The impact of motivational interviewing on behavioural change and health outcomes in cancer patients and survivors. A systematic review and meta-analysis

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Review article

The impact of motivational interviewing on behavioural change and health outcomes in cancer patients and survivors. A systematic review and meta-analysis

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ABSTRACT

Background: Cancer patients and survivors commonly have poorer health behaviours and subsequent outcomes, often as a result of negative impacts of diagnosis and treatment. Motivational interviewing is reported to be an effective psychological tool to produce a shift in one's behaviour resulting in improved outcomes. However, there is a lack of analyses investigating this tool's impact on healthy behaviours and health outcomes in cancer populations.

Objective: To investigate the effect of motivational interviewing on behaviours and health outcomes in cancer populations.

Methods: The studies were identified from four databases using variations of the terms "cancer" and "motivational interviewing". Randomised trials, non-randomised trials and quasi-experimental studies which contained control (or usual care) comparators were included. Risk of bias was assessed using the Cochrane Risk of Bias Version 5.1.0 and the Risk of Bias In Non-Randomised Studies of Interventions tools. The quality of evidence was assessed using the GRADE framework. Means difference and standardised mean differences and 95 % confidence intervals were used to report the pooled effects using a random effects model.

Results: Twenty-one studies were included in the review and 17 studies were included in the meta-analysis. A total of 1752 cancer patients and survivors received MI as an intervention (or part thereof). Quality of life, anxiety, depression, functional tasks (6-minute walk test), body mass index and body weight (BMI/BW), physical activity (PA), self-efficacy and fatigue were outcomes measured in the selected studies. Effects were seen in functional tasks, physical activity, BMI/BW, depression and self-efficacy. All of these outcomes were from studies that were classed as very low-quality evidence except for BMI/BW and PA, which were from moderate-quality evidence.

Conclusion: Motivational interviewing had positive effects on functional tasks, PA, BMI/BW, depression and self-efficacy in people diagnosed with cancer. However, more higher-quality studies need to be conducted to further ascertain the effect of this intervention.

1. Introduction

The prevalence of cancer is steadily increasing each year, with an estimated 151,000 new cancer diagnoses in Australia in 2021 [1]. Many patients suffer from adverse effects of cancer diagnosis or treatment including fatigue [2], depression [3], pain [4], financial challenges and social isolation [5] both during active treatment and well into longer-term survivorship periods. Consequently, an individual's motivation and ability to engage in recommended levels of healthy behaviours can become limited [6,7]. Only 10 % of female breast cancer survivors

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(fBCS) achieve recommended physical activity (PA) levels [8], whilst approximately 15 % of cancer survivors are cigarette smokers [9]. Unhealthy behaviours such as these are disadvantageous as maintaining healthy behaviours can help to ameliorate many adverse effects of treatment [10], improve cancer survival and reduce further cancer risk [9,11]. The time of initial diagnosis and treatment is proposed by Denmark-Wahnefried et al., to be a 'teachable moment', which presents a unique opportunity for oncologists to advise and motivate cancer patients to engage in behavioural change [12]. Paradoxically, this is when adverse effects can maximally impact the capacity to maintain or improve health behaviour. The importance of behavioural change strategies in boosting adherence to desired behaviour in cancer populations is well recognised. Evidence supports the use of motivational tools such as pedometers, print materials and counselling to significantly improve self-directed PA levels in fBCS [13] and increased adherence to PA and nutritional recommendations in mixed cancer survivor populations [14].

Motivational interviewing (MI) is a psychological motivational tool primarily designed to resolve an individual's ambivalence to behavioural change [15]. MI has specific hallmarks that ensure its overall effectiveness, including collaboration between practitioner and patient, showing empathy, identifying reasons for ambivalence, being flexible with resistance to change and reinforcing a patient's confidence in their capacity for change. Therefore, MI can be useful in achieving particular goals, such as eating a healthy diet (behavioural change), or managing pain (perception and attitudes to symptoms) in a specific population or context. A large meta-analysis of 48 studies (9618 participants) investigated the effects of MI in a medical setting and showed a statistically significant improvement in a range of health outcomes such as blood pressure, body weight, cholesterol level, death rate, dental caries, HIV viral load, body weight, physical strength, quality of life (QoL) and healthy behaviours such as substance abuse, sedentary behaviour, treatment adherence, self-efficacy and intention to change [16]. Additionally, in a systematic review, common features of MI including conducting the interview over the phone with a trained nurse, the use of worksheets or diaries and strategies targeting improving PA behaviour were all associated with improved behavioural outcomes in cancer populations [17].

