly duration, session duration and session frequency.



eFigure 14: Results of subgroup meta-analyses for depression based on session frequency.



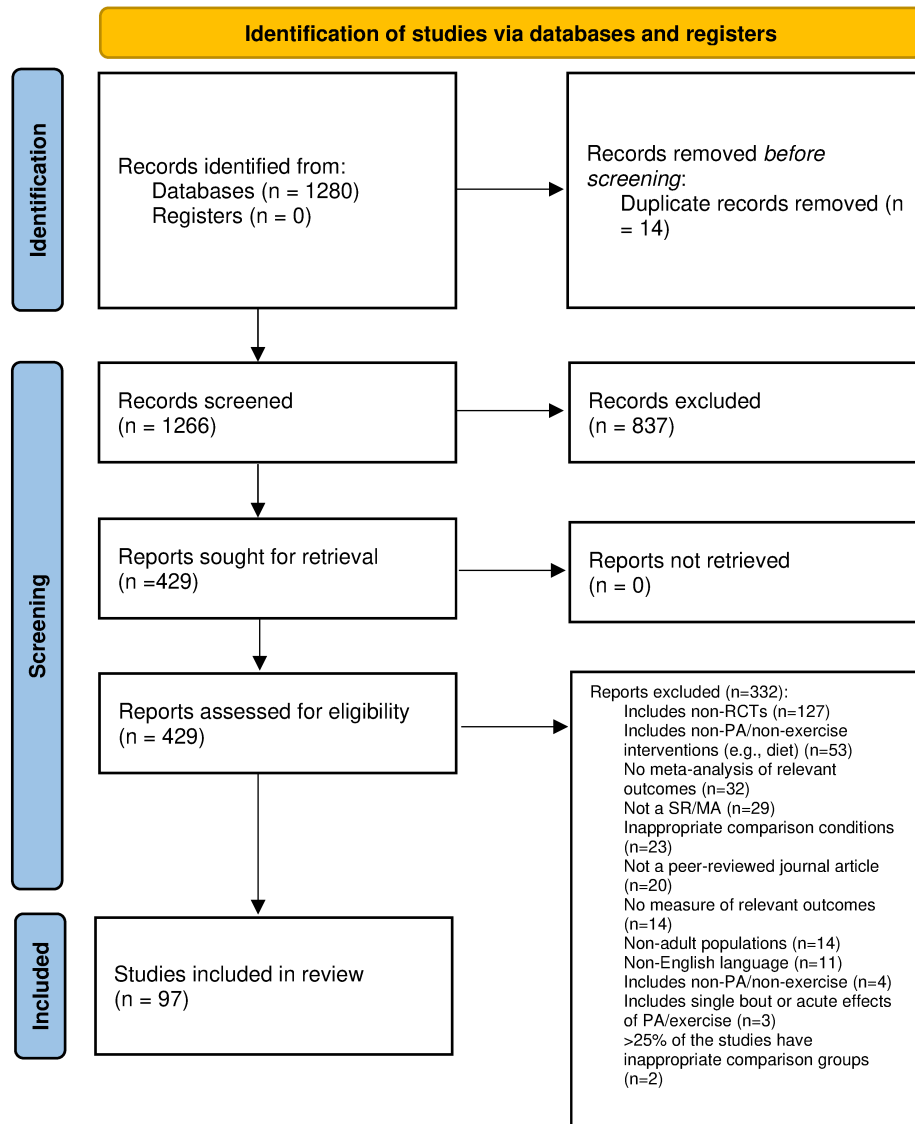
eFigure 15: Results of subgroup meta-analyses for depression based on session duration.



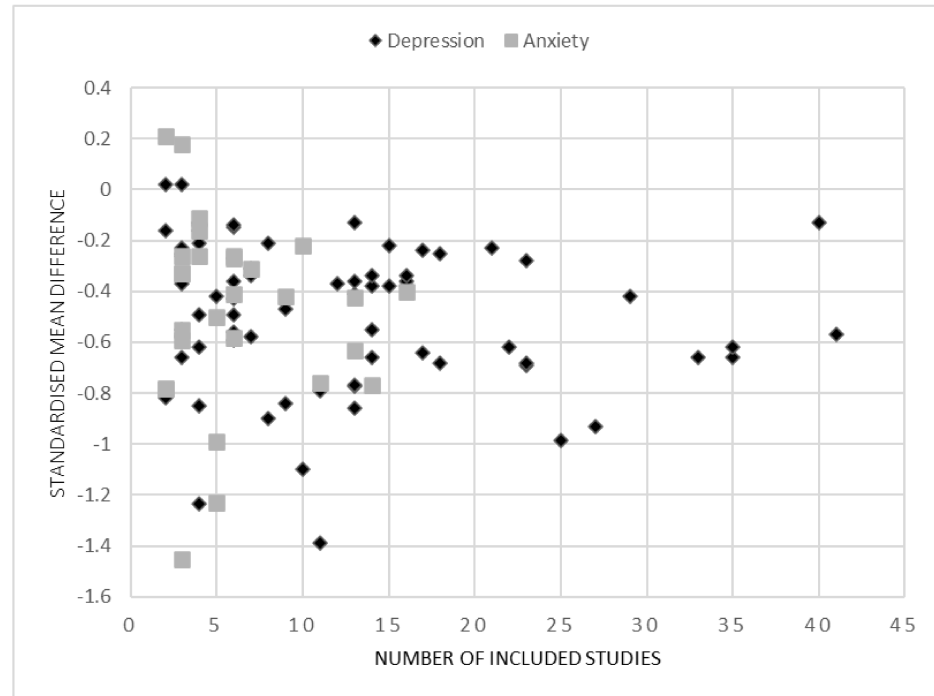
eTable 1. Medline search strategy and terms

MEDLINE(R) ALL <1946 to November 12, 2021> Ovid MEDLINE(R) ALL <1946 to November 19, 2021>	
1 Meta-Analysis as Topic/ 2 meta analy\$.tw. 3 metaanaly\$.tw. 4 Meta-Analysis/ 5 Systematic Review/ [addition] 6 Systematic Reviews as Topic/ [addition] 7 (systematic adj (review\$1 or overview\$1)).tw. 8 exp Review Literature as Topic/ 9 or/1-8 10 cochrane.ab. 11 embase.ab. 12 (psychlit or psyclit).ab. 13 (psychinfo or psycinfo).ab. 14 (cinahl or cinhal).ab. 15 science citation index.ab. 16 bids.ab. 17 cancerlit.ab. 18 or/10-17 19 reference list\$.ab. 20 bibliograph\$.ab. 21 hand-search\$.ab. 22 relevant journals.ab. 23 manual search\$.ab. 24 or/19-23 25 selection criteria.ab. 26 data extraction.ab. 27 25 or 26 28 Review/ 29 27 and 28 30 Comment/ 31 Letter/ 32 Editorial/ 33 animal/	34 human/ 35 33 not (33 and 34) 36 or/30-32,35 37 9 or 18 or 24 or 29 38 37 not 36 39 exp exercise/ 40 exp exercise therapy/ 41 exp sports/ 42 Physical Fitness/ 43 (physical* adj5 (fit* or train* or activ* or endur* or exer*)).ti,ab. 44 (exercis* adj5 (train* or physical* or activ*)).ti,ab. 45 sport*.ti,ab. 46 walk*.ti,ab. 47 swim*.ti,ab. 48 pilates.ti,ab. 49 step*.ti,ab. 50 HIIT.ti,ab. 51 (tai ji or tai chi or tai-ji or tai-chi).ti,ab. 52 (resistance adj3 train*).ti,ab. 53 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 54 38 and 53 55 depress*.ti,ab. 56 anxiety.ti,ab. 57 distress.ti,ab. 58 55 or 56 or 57 59 54 and 58 60 food.ti,ab. 61 diet*.ti,ab. 62 nutriti*.ti,ab. 63 59 not (60 or 61 or 62)

eFigure 1. PRISMA flow diagram.



eFigure 2. Funnel plot showing the relationship between systematic review-level standardised mean differences and the number of studies included in each meta-analysis for depression and anxiety.



eTable 2. Overview of all included studies.