As previous studies of MI have not focused on cancer survivors, who have a unique set of needs and circumstances which effect adherence, this systematic review and meta-analysis investigated the impact of MI on healthy behaviours and related behavioural health outcomes in mixed-cancer populations. We aimed to identify the effect of MI on healthy PA behaviours and health outcomes such as QoL, anxiety, depression, functional tasks, self-efficacy, BMI and fatigue were determined in cancer patients and survivors. Findings from this review will help to inform future research in methods that can improve the well-being of cancer patients and survivors.

2. Methods

2.1. Protocol and registration

A protocol was written according to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA 2020) [18]. The protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42022315725).

2.2. Eligibility criteria

2.2.1. Participants

Studies were included if participants were: (1) 18 years or older; (2) had a previous or current cancer diagnosis; and (3) human subjects.

2.2.2. Intervention

The systematic review included studies that used MI as the solitary intervention or combined with other components, such as primary exercise or diet interventions. For the purpose of this review, MI was defined as an intervention that was in 'real-time' either in-person or over the phone (inclusive of associated terms such as 'counselling' or 'coaching') that was underpinned by MI principles. Interventions that were passively delivered such as an educational video or print materials alone were excluded given the interactive dynamic nature of MI.

2.2.3. Comparator

Studies included in this review were randomised controlled trials (RCTs) and quasi-experimental studies which involved using one or more comparators, or a control group within the design. Those with a mixed-methods design were included if the relevant quantitative data could be extracted. In three-arm studies involving two interventions (one with and one without MI) and one control group, two comparisons were conducted. Studies were considered eligible if the control group received either no intervention or 'usual care', so long as it did not involve any components of MI.

2.2.4. Outcome

Studies that measured either health behaviours or health outcomes were included.

2.2.5. Report characteristics

This systematic review and meta-analysis included articles that were peer-reviewed, with full-text availability and in English. Exclusions were book chapters, conference abstracts and review articles.

2.3. Information sources and search strategy

The search was conducted in September 2022. The databases: PubMed, PsychINFO (EBSCOhost), SPORTDiscus with full text (EBSCOhost), and Cumulative Index to Nursing and Allied Health Literature (CINAHL) with full text (EBSCOhost), were searched for articles published since 1980 (based on development of MI). The terms used within each database during the final search are presented in Supplementary Table 1.

Search results from each of the four databases were imported into EndNote X9 and duplicates removed. All articles were then exported into the ©2022 Covidence software, with two co-authors independently screening the titles and abstracts according to the eligibility criteria, prior to full-text review. Inconsistencies or disagreements were resolved by a third reviewer (JF). A summary of article inclusion and exclusion at each stage was conducted using the Preferred Reporting of Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram of identification, screening, eligibility and inclusion of studies template [19].

2.4. Data extraction

Data from the included studies were extracted and manually entered into a Microsoft Excel spreadsheet by a reviewer (KH). Authors of studies where data was inconsistent or not reported were contacted via email, and if no response was received, then the study was excluded.

The following data were extracted from each study: publication details (author and year), type of study design (RCT, quasi-experimental), sample size, demographic details of participants (mean age, cancer type, patient stage such as active or survivorship), intervention characteristics (the aim of MI, duration and number of MI sessions; delivery mode of MI: combined, in-person or phone; and other components such as pedometer or print materials), outcome details (outcomes measured and measurement follow-up time-points) and additional comments such as financial reimbursement and if intervention fidelity measures were undertaken.

2.5. Assessment of risk of bias

The two independent reviewers (KH and NT) assessed the risk of bias in the included studies, with a randomised controlled study methodology, using a modified version of the Cochrane Collaboration's tool assessing the risk of bias Version 5.1.0. (RoB 5.1.0) [20]. As blinding participants to MI and any other components of the intervention was impossible, the third domain of performance bias was modified to be defined as blinding of personnel only [21]. Furthermore, the reporting bias domain was defined as being specific to the reporting of outcomes by the authors and researchers, and not reporting bias associated with self-reporting of outcomes by participants, such as medication adherence and PA levels. If there was a suspected reporting bias due to participant self-reporting measures, it was included as a high risk within the seventh domain. Each of the domains were then be assigned either 'low risk', 'high risk' or 'unclear risk' [20]. The methodological quality of studies that were either quasi-experimental or non-randomised were assessed using the Cochrane Risk of Bias In Non-Randomised Studies of Interventions (ROBINS-I) tool [22]. Disagreements were resolved by a third reviewer (JF).

2.6. Synthesis of results

Two reviewers (KH and NT) conducted the meta-analysis using Review Manager (RevMan) Version 5.4.1 (The Cochrane Collaboration, Denmark). For continuous outcome data, mean change from baseline or post-intervention and standard deviation, were calculated for each study. Functional task (6 minute walk test) data were analysed using the mean difference (MD) statistic as all included studies utilised the same outcome measuring tool. QoL, anxiety, depression, BMI, PA, self-efficacy and fatigue were analysed using the standardised mean difference (SMD) statistic given the heterogeneity between outcome assessment tools. The effect score of SMD or MD was considered as either; small (<0.20), moderate (0.20–0.80) or large (>0.80).

The I^2 statistic was used to identify heterogeneity between studies using the following ranges: 0–30 % no relevant heterogeneity, 31–60 % moderate heterogeneity, 61–90 % substantial heterogeneity and 91–100 %.

The Grading of Recommendations, Assessment, Development and Evaluations (GRADE) framework was used to assess the quality of evidence across five criteria [23]. The five criteria were modified and based upon those in other similar meta-analyses of MI [24]:

1. Risk of Bias: Assigned 'Yes' if >25 % of studies included within the outcome analysis were classified as 'high' or 'serious' risk
2. Inconsistency (unexplained heterogeneity): Assigned 'Yes' if I^2 value was >50 %
3. Indirectness: Assigned 'Yes' if there were any of the following: a) Indirect comparison between MI and the comparator group; or b) specifics of the MI mode delivery were difficult to ascertain
4. Imprecision (wide CIs): Assigned 'Yes' if The CI for the SMD was >0.8 (a large effect according to Cohen [25]).
5. Publication Bias: Assigned 'Yes' if funnel plot was used to evaluate when >10 studies within the same outcome.

For every 'Yes' assigned to each criterion there was one point deduction (downgrading of quality of evidence) from a starting total figure of five. Reporting bias was evaluated by visual analysis of the funnel plot, if there were adequate studies. Overall quality criteria were assigned a classification of: High if no 'Yes' responses, Moderate if one 'Yes' response, Low if two 'Yes' responses, Very Low if three or more 'Yes' responses. See Table 2 for results.

3. Results

3.1. Study selection

The four databases yielded a resultant total of 13,607 articles: PubMed (10,806), CINAHL (2319), APA PsychInfo (101) and SPORTDiscus (381), with 9263 unique records following duplicate removal. Of these, 8959 studies were excluded after title and abstract screening for relevance and eligibility. Full texts of ten of the remaining 304 studies could not be retrieved. Full-text screening on the remaining 294 studies led to the ultimate inclusion of 21 studies for the literature review and 17 studies for data extraction used within the meta-analysis. This process is illustrated in Fig. 1 [18].

3.2. Study characteristics

Study characteristics are summarised in Table 1.