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Adamson 2015	26	1324	Neurological disorders; males and females; mean±SD and range NR	AE, RE, Yoga, Tai Chi, Qigong, gymnastics; various intensities; 4w-52w	1) Depression (BDI, BDI-II, CES-D, CESD-10, CSDD, GDS, HADS, IDS-SR, Levine-Pilowsky depression questionnaire, MADRS, MDI, POMS)	Critically low
Aylett 2018	15	675	Anxiety; males and females; mean±SD and range NR	AE, RE; various intensities; 2w-10w	1) Anxiety (PSWQ, Liebowitz Social scale, Anxiety Sensitivity Index, BAI, STAI)	Critically low
Barreto 2015	20	1627	Dementia; males and females; mean±SD and range NR	AE, RE, Tai Chi, dance; various intensities; 6w-1y	1) Depression (GDS-15, GDS-30, MADRS, GSDD)	Critically low
Bellón 2021	14	1737	Adults without depression; males and females; 44.7±18.6	AE, RE, Yoga; various intensities; 4w-2y	1) Depression (HADS, PHQ-9, BDI, SCID-I, EPDS, POMS, CES-D, BDI-FS, GDS, BDI-II)	Critically low
Bergenthal 2014	9	818	Haematological cancer; males and females; 50.7±2.4	AE, RE; various intensities; 10d-36w	1) Depression (not specified) 2) Anxiety (not specified)	High
Bradt 2015	3	207	Breast cancer; females; 55.4±4.8	Dance; various intensities; 3w-12w	1) Depression (POMS, HADS) 2) Anxiety (HADS, Symptom Checklist 90-Revised)	High
Bridle 2012	9	667	Older adults with depression; males and females; 75.7±6.8	AE, RE, Tai Chi, Qigong; various intensities; 12w-1y	1) Depression (PHQ-9, GDS, HSCL-20, CES-D, HRSD, BDI, CSDD)	Low
Brinsley 2020	19	1080	Mental disorders; males and females; 38.5±9.4	Yoga; various intensities; 5w-12w	1) Depression (PANSS, HDRS, CES-D, HAD-C, FBGL, DASS-21, CDS, BDI, CAPS, HAM-D-21, QIDS)	Critically low
Broderick 2015	8	457	Schizophrenia; males and females; mean±SD and range NR	Yoga; various intensities; 4w-16w	1) Depression (Calgary Depression Scale)	Low
Brown 2012	40	2929	Cancer; males and females; 51.3±6.5	AE, RE, Yoga; various intensities; 3w-1y	1) CES-D, Center for Epidemiologic Studies Depression scale; POMS, Profile of Mood States; BDI, Beck Depression Inventory; HADS, Hospital Anxiety and Depression Scale; Symptom Assessment Scale.	Critically low
Carneiro 2020	4	295	Depression; males and females; 61.1±14.4	RE; various intensities; 10w-16w	1) Depression (HAM-D, CES-D, GDS, BDI)	Low
Carter 2019	18	1428	Postnatal women; females; 29.3±2.9	AE, RE; various intensities; 6w-14m	1) Depression (DASS, EPDS, GHQ12, HDRS, IDAS, PHQ, SCID, SF-36, HAM-D, SCID-PN diagnosis, SF-36v2, CES-D, PHQ-9, SCID-I)	Low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Chi 2013	4	253	Older adults with depressive symptoms; males and females; mean±SD NR; age range=52-82	Tai Chi; low-intensity; 12w-24w	1) Depression (DASS-21, CES-D)	Critically low
Choo 2020	13	869	Chronic diseases; males and females; 67.2±3.5	Tai Chi; low-intensity; 10w-24w	1) Depression (CES-D, Zung depression scale, Depression, Anxiety, and Stress Scales)	Low
Chung 2017	17	651	End Stage Renal Disease; males and females; mean±SD and range NR	AE, RE; various intensities; 8w-48w	1) Depression (Zung depression scale, BDI, SF-36)	Critically low
Cooney 2013	39	2326	Depression; males and females; 52.7±19.3	AE, RE; various intensities; 10d-16w	1) Depression (Hamilton Rating Scale for Depression, BDI, BDI-II, Lubin's Depression Adjective List, Zung Depression Scale, MADRS, HAM-D, Global Assessment Scale, CES-D, POMS, Cornell Scale for Depression in Dementia, GDS)	High
Coventry 2007	6	545	COPD; males and females; 65.3±2.9	AE, RE; various intensities; 5w-1y	1) Depression (HADS, Lorr-McNair Mood Questionnaire, CES-D, SCL-90-R) 2) Anxiety (HADS, STAI-State Anxiety, SCL-90-R)	Critically low
Craft 2012	15	1371	Cancer; males and females; 55.1±7.8	AE, RE; various intensities; 6w-6m	1) Depression (CES-D Short Form, CES-D, BDI-II, HADS)	Critically low
Dalgas 2015	15	591	Multiple sclerosis; males and females; 46.7±6.3	AE, RE, water aerobics, yoga, sports climbing; various intensities; 3w-26w	1) Depression (BDI-I, BDI-II HADS-D, MDI, CES-D, IDS-SR30, POMS)	Critically low
deAlmeida 2020	16	1129	Dementia; males and females; 77.3±7.3	AE, RE; various intensities; 6w-2y	1) Depression (Cornell Scale for Depression in Dementia, NPI Depression, GDS – Short Form) 2) Anxiety (Generalized Anxiety Disorder 7-item, NPI Anxiety)	Critically low
Duan 2020	15	1461	Cancer; males and females; 54.6±6.6	Yoga, Qigong, Tai Chi, Dance; various intensities; 3w-24w	1) Depression (HADS, BDI, CES-D, PHQ-9) 2) Anxiety (FACT-B, FACT-C, SF-12, FACT-G) 3) Distress (Perceived Stress Scale General Quality of Life: FACT-G, FACT-B, EORTC-QLQ-C-30)	Critically low
Eng 2014	13	1022	Stroke; males and females; mean±SD NR; age range=21-93	AE, RE; various intensities; 4-12w	1) Depression (HADS, GDS, BDI, CES-D)	Critically low
Ensari 2014	13	477	Multiple sclerosis; males and females; 45.1±5.8	AE, RE, water aerobics, yoga; various intensities; 4-26w	1) Depression (BFI, IFD, MDI, BDI-II, HADS, CES-D, POMS, POMS-SF)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Felbel 2014	1	39	Haematological cancer; males and females; 51	Yoga; low intensity; 7w	1) Depression (CES-D) 2) Anxiety (STAI) 3) Distress (Impact of Events Scale)	High
Ferreira 2021	8	376	Kidney disease; males and females; 51.7±8.6	AE, RE, Pilates, intradialytic exercise; various intensities; 4w-48w	1) Depression (HADS, DASS, BDI, General Health Dimensions - depression subscale) 2) Anxiety (HADS, DASS)	Critically low
Fong 2012	34	4113	Cancer; males and females; 55.7±5.8	AE, RE, Yoga; various intensities; 3w-60w	1) Depression (HADS, BDI) 2) Anxiety (HADS)	Critically low
Forbes 2008	4	280	Dementia; males and females; mean±SD and range NR	AE, RE; various intensities; 2w-1y	1) Depression (MADRS)	Low
Furmaniak 2016	32	2626	Breast cancer; females; mean±SD and range NR	AE, RE; various intensities; 6w-1y	1) Depression (BDI, CES-D, HADS) 2) Anxiety (STAI, HADS)	High
Gascoyne 2020	4	133	Multiple sclerosis; males and females; 43.9±7.6	AE, RE; various intensities; 8w-26w	1) Anxiety (POMS, HADS, STAI, BAI)	Critically low
Gong 2015	6	375	Pregnant women; females only; mean±SD NR; range = 18-40	Yoga; various intensities; 12w-16w	1) Depression (CES-D, HADS, EPDS)	Critically low
Gordon 2018	33	1877	Adults with or without chronic conditions; males and females; 52±18	RE; various intensities; 6w-1y	1) Depression (BDI, GDS, CES-D, MDI, MHFI, DACL, HRSD, BRUMS-D, HADS, POMS, SCL-90-D, DSM, DASS-21)	Critically low
Gouw 2019	13	1340	Older adults with chronic disease; males and females; 70.4±6.2	Qigong; low intensity; 8w-26w	1) Depression (GDS, HADS, HRSD, Self-rating scale)	Critically low
Guo 2020	16	1096	COPD, males and females; 67.4±4.9	Tai Chi; various intensities; 2w-1y	1) Depression (HADS, Self-rating scale) 2) Anxiety (HADS, Self-rating scale)	Critically low
Hall 2021	17	1456	Knee osteoarthritis; males and females; 65.9±4.6	AE, RE, Yoga, Tai chi, Qigong; various intensities; 6w-1y	1) Depression (HADS, CES-D) 2) Anxiety (HADS)	Critically low
Heinzel 2015	18	1063	Older adults; males and females; 71.9±6.0	AE, RE, Tai chi, Qigong; various intensities; 6w-26w	1) Depression (HADS, HDG, HAM-D, PHQ-9, BDI, DSM-IV diagnostic criteria)	Critically low
Heissel 2019	10	479	HIV; males and females; mean±SD and range NR	AE, RE, Yoga; various intensities; 4w-12w	1) Depression (BDI, GHQ-28, POMS, HADS) 2) Anxiety (GHQ-28, POMS, HADS, STAI)	High