3.3. Study details

There were a total of 17 two-arm [26–42] and 2 three-arm RCT [42,43], one quasi-experimental [44] and one non-randomised controlled study [45]. The 21 included studies had 4154 participants (1752 intervention and 2402 control or non-MI intervention) with a mean age range from 43.7 to 67.1 years of age.

3.3.1. Demographic characteristics of participants

There were several cancer types that constituted the participant population with eight studies in mixed cancer [26–28,35,36,38,43,44], nine in breast cancer [29–31,33,34,37,39–41], one study in each of abdomino-pelvic [45], head and neck [42], lung [32] and colorectal cancer [46] populations. The point within the cancer continuum that participants were at varied with the meantime since the end of treatment or diagnosis being: one year or more in eight studies, between ten weeks and one year in five studies, between hospital discharge and one month in four studies, during the active phase of treatment in three studies and during pre-treatment phase in one study.

3.4. Intervention characteristics

The focus of the MI differed across the 21 included studies. Five studies used a MI intervention that was aimed at increasing or achievement of recommended PA levels [26,28,30,38,39]. Four studies focused at improving general health behaviour (diet and PA) and symptom management combined [33,37,45,46], whilst three studies used MI targeting general health behaviour (diet and PA), symptom management and self-efficacy combined [32,42,44]. Only one study aimed at improving only general health behaviour (diet and PA) [34]. Two studies focused on symptom management only; one primarily aimed at improving fatigue [36] and one aimed at pain [43]. Adherence to dietary goals was the focus in three studies [29,31,41] and adherence to oral medication was the focus in one study [27]. One study aimed their MI at improving smoking cessation and pain management [35] and one study used MI that was targeting improving sexual behaviour and body image [40].

Five studies delivered the MI in-person [33,38,40,42,46], six were over the phone [28,29,35,36,41,43] and ten were a combination of both in-person and over the phone [26,27,30–32,34,37,39,44,45]. There was great heterogeneity between the number, duration and frequency of MI sessions ranging from 1 to 32 sessions, 10 to 75 min in duration and between a few days to 6 months apart.

Many studies utilised other components (in addition to MI) within their intervention such as; pedometers [26,29,30,37,39,45], supervised PA sessions [28,37], group education sessions [28,37,41], workbook or diary [28,34–37,41,45] and information booklets [27,29–32,34–38,40,43–46]. Nine studies contained methods that were

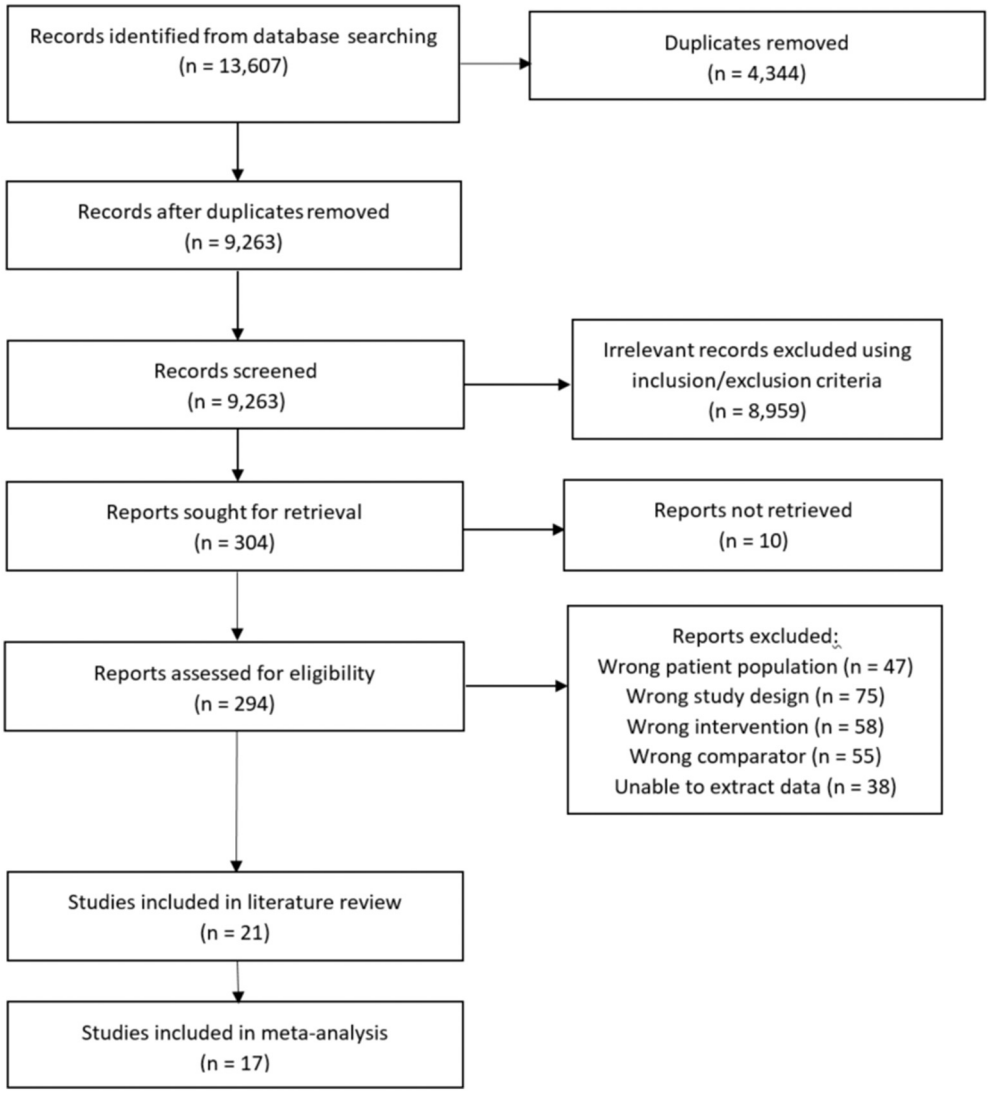

Fig. 1. Literature search summary according to PRISMA guidelines.

taken to ensure fidelity of the MI intervention [28,29,31–33,36,38,43,44].

3.5. Outcomes

All studies measured at least one outcome with a mixture of both health behaviour and health outcomes. Nine studies measured PA behaviour [26,28–30,34,37–39,45], four assessed dietary behaviour [29,31,37,41], one measured adherence to oral medication [27], and one measured smoking cessation [35]. Many studies measured specific health outcomes such as: QoL [26,28,29,32,33,35,39,42,43,45,46], fatigue [26,28,36,38,39], anthropometric measures [29,30,34,37], functional and fitness measures [26,28,30,32,34,43,45,46] and mental health [28,32,33,35,36,38,42,45,46]. Finally, self-efficacy was investigated in eleven studies [26–28,32,33,36–38,42,44,45].

3.6. Risk of bias within the studies

The randomisation (or lack thereof) and concealment of allocation into groups were reported by most studies. Due to the inherent nature of the intervention being delivered by personnel, all studies were deemed 'high risk' in the criteria of performance bias or 'serious risk' in the criteria of bias due to deviations from intended interventions. However, with regards to the reporting of blinding of assessors to the participant allocation (bias in measurement of outcomes in the ROBINS-I tool), two clearly stated the assessors were not blinded [40,46] and 11 studies didn't report if the assessors were different to those delivering the intervention, and were therefore deemed either 'unclear risk' or 'no information' for that criteria. The reporting on management of missing data was poor with more than half either not reported [29,31–33,37–40,42] or showing missing data in the outcomes, without outlining accommodation methods [27,36,45], thus deemed 'unclear risk' or 'no information' by the reviewers. One study was deemed high risk as the authors made the assumption that surveys non-responders were ongoing smokers (in a study assessing smoking cessation rates) [35]. Another study was deemed high risk for reporting bias where not all domains within the QoL outcome were reported [43]. Finally, seven studies were deemed high risk of 'other' bias (or serious risk in bias in selection of the reported result in the ROBINS-I tool) which included: possible between group contamination during an outcome assessment [26,38], contamination between groups during intervention delivery of the exercise component (which both groups received) [28], bias in reporting due to self-reported outcome measures that could otherwise be measured with objective methods, such as PA and medication adherence or smoking cessation [26,27,29,34,35,37,38,45], control groups which were 'wait-list' rather than pure controls as stated [35], non-assessment

Table 1
Study characteristics.