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Herring 2017	14	624	Multiple Sclerosis; males and females; 44±6.6	AE, RE, Yoga; various intensities; 3w-26w	1) Depression (BDI, CES-D, HADS, IDS-SR, POMS, MDI)	Critically low
Josefsson 2014	15	880	Depression; males and females; 46.3±13	AE, RE; various intensities; 4w-16w	1) Depression (HRSD, BDI, MARDS, PHQ-9, MMPI)	Critically low
Kelley 2018	14	926	Arthritis and rheumatic diseases; males and females; 54.5±8.9	AE; RE; various intensities; 8w-32w	1) Depression (AIMS, BDI, CES-D, DASS-21, FIQ, HADs, MHI, VAS) 2) Anxiety (STAI, AIMS, HADS, DASS-21, MHI, FIQ, VAS)	High
Kelley 2015	29	2449	Arthritis; males and females; 52.3±9.7	AE, RE, Tai chi, Qigong; various intensities; 4w-32w	1) Depression (BDI, CES-D, DASS-21, MIH, FIQ, AIMS, POMS, HADS, VAS)	High
Krogh 2017	35	2498	Depression; males and females; 44±12.8	AE, RE; various intensities; 2w-32w	1) Depression (HAM-D17, SCL-D, BDI, MADRS, PHQ-9)	Low
Kvam 2016	23	977	Depression; males and females; 36.9±14.4	AE, RE; various intensities; 1w-8m	1) Depression (HAMD-17, MDD, BDI, BDI-II, SCL-90)	Critically low
Lawlor 2001	14	479	Depression; males and females; 44.7±17	AE, RE; various intensities; 4w-12w	1) Depression (BDI, Depression symptom checklist)	Critically low
Lawrence 2017	2	72	Stroke; males and females; 59.5±4.6	Yoga; various intensities; 8w-10w	1) Depression (GDS15) 2) Anxiety (STAI, STAI-Y1, STAI-Y2, Stroke Impact Scale version 3)	Critically low
Lee 2021	22	1025	Depression; males and females; 48.5±12.6	AE, RE; various intensities; 10d-24w	1) Depression (BDI-II, HAM-D, BDI, MADRS, MARDS-S, BRMS, GDS)	Critically low
Lee 2020	29	2989	Breast cancer; females; 50±7.7	AE, RE; Yoga; various intensities; 4w-26w	1) Depression (HADS, CES-D) 2) Anxiety (HADS, Spielberger State-Anxiety Inventory)	Critically low
Leng 2018	21	2589	Cognitive impairment; males and females; 76.3±5.9	AE, RE, Tai Chi, Yoga; various intensities; 6w-1y	1) Depression (CSDD, GDS, Depression Rating Scale, BDI, HAMD)	Critically low
Liu 2019	6	429	Lymphoma; males and females; 53.6±6.4	AE, Yoga, Qigong; various intensities; 3w-36w	1) Depression (CES-D)	Critically low
Li 2019	13	906	COPD; males and females; 63.9±6.9	Yoga, Qigong, Tai chi, various intensities; 8w-48w	1) Depression (CES-D, SSAI, HADS, BDI, Self-rating scale, HAMD) 2) Anxiety (HADS, STAI, Self-rating scale, HAMA)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Li 2019	20	2051	Dementia; males and females; 80.9±5.1	AE, RE, dance; various intensities; 6w-18m	1) Depression (HAMD-17, GDS, CSDD, MADRS)	Critically low
Lund 2020	8	552	Colorectal cancer; males and females; 58±4.6	AE, RE; various intensities; 6w-24w	1) Depression (HADS, BDI)	Critically low
Lyu 2021	11	732	Stroke patients with mental or sleep disorders; males and females; 62.2±6.6	Tai Chi; low intensity; 6w-24w	1) Depression (CES-D, HAM-D, BDI) 2) Anxiety (HAMA)	Critically low
McCurdy 2017	16	1327	Postpartum women, females; 29.6±2.8	AE, RE, Yoga; various intensities; 6w-1y	1) Depression (EPDS, CES-D, HAMD)	Critically low
McGettigan 2020	16	992	Colorectal cancer; males and females; 59.5±4.6	AE, RE; various intensities; 6w-1y	1) Depression (HADS, CES-D) 2) Anxiety (HADS, STAI)	Low
McGranahan 2021	4	149	PTSD; males and females; 44.7±16.3	AE, RE; various intensities; 3w-12w	1) Depression (CES-D, DASS, PHD) 2) Anxiety (STAI, DASS)	Critically low
Miller 2020	69	5379	Older adults; males and females; 73.4±5.6	AE, RE, Yoga, Tai Chi, Qigong; various intensities; 4w-15m	1) Depression (BDI, CESD-20, POMS-D, GDS-15, GDS-30, BDI-II, MADRS, GADS-D, CSDD, TDQ, HADS-D, HRSD, DASS-D, IDS-C, GDS-5, POMS-SF-D, CESD-10, PROMIS-EDD SF-8a, CESD-6)	Low
Miller 2020	15	596	Older adults with depression; males and females; 73.9±5.9	AE, RE, Yoga, Tai Chi, Qigong, dance; various intensities; 4w-16w	1) Depression (GDS-15, CESD-20, GDS-30, HRSD, BDI, CSDD)	Low
Mishra 2012	40	3694	Cancer; males and females; 53.3±5.4	AE, RE, Yoga, Tai Chi, Qigong; various intensities; 3w-1y	1) Depression (CES-D, HADS, BDI, VAS, POMS) 2) Anxiety (HADS, STAI, VAS, POMS)	High
Morres 2019	11	455	Depression; males and females; Mean (SD) = 37 (9.4); range = 20.9-49.1	AE; various intensities; 10d-32w	1) Depression (HAMD-17, BDI, CIS, MADRS)	Critically low
Nebiker 2018	27	1452	Depression; males and females; 49.5±16.0	AE, RE, Yoga, Tai Chi; various intensities; 10d-32w	1) Depression (BDI, BDI-II, HRSD, CES-D, GDS-15, GDS, HAM-D, MADRS, PHQ-9)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Nixon 2005	10	276	HIV/AIDS; males and females; mean±SD NR; age range=18-58	AE, RE; various intensities; 5w-24w	1) Depression (POMS)	Critically low
Park 2014	18	3297	Older adults; males and females; mean±SD and range NR	AE, RE, Yoga, Tai Chi, dance; various intensities; 4w-2y	1) Depression (GDS, GDS-15, HADS, Zung Self-rating depression scale, CES-D)	Critically low
Patsou 2017	14	1701	Breast cancer; females; 52.1±2.9	AE, RE, Yoga; various intensities; 6-1y	1) Depression (HADS, BDI-II, CES-D, POMS)	Critically low
Pavey 2011	8	5109	Adults; males and females; 59±7	AE; various intensities 8w-52w	1) Depression (not specified)	Critically low
Pearsall 2014	8	374	Schizophrenia; males and females; mean±SD NR; range = 27-52	AE; various intensities 10w-24w	1) Depression (BSI, WHOQOL-BREF-TR, BDI, MHI, CGI-Severity) 2) Anxiety (BSI, WHOQOL-BREF-TR, MHI, CGI-Severity)	Critically low
Peddle-McIntyre6 2019	6	221	Lung cancer; males and female; 60.9±5.3	AE, RE; various intensities; 4w-12w	1) Depression (GHQ-12, HADS) 2) Anxiety (GHQ-12, HADS)	Critically low
Pentland 2021	5	242	Postpartum women; females; 30±3.5	AE, RE; various intensities; 12w-6m	1) Depression (EPDS)	Critically low
Ramachandran 2021	14	2869	Heart disease; males and females; 59.4±5.7	AE; various intensities; 6w-6m	1) Depression (Patient Health Questionnaire, CES-D, DASS)	Critically low
Ramirez-velez 2021	57	6988	Breast cancer; females; 52.3±3.3	AE, RE; various intensities; 5w-1y	1) Depression (HADS, FACT-B Depression, BDI, Finnish version of modified BDI, CES-D) 2) Anxiety (HADS, FACT-B Anxiety, Social Physique Anxiety Scale-7, SSAI, State-Trait Anxiety Inventory (STAI))	Critically low
Ramos-Sanchez 2021	13	731	Anxiety disorder; males and females; 39.2±11.7	AE, RE; various intensities; 3w-20w	1) Anxiety (Hamilton Scale for Anxiety, Penn State Worry Questionnaire, Anxiety stress scale, Chinese Mandarin version STAI)	High
Rhyner 2016	41	NR	Older adults; males and females; 73.9±5.2	AE, RE, Yoga, Tai Chi, Qigong; various intensities; 3w-144w	1) Depression (GSD, CES-D, GSD-15, BDI, Taiwanese Depression Questionnaire, HSCL-20, DASS, HDRS, Cornell Scale for Depression in Dementia, MADRS)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Rosenbaum 2015	4	200	PTSD; males and females; 43.7±6.7	AE, RE, Yoga; various intensities; 6w-12w	1) Depression (PSS-I, PCL-C, CAPS)	Critically low
Russ 2021	9	456	Dementia; males and females; 85.5±1	RE; various intensities; 12w-7m	1) Depression (GDS, CCSD, MADRS)	Critically low
Salihu 2021	28	2249	Adults; males and females; 65.3±16	Dance; various intensities; 10d-1y	1) Depression (BDI, GDS, POMS, CESD, HADS, DASS-21) 2) Anxiety (Test Anxiety Inventory, DASS-21, HADS, STAI)	Critically low
Schuch 2016	8	267	Older adults with depression or depressive symptoms; males and females; 69.5±0.71	AE, RE; various intensities; 6w-16w	1) Depression (HAM-D, GDS-15, BDI, GDS, PHQ-9, CES-D, CSDD)	Critically low
Schuch 2016	25	1487	Depression or depressive symptoms; males and females; 50.9±17.1	AE, RE; various intensities; 4w-32w	1) Depression (HAM-D, BDI, BDI-II, MARSD, GDS-15, CES-D, PHQ-9, DACL, MMPI, CSDD)	Critically low
Schumacher 2021	7	391	Prostate cancer, males; 67.9±1.5	AE, RE; various intensities; 4w-24w	1) Depression (CES-D, BDI)	Critically low
Singh 2018	61	5200	Breast cancer; females; 53±3.6	AE, RE, Yoga; various intensities; 6w-1y	1) Depression (POMs, HADs, CES-D, Greene Climacteric Scale, NDI, Functional Living Index of Cancer) 2) Anxiety (POMs, HADs, STAI, FACT-Amemia, Greene Climacteric Scale, SSAI, Social Physique Anxiety Scale, Functional Living Index of Cancer)	Critically low
Singh 2020	31	2109	Lung cancer; males and females; 64±3	AE, RE, Yoga; various intensities; 1w-20w	1) Depression (HADs, GHQ) 2) Anxiety (HADs, GHQ)	Critically low
Stathopoulou 2006	11	513	Depression; males and females; mean±SD and range NR	AE, RE; various intensities; 4w-16w	1) Depression (HRSD, EPSD, BDI, Self-rating scale, Depression - Symptom Checklist 90)	Critically low
Stubbs 2017	6	262	Anxiety or stress disorder; males and females; 34.7±9.6	AE; various intensities; 6w-12w	1) Anxiety (HAM-A, Penn State Worry Questionnaire, PSWQ, DASS21, PTSD symptom scale, PSSI, PTSD checklist-civilian version)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Tu 2014	19	3447	Heart failure; males and females; 63.7±7.8	AE, RE, Tai Chi; various intensities; 6w-76w	1) Depression (Depression - Symptom Checklist 90, HADS, BDI, BDI-II, MADRS, Multiple Affect Adjective Checklist, GDS, HAM-D, Cognitive Behavioural Assessment Hospital form, CES-D, Psychological General Well-being Index, Hare-Davis Cardiac Depression Scale, POMS)	Critically low
vanHaren 2013	11	734	Cancer; males and females; mean±SD and range NR	RE, AE; various intensities; 4w-24w	1) Depression (POMS, HADS) 2) Anxiety (POMS, HADS) 3) Distress (Self-perception scale of physical and emotional well-being)	Critically low
Vashistha 2016	13	1057	Prostate cancer; males; 69.2±2.3	AE, RE, Qigong; various intensities; 4w-6m	1) Depression (BSI-18) 2) Anxiety (BSI-18)	Critically low
Wang 2014	22	2894	Substance use disorder; males and females; 38.9±5.8	AE, RE, Yoga, Tai Chi, sports; various intensities; 10d-6m	1) Depression (BDI, CES-D, Self-rating depression scale, HADS) 2) Anxiety (Self-rating scale, Hamilton Anxiety Scores, Mood and Physical Symptoms Scale-anxiety, STAI)	Critically low
Wang 2019	12	516	Heart failure; males and females; mean±SD NR; range = 43-74	AE, RE; various intensities; 8w-48w	1) Depression (not specified)	Critically low
Weber 2020	37	3224	Older adults; males and females; 72.2±7.3	Tai Chi, Qigong, Yoga, Pilates; various intensities; 4w-1y	1) Depression (GDS, GDS-SF, HADS, BDI, BDI-II, CES-D, DASS-21, MHI-18, POMS, POMS-SF, Taiwanese Depression Questionnaire, Warwick-Edinburgh Mental Well-being Scale)	Critically low
Wu 2019	6	415	COPD; males and females; 66.3±4.6	Qigong; various intensities; 4w-24w	1) Depression (Self-rating scale) 2) Anxiety (Self-rating scale)	Critically low
Xiang 2017	10	689	Fatigue; males and females; mean±SD NR; range=18-88	Tai Chi; various intensities; 4w-6m	1) Depression (POMS, POMS-SF, IDS-C, CES-D, BDI, BDI-II)	Critically low
Yi 2021	7	693	Breast cancer; females; 50.4±3.5	Yoga; various intensities; 8w-16w	1) Depression (BDI, POMS, HADS, Self-rating scale, CES-D) 2) Anxiety (POMS, HADs, Self-rating scale)	Critically low
Zeng 2019	12	915	Cancer; males and females; 62.2±4.3	Qigong; various intensities; 6w-12w	1) Depression (DASS, HADS) 2) Anxiety (DASS, HADS) 3) Stress (BSI, FACT-G)	Critically low