Study details	Demographic characteristics				Intervention			Comparator	Outcome		Additional comments
Author (year), study design	Sample size	Mean age (years)	Cancer type	Cancer stage	Aim	Duration, number, and mode	Other components	Comparator group	Outcomes, measurement tools	FU (wks)	
Bennett (2007) [26] RCT	56	IG = 55.5, CG = 60.1	Mixed Ca	Survivors, mean time 42 M since completion of tmt	^PA Behaviour	3 × 30 min sessions, C	Pedometer	Received two social phone calls without MI content. No pedometer received	1) PA 2) Self-efficacy 3) Aerobic fitness 4) QoL 5) Fatigue	12, 24	Received financial reimbursement
Çakmak (2021) [27] RCT	80	IG = 57, CG = 62	Mixed Ca	Active tmt	^Adherence to oral medication	5 × 15-20 min sessions, C	Print materials	Printed general health information and standard health advice	1) Self-efficacy 2) Medication adherence	12	
Coolbrandt (2018) [44] Quasi-experimental	142	IG = 62 (median), CG = 65 (median)	Mixed Ca	Active tmt	^Self-efficacy, healthy behaviours and symptom management	Minimum of 2 × 10–60 min sessions, C	Print materials	Printed general health information and standard health advice	1) Overall Symptom Distress & Severity 2) Self-efficacy	3, 6, 12	Using TTM to inform the MI design. Measures taken for MI fidelity
Dennett (2018) [28] RCT	46	IG = 57, CG = 60	Mixed cancer	Combined during and post active tmt, mean time since tmt 4.4 M	^PA behaviour	7 × 20 min sessions, P	Group education, supervised and home-based exercise sessions and print materials	Supervised and home-based PA sessions, group education sessions and print materials	1) PA 2) Physical function 3) Self-efficacy 4) Fatigue 5) QoL 6) Mental health 7) Blood analysis	8	Measures taken for MI fidelity
Djuric (2011) [29] RCT	40	Combined 52.3	Breast Ca	Pre-active tmt	^Adherence to dietary goals	19 × sessions, P	Print materials, pedometer	Print materials and pedometer	1) Anthropometrics 2) PA 3) QoL 4) Dietary intake 5) Blood analysis	24, 52	Measures taken for MI fidelity. Received financial reimbursement
Frawley (2020) [45] Non-randomised, controlled before and after study	188	IG = 66.1, CG = 67.1	Abdomino-pelvic Ca	Completed surgical tmt, mean time since surgery 70.5 days	^Adherence to PA and dietary recommendations + emotional management	16 × 1 h group sessions, C	Home-based ex program, print materials and pedometer	Nothing received	1) Feasibility 2) Physical function (IG only) 3) PA 4) Mental health 5) QoL 6) Self-efficacy 7) Pelvic floor symptoms	8, 24	
Hartman (2018) [30] RCT	87	IG = 58.2, CG = 56.2	Breast Ca	Survivors, mean time since surgery 30.1 M	^PA Behaviour	3 × sessions, C	Individualised PA recommendations and pedometer	Printed general health advice	1) PA 2) Objective neurocognitive functioning 3) Self-reported cognition 4) Anthropometrics	12	
Hoy (2009) [31] RCT	2437	IG = 58.6, CG = 58.5	Breast Ca	Survivors, within 365 days of active tmt	^Adherence to dietary goals	34 × 60 min sessions, C	Print materials	Print materials only	1) Dietary intake 2) Anthropometrics	12, 24, 36, 48, 60, 72	Measures taken for MI fidelity. TTM informing MI
Huang (2018) [32] RCT	30	IG = 57, CG = 61.1	Lung Ca	Immediately post-surgery	^Self-efficacy, healthy behaviours and	6 × 15-40 min sessions, C	Print materials	Print materials and four general	1) Feasibility 2) Acceptability 3) Self-efficacy	12	Measures taken for MI fidelity.