Reference	Studies (n=)	Total sample (n=)	Population or condition; gender; age mean±SD or range (years)	Main interventions; intensity; duration (range).	Relevant outcomes (instruments)	AMSTAR category
Zeng 2014	13	592	Cancer; males and females; mean±SD and range NR	Tai Chi; various intensities; 6w-24w	1) Depression (BDI, CES-D) 2) Anxiety (BAI)	Critically low
Zeng 2019	10	838	Cancer; males and females; 52.5±4.1	AE, RE; various intensities; 8w-96w	1) Depression (Not specified)	Critically low
Zhang 2019	5	803	Older adults with mild cognitive impairment; males and females; 74.8±5.7	Tai Chi; various intensities; 12w-1y	1) Depression (CDS)	Critically low
Zhao 2019	13	614	End-stage renal disease; males and females; 54.58±11.68	AR, RE, Yoga; various intensities; 8w-1y	1) Depression (BDI, HADS) 2) Anxiety (HADS)	Critically low
Zhou 2021	8	570	Lung cancer; males and females; 64.4±2.1	AR, RE, Tai Chi; various intensities; 6w-12w	1) Depression (HADS, GHQ-12) 2) Anxiety (HADS, GHD)	Critically low
Zuo 2016	21	1762	Breast cancer; females; 42.6±4.7	Yoga; various intensities; 2w-24w	1) Depression (HADS, BDI, CES-D, DMI, Self-rating scale) 2) Anxiety (HADS, STAI, Self-rating scale) 3) Distress (Positive and Negative Affect Schedule, Subjective Symptom Checklist, The Rotterdam Symptom Checklist)	Critically low
Abbreviations: AE: Aerobic exercise; RE: Resistance exercise; NR: Not reported						

eTable 3. AMSTAR 2 quality appraisal of reviews.

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Adamson 2015	Y	N	Y	PY	Y	Y	N	N	Y	N	Y	N	N	Y	N	N	Critically low
Aylett 2018	Y	N	Y	N	Y	Y	Y	Y	Y	N	N	N	N	Y	N	Y	Critically low
Barreto 2015	Y	N	Y	PY	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Bellón 2021	Y	N	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Bergenthal 2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Bradt 2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Bridle 2012	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Low
Brinsley 2020	Y	PY	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	N	Y	Y	Critically low
Broderick 2015	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Low
Brown 2012	Y	N	Y	N	N	Y	N	PY	Y	Y	Y	Y	Y	N	Y	Y	Critically low
Carneiro 2020	Y	PY	Y	Y	Y	N	Y	PY	Y	Y	Y	Y	Y	Y	N	Y	Low
Carter 2019	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Low
Chi 2013	Y	PY	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Critically low
Choo 2020	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Low
Chung 2017	Y	N	Y	N	Y	Y	N	N	Y	N	N	Y	Y	Y	Y	Y	Critically low
Cooney 2013	Y	PY	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Coventry 2007	Y	N	Y	PY	N	Y	N	Y	PY	N	Y	Y	Y	Y	N	Y	Critically low
Craft 2012	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y	Y	Critically low
Dalgas 2015	Y	N	Y	N	N	N	N	Y	Y	N	Y	N	N	Y	N	Y	Critically low
deAlmeida 2020	Y	PY	Y	N	Y	N	N	Y	Y	N	Y	N	N	Y	N	Y	Critically low
Duan 2020	Y	N	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Eng 2014	Y	N	Y	PY	N	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Ensari 2014	Y	N	Y	PY	N	N	N	N	Y	N	Y	N	Y	Y	Y	Y	Critically low
Felbel 2014	Y	Y	Y	PY	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Ferreira 2021	Y	Y	Y	PY	Y	N	N	N	Y	N	Y	N	Y	Y	N	Y	Critically low
Fong 2012	N	N	N	N	Y	Y	N	PY	N	N	Y	Y	Y	Y	Y	Y	Critically low
Forbes 2008	Y	PY	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	Low
Furmaniak 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Gascoyne 2020	Y	Y	Y	Y	Y	Y	N	PY	N	N	Y	N	N	Y	N	Y	Critically low
Gong 2015	Y	N	Y	PY	N	Y	N	PY	PY	N	Y	N	N	Y	N	Y	Critically low
Gordon 2018	Y	N	Y	N	N	Y	N	PY	Y	N	Y	N	Y	Y	Y	Y	Critically low
Gouw 2019	Y	N	Y	Y	Y	Y	N	PY	Y	N	Y	N	N	N	N	Y	Critically low
Guo 2020	Y	Y	N	N	Y	Y	N	PY	Y	N	Y	Y	N	Y	N	Y	Critically low

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Hall 2021	Y	N	Y	PY	Y	Y	N	PY	Y	N	N	N	N	N	Y	Y	Critically low
Heinzel 2015	Y	N	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	Y	N	Y	Critically low
Heissel 2019	Y	PY	Y	PY	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	High
Herring 2017	Y	N	Y	PY	Y	Y	N	Y	Y	N	Y	Y	N	N	Y	Y	Critically low
Josefsson 2014	Y	N	Y	PY	N	N	N	PY	PY	N	Y	Y	Y	Y	N	N	Critically low
Kelley 2018	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Kelley 2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Krogh 2017	Y	Y	Y	PY	N	Y	N	PY	Y	Y	Y	Y	Y	Y	Y	Y	Low
Kvam 2016	Y	N	Y	Y	Y	Y	Y	Y	Y	PY	N	N	Y	Y	N	Y	Critically low
Lawlor 2001	Y	N	Y	Y	Y	Y	Y	Y	Y	PY	N	Y	N	N	Y	N	Critically low
Lawrence 2017	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	N	Y	Critically low
Lee 2021	Y	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y	Y	Y	N	Y	Critically low
Lee 2020	N	N	Y	N	Y	N	N	PY	N	N	N	N	N	N	N	Y	Critically low
Leng 2018	Y	N	Y	PY	Y	Y	N	PY	Y	N	Y	N	N	N	Y	Y	Critically low
Liu 2019	Y	N	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y	N	Y	Critically low
Li 2019	Y	N	Y	PY	Y	Y	N	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Li 2019	Y	N	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	Y	Y	Y	Critically low

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Lund 2020	N	Y	Y	PY	Y	N	N	N	Y	N	N	Y	Y	N	N	Y	Critically low
Lyu 2021	Y	Y	Y	PY	Y	Y	N	PY	Y	N	N	N	N	N	N	Y	Critically low
McCurdy 2017	Y	N	Y	PY	Y	Y	N	PY	Y	N	Y	Y	Y	Y	N	Y	Critically low
McGettigan 2020	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Low
McGranahan 2021	N	N	N	N	N	N	N	PY	N	N	Y	Y	Y	Y	Y	Y	Critically low
Miller 2020	Y	Y	Y	PY	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Low
Miller 2020	Y	Y	Y	PY	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Low
Mishra 2012	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Morres 2019	Y	N	Y	PY	Y	Y	N	PY	Y	N	Y	Y	Y	Y	Y	N	Critically low
Nebiker 2018	Y	N	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	N	Y	Y	Critically low
Nixon 2005	Y	Y	Y	Y	Y	Y	Y	PY	PY	N	Y	N	N	N	N	Y	Critically low
Park 2014	Y	N	Y	Y	Y	Y	N	N	Y	N	Y	Y	Y	N	Y	N	Critically low
Patsou 2017	Y	N	Y	N	N	N	N	Y	Y	N	Y	N	N	N	Y	Y	Critically low
Pavey 2011	Y	N	Y	N	Y	N	Y	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Pearsall 2014	Y	N	Y	N	N	N	N	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Peddle-McIntyre 2019	Y	Y	Y	Y	Y	Y	Y	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Pentland	Y	PY	Y	N	Y	Y	N	PY	Y	N	Y	N	N	Y	Y	Y	Critically low

Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Ramachandran 2021	Y	N	Y	PY	Y	Y	Y	PY	Y	Y	Y	N	N	Y	N	Y	Critically low
Ramirez-velez 2021	Y	PY	Y	N	Y	Y	N	PY	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Ramos-Sanchez 2021	Y	Y	Y	PY	Y	Y	PY	PY	Y	Y	Y	N	Y	Y	Y	Y	High
Rhyner 2016	Y	N	Y	PY	N	N	N	PY	N	N	Y	N	N	N	Y	N	Critically low
Rosenbaum 2015	Y	N	Y	Y	Y	Y	N	PY	PY	N	Y	N	N	Y	Y	N	Critically low
Russ 2021	Y	N	Y	N	Y	N	N	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Salihu 2021	Y	Y	Y	N	Y	N	N	Y	Y	N	Y	Y	Y	Y	N	Y	Critically low
Schuch 2016	Y	N	Y	PY	Y	Y	N	N	Y	N	Y	Y	N	N	Y	Y	Critically low
Schuch 2016	Y	N	Y	PY	Y	Y	N	N	Y	N	Y	Y	Y	N	Y	Y	Critically low
Schumacher 2021	Y	PY	Y	PY	Y	Y	N	N	Y	N	N	N	N	Y	N	N	Critically low
Singh 2018	Y	N	N	Y	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Singh 2020	Y	N	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	N	N	Y	Critically low
Stathopoulos 2006	N	N	Y	N	N	N	Y	Y	N	N	N	N	N	N	Y	N	Critically low
Stubbs 2017	Y	N	Y	Y	Y	Y	N	Y	Y	N	Y	N	N	Y	Y	Y	Critically low
Tu 2014	Y	N	Y	N	N	Y	N	Y	Y	N	Y	N	Y	Y	Y	Y	Critically low
vanHaren 2013	N	N	Y	N	N	N	N	N	Y	N	Y	Y	N	N	N	N	Critically low
Vashistha 2016	Y	PY	Y	N	Y	Y	N	PY	Y	N	Y	N	N	N	N	Y	Critically low

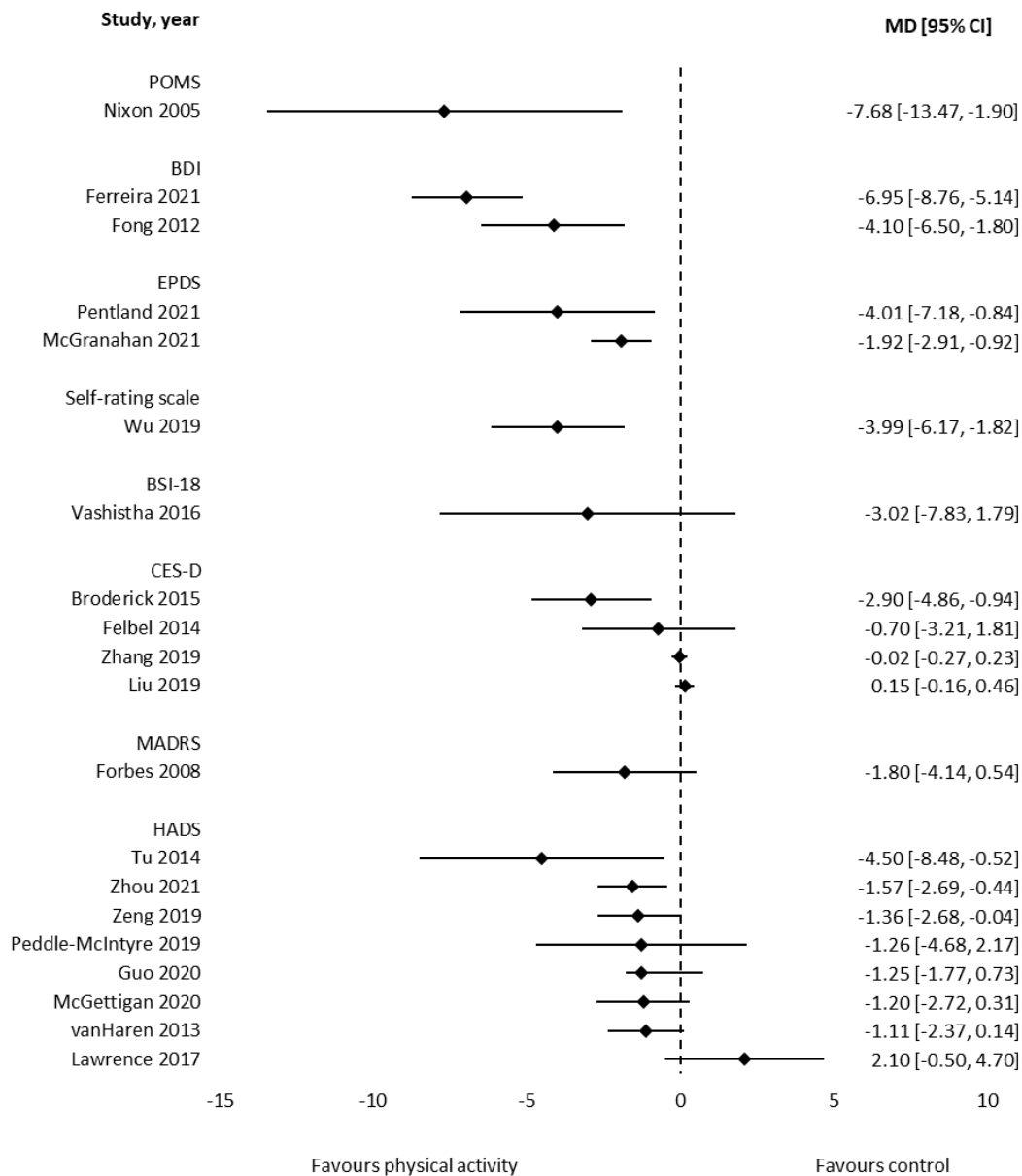
Review	AMSTAR 2 Items																Overall confidence rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Wang 2014	N	N	Y	N	Y	Y	N	PY	PY	N	N	N	N	Y	Y	Y	Critically low
Wang 2019	Y	N	Y	N	Y	Y	N	N	Y	N	N	N	N	N	N	N	Critically low
Weber 2020	Y	N	N	N	N	Y	N	PY	Y	N	N	N	N	N	Y	Y	Critically low
Wu 2019	Y	N	Y	N	Y	Y	N	PY	Y	N	N	N	N	N	N	Y	Critically low
Xiang 2017	Y	Y	Y	N	Y	N	N	PY	Y	N	Y	Y	Y	Y	Y	Y	Critically low
Yi 2021	Y	N	N	N	Y	Y	N	PY	Y	N	N	N	N	Y	Y	Y	Critically low
Zeng 2019	Y	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	Y	Critically low
Zeng 2014	Y	N	N	Y	Y	Y	N	PY	Y	N	N	N	N	N	N	Y	Critically low
Zeng 2019	Y	N	N	Y	N	Y	N	PY	Y	N	Y	Y	Y	Y	N	Y	Critically low
Zhang 2019	Y	N	N	Y	Y	Y	N	PY	Y	N	N	Y	N	Y	N	Y	Critically low
Zhao 2019	Y	N	N	N	Y	Y	N	PY	Y	N	N	N	N	N	Y	Y	Critically low
Zhou 2021	Y	N	N	N	Y	Y	N	PY	Y	N	Y	N	N	Y	N	Y	Critically low
Zuo 2016	Y	N	N	N	Y	Y	N	PY	Y	N	N	N	N	N	Y	N	Critically low

Note: Y=yes; N=no; Partial Y=meets criteria for partial yes; N/A=not applicable as no meta-analysis conducted

Legend: AMSTAR 2 Items: 1) The Participant, Intervention, Comparator and Outcome (PICO) components included in the review research question and inclusion criteria; 2) Explicit statement included that review methods were established prior to conduct and significant deviations justified; 3) Selection of included study designs explained; 4) Comprehensive search strategy used; 5) Study selection performed in duplicate; 6) Data extraction performed in duplicate; 7) List of excluded studies with justification provided; 8) Included studies described in adequate detail; 9) Satisfactory technique used for assessing risk of bias in included studies; 10) Sources of funding for included studies reported; 11) Appropriate methods for statistical combination of results used if meta-analysis performed; 12) Potential impact of risk of bias of individual studies assessed if meta-analysis performed; 13) Risk of bias of individual studies accounted for in discussion of the review results; 14) Any heterogeneity observed in the review

results was explained and discussed; 15) Publication bias investigated and discussed if meta-analysis performed; 16) Authors reported any potential sources of conflict of interest.

eFigure 3. Results of meta-analyses that assessed depression using mean differences.



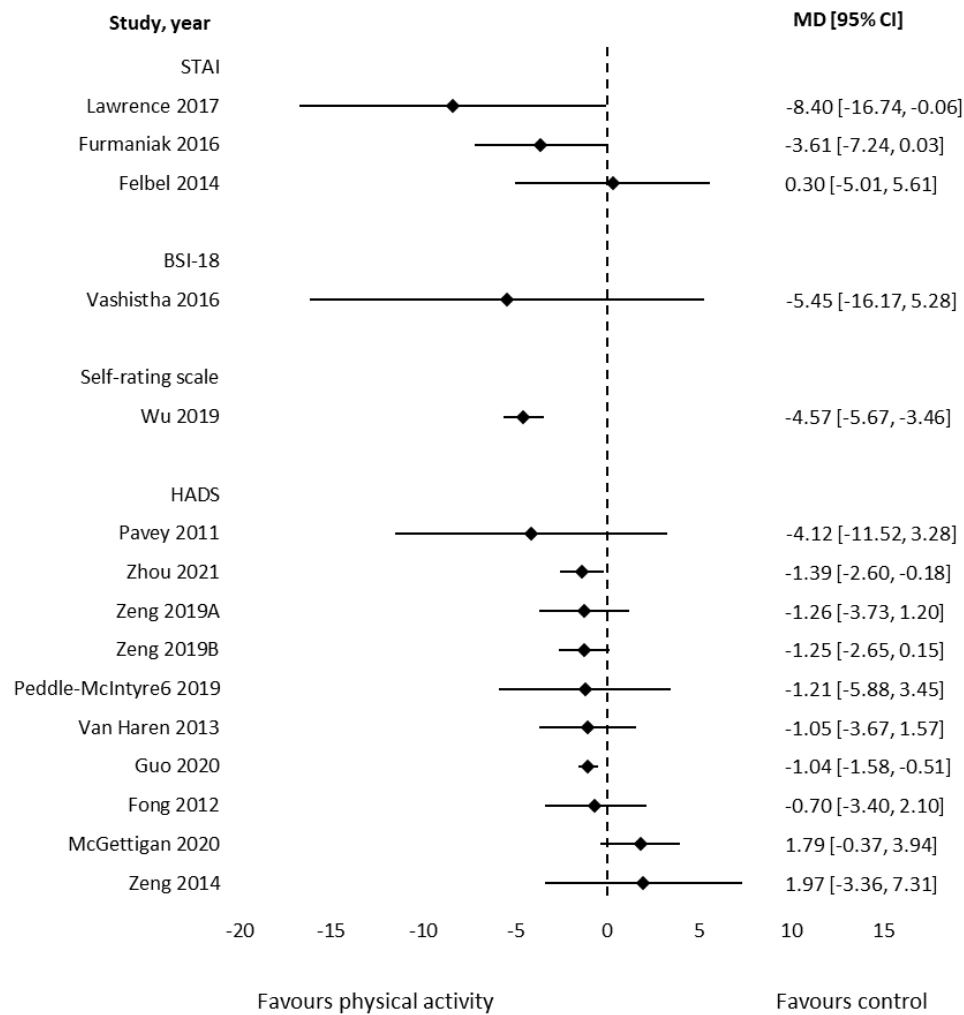
BDI: Beck Depression Inventory; CES-D: Center for Epidemiological Studies Depression; EPDS: The Edinburgh Postnatal Depression Scale; HADS: Hospital Anxiety and Depression Scale; MADRS: Montgomery-Asberg Depression Rating Scale; POMS: Profile of Mood States.

eTable 4. Overview of results of meta-analyses using mean differences for anxiety and depression.

	Reviews	Studies	Participants	Mean difference			Standardised mean difference (95% CI)
				25%ile	Median	75%ile	
Depression (instrument)							
Profile of Mood States	1	2	65		-7.68		-0.96 (-1.47, -0.44)
Beck Depression Inventory	2	7	>134	-6.24	-5.53	-4.81	-0.69 (-1.04, -0.34)
The Edinburgh Postnatal Depression Scale	2	19	1110	-3.49	-2.97	-2.44	-0.74 (-0.86, -0.62)
Self-rating scale	1	6	415		-3.99		-0.79 (-0.99, -0.59)
Brief Symptom Inventory 18	1	2	92		-3.02		
Center for Epidemiological Studies Depression	4	6	847	-1.25	-0.36	0.02	-0.72 (-0.85, -0.58)
Montgomery-Asberg Depression Rating Scale	1	1	117		-1.80		-0.33 (-0.74, -0.07)
Hospital Anxiety and Depression Scale	8	15	622	-1.41	-1.26	-1.18	-0.18 (-0.33, -0.02)
Anxiety (Instrument)							
The State-Trait Anxiety Inventory	3	4	262	-6.01	-3.61	-1.66	-0.51 (-0.76, -0.27)
Brief Symptom Inventory-18	1	2	92		-5.45		-0.49 (-0.91, -0.08)
Self-rating scale	1	6	415		-4.57		-0.41 (-0.61, -0.22)
Hospital Anxiety and	10	22	3360	-1.13	-1.26	-0.79	-0.21 (-0.27, -0.14)

Depression Scale							

eFigure 5. Results of meta-analyses that assessed anxiety using mean differences.



BSI-18: Brief Symptom Inventory-18; HADS: Hospital Anxiety and Depression Scale; STAI: The State-Trait Anxiety Inventory.

Figure 6. Results of subgroup meta-analyses for depression based on physical activity mode.

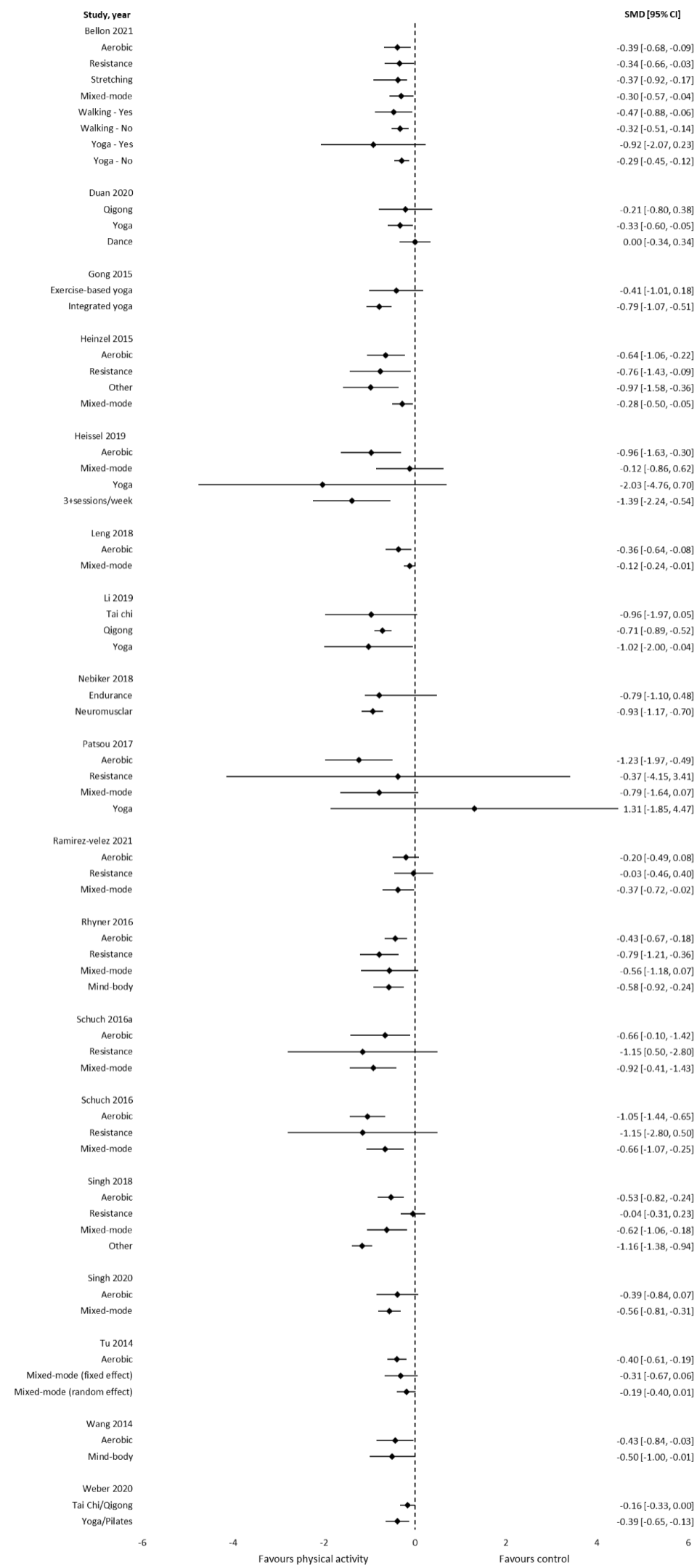
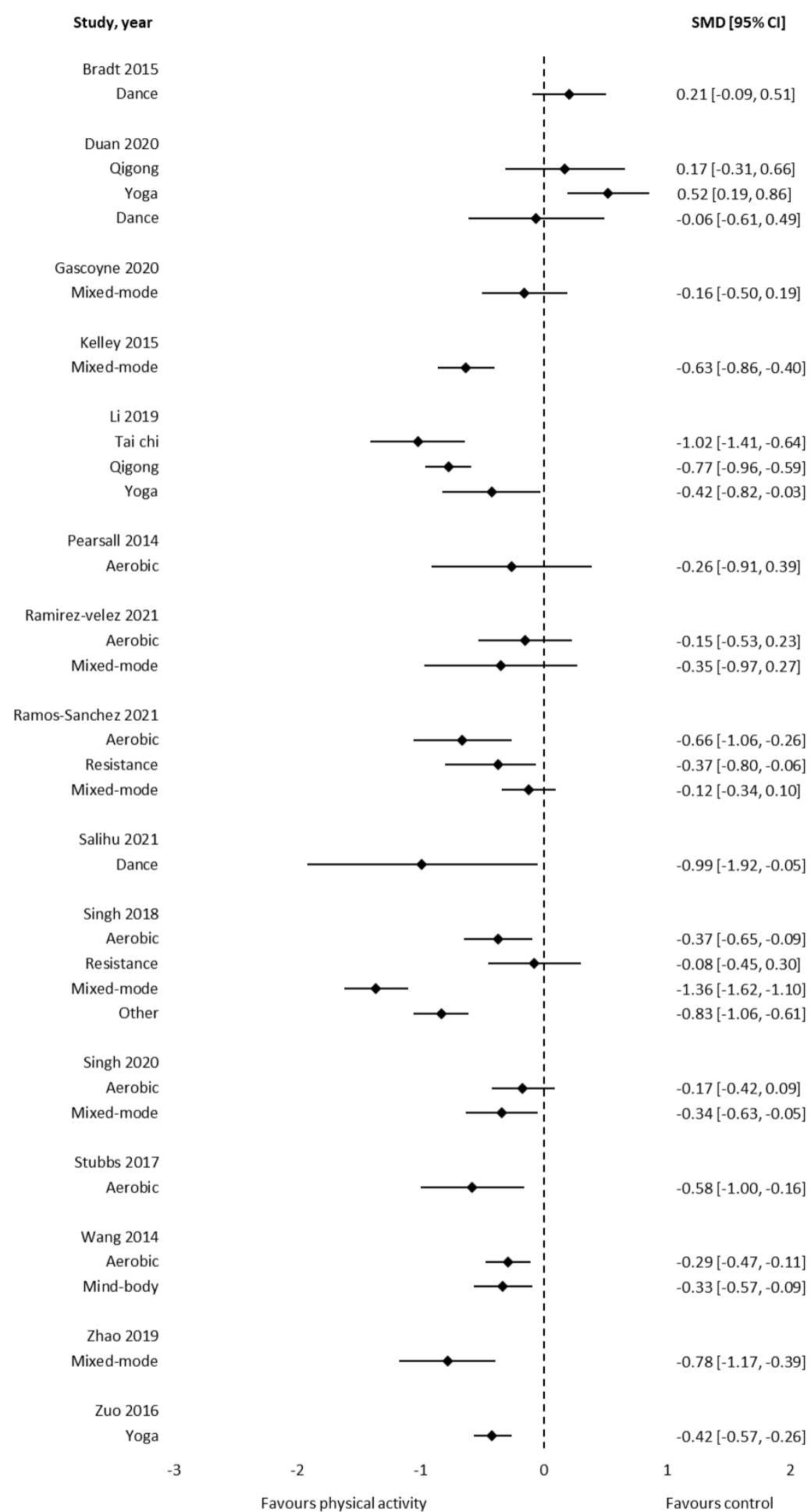


Figure 7. Results of subgroup meta-analyses for anxiety based on physical activity mode.



eFigure 8. Results of subgroup meta-analyses for depression based on physical activity intensity.

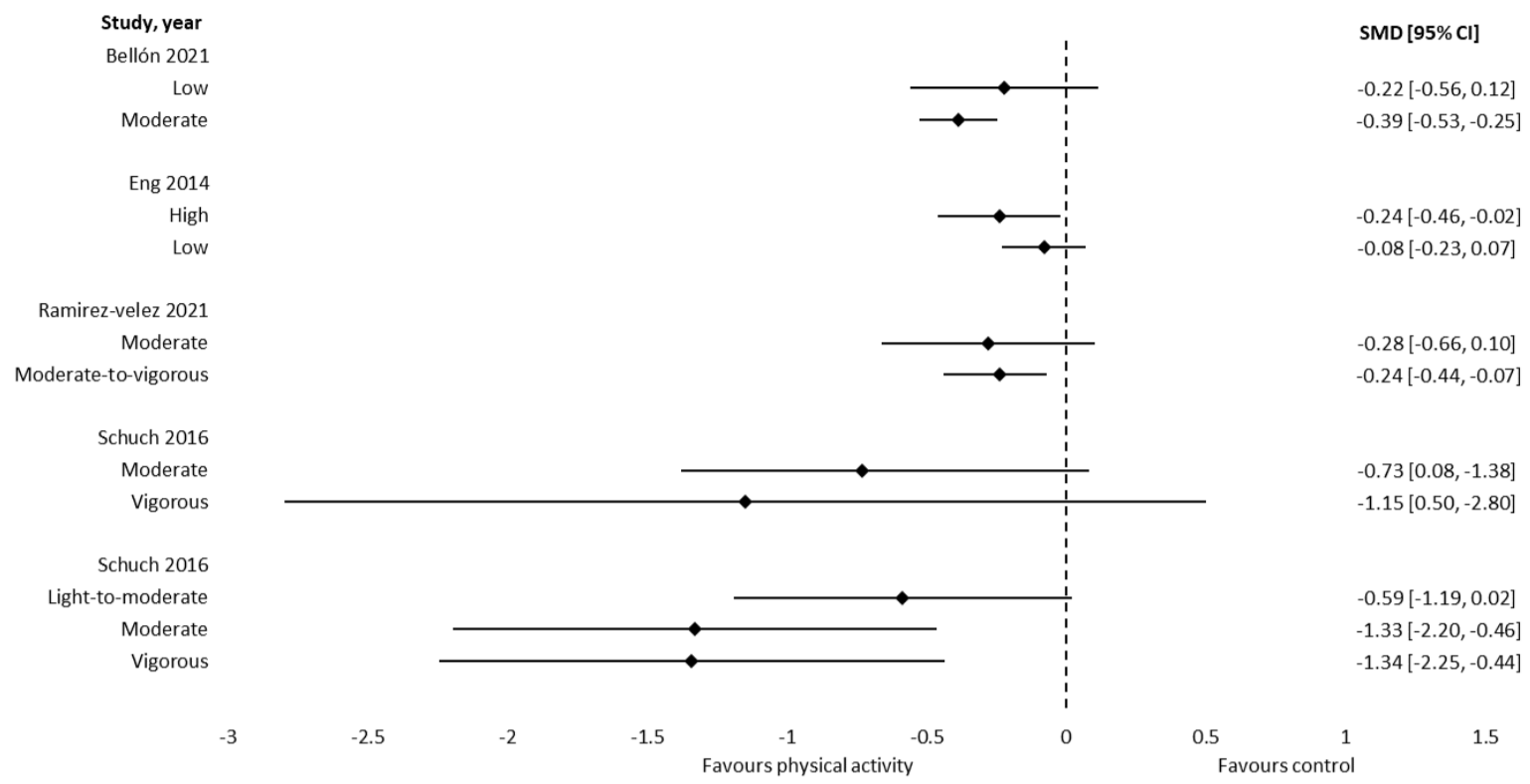
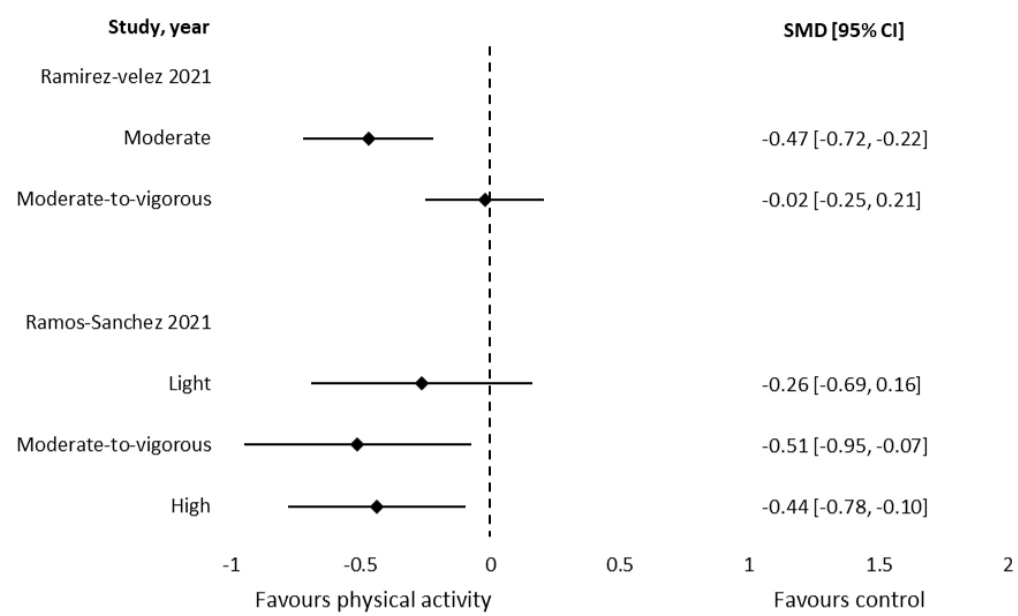


Figure 9: Results of subgroup meta-analyses for anxiety based on physical activity intensity.



eFigure 10: Results of subgroup meta-analyses for depression based on intervention duration.

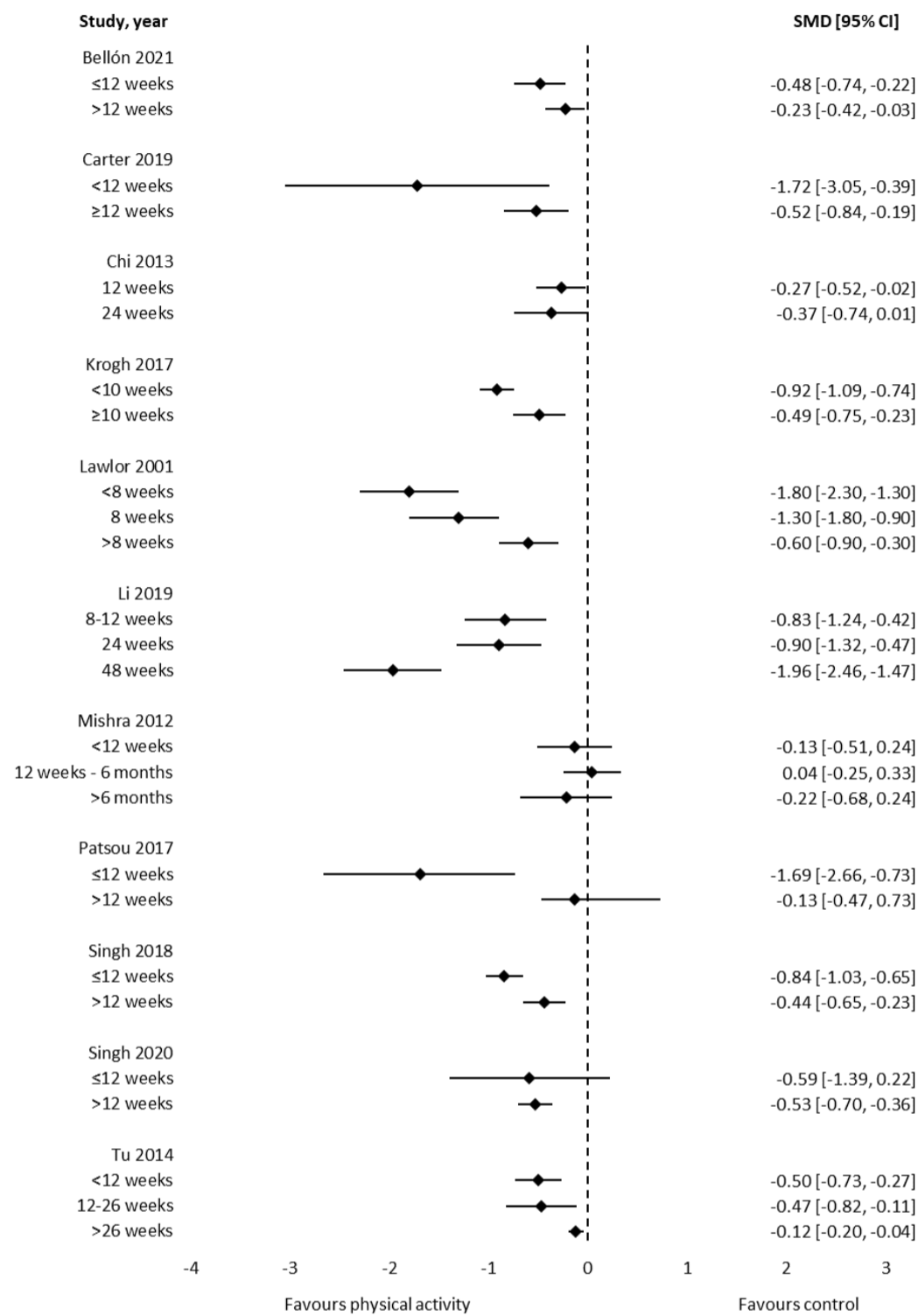


Figure 11: Results of subgroup meta-analyses for anxiety based on intervention duration.

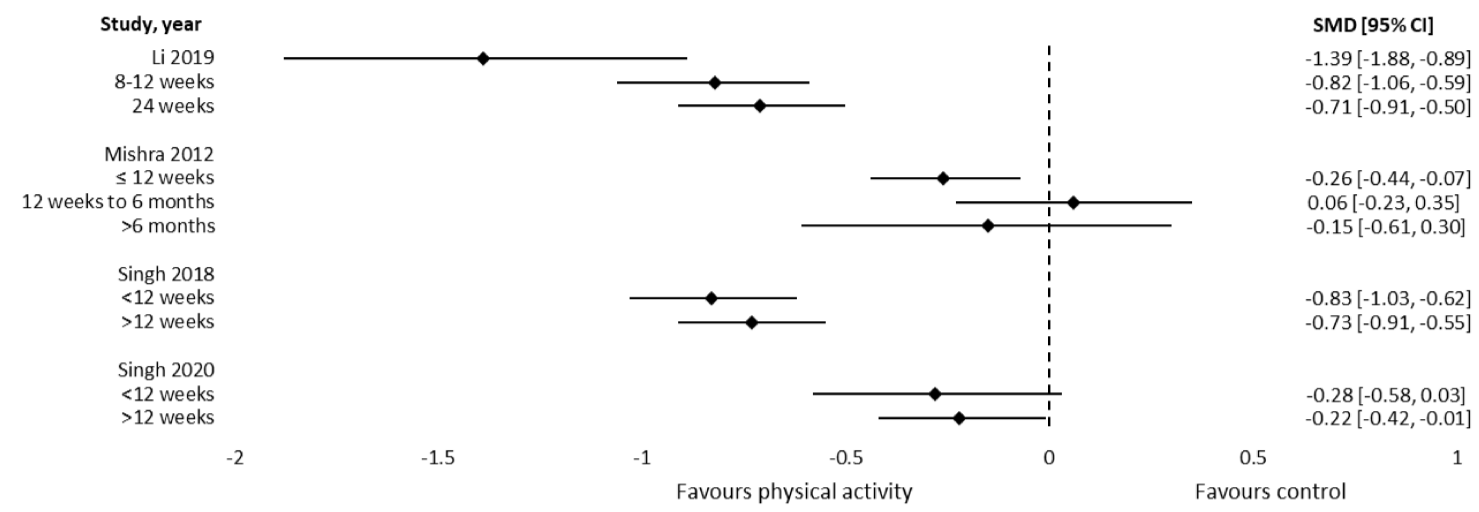


Figure 12: Results of subgroup meta-analyses for depression based on weekly duration.

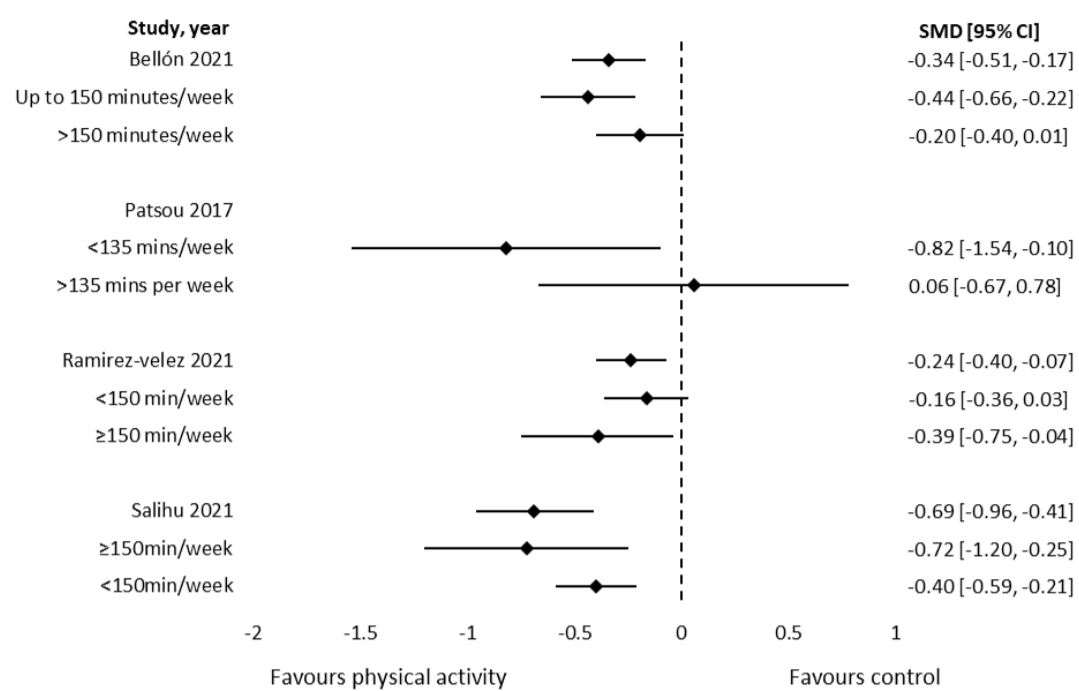
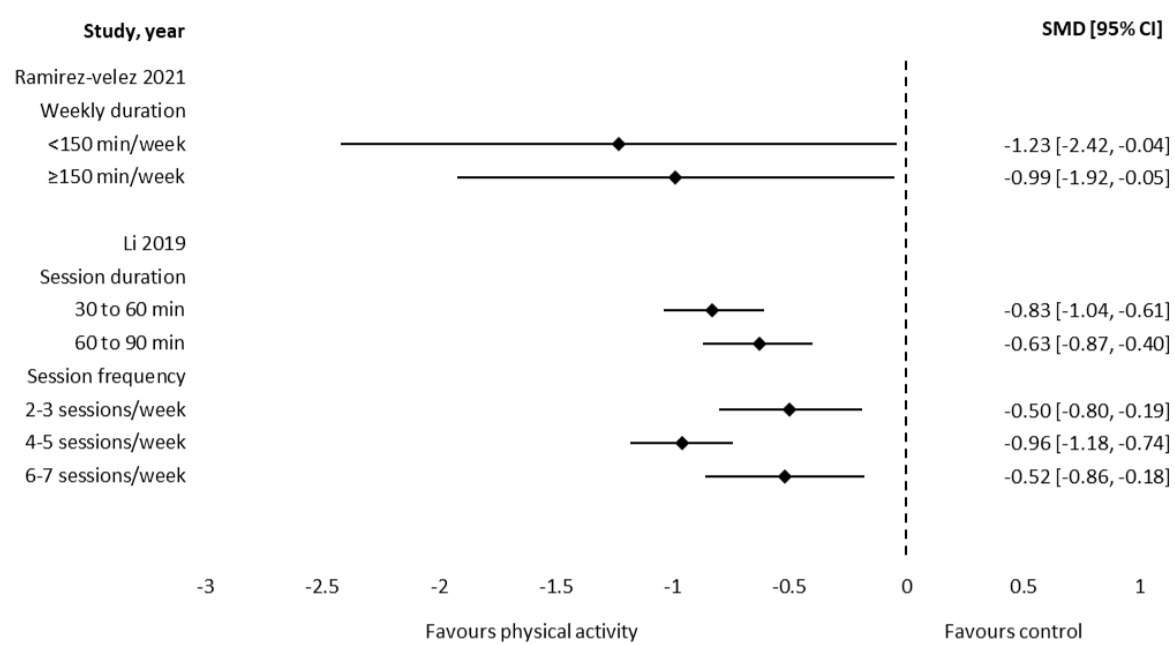
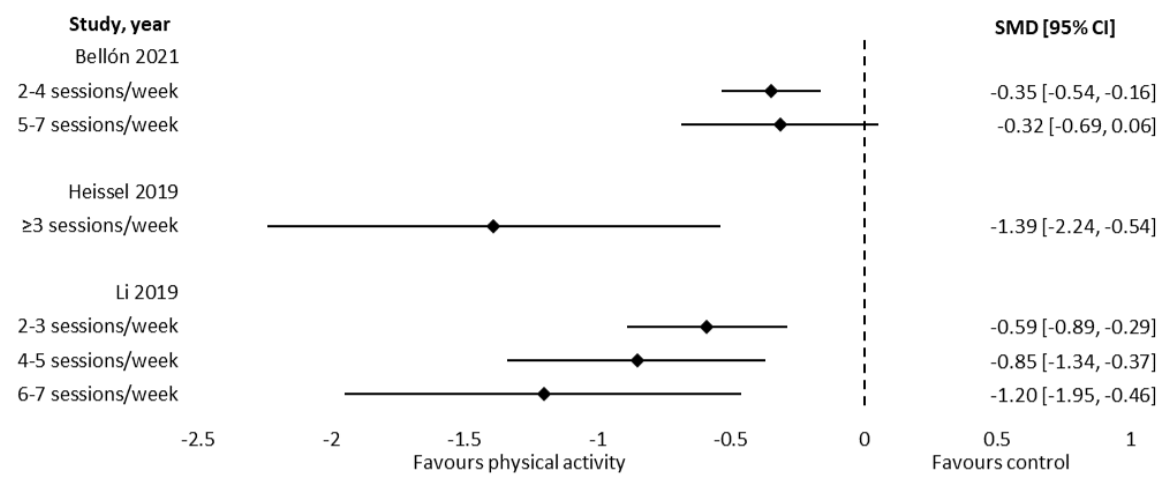


Figure 13: Results of subgroup meta-analyses for anxiety based on weekly duration, session duration and session frequency.



eFigure 14: Results of subgroup meta-analyses for depression based on session frequency.



eFigure 15: Results of subgroup meta-analyses for depression based on session duration.