(*continued on next page*)

Table 1 (*continued*)

Study details	Demographic characteristics				Intervention			Comparator	Outcome		Additional comments
Author (year), study design	Sample size	Mean age (years)	Cancer type	Cancer stage	Aim	Duration, number, and mode	Other components	Comparator group	Outcomes, measurement tools	FU (wks)	
					symptom management			follow up phone calls	4) QoL 5) Mental health 6) Social support 7) Subjective wellbeing 8) Coping styles 9) Post-traumatic growth 10) Pulmonary rehabilitation effect		
Kvale (2016) [33] RCT	79	IG = 57 CG = 59	Breast Ca	Survivors, mean time since tmt 115 days	^Healthy behaviour + symptom management	1 × 75 min session, IP		Usual care (no detail given)	1) QoL 2) Self-reported health 3) Depression 4) Limitations in Social roles and activities 5) Self-Management 6) Self-efficacy 7) Care co-ordination	12	Measures taken for MI fidelity.
Lahart (2018) [34] RCT	32	IG = 52.5, CG = 52	Breast Ca	Survivors, mean time since tmt 10.9 wks	^Healthy Behaviour	4: 1 × 30-45 min sessions, C	Print materials, DVD, reminder emails and exercise diaries	Print materials on general health advice	1) Cardio-vascular fitness 2) Exercise tolerance 3) PA 4) Anthropometrics	24	
Pollak (2018) [35] RCT	30	IG = 60, CG = 54	Mixed Ca	Survivors, within 5 yrs of diagnosis	^Smoking cessation + pain management	4 × 60 min sessions, P	NRT, print materials and workbook	Nothing received	1) Feasibility 2) Acceptability 3) Abstinence 4) Mental health 5) Coping 6) QoL	8	
Ream (2015) [36] RCT	44	IG = 52, CG = 55	Mixed Ca	Active tmt	Symptom management (mostly fatigue)	3 × sessions, P	Print materials (information handbook and fatigue diary)	Nothing received	1) Global Fatigue 2) Fatigue DISTRESS 3) Self-efficacy 4) Mental health	3 treatment cycles	Measures taken for MI fidelity.
Sheppard (2016) [37] RCT	31	Combined 54.7	Breast Ca	Survivors, mean time since tmt 1.7 yrs	^Adherence to PA and dietary recommendations + emotional management	6 × 60 min + 6 × 15 min sessions, C	Print materials, supervised exercise sessions, pedometers	Print materials	1) PA 2) Anthropometrics 3) Cardio-vascular fitness 4) Self-efficacy 5) Dietary intake 6) Intervention satisfaction	12	Some interviewers were fBCS. MI informed by the TPB and SCT. Financial reimbursement
Thomas (2012) [43] 3 arm RCT: 2 × IG (1 × MI + education, 1 × education only) + 1 × CG	317	IG (MI) = 61.8, IG (non-MI) = 62.5, CG = 58.7	Mixed Ca	Survivors, mean time since diagnosis: MI group 30 M, non-MI group 37.5 M	Symptom management (pain)	4 × 30 min sessions, P	Information video on management of symptoms + print materials	Information video on cancer	1) Pain 2) Physical Function 3) Attitudinal barriers 4) QoL	12	Measures taken for MI fidelity.

(*continued on next page*)

Table 1 (*continued*)

Study details	Demographic characteristics				Intervention			Comparator	Outcome		Additional comments
Author (year), study design	Sample size	Mean age (years)	Cancer type	Cancer stage	Aim	Duration, number, and mode	Other components	Comparator group	Outcomes, measurement tools	FU (wks)	
Tsianakas (2017) [38] RCT (mixed methods)	42	IG: Male = 65, female = 60 CG: Male = 66.2, female = 58	Mixed Ca	Advanced, meantime since diagnosis: 25 % < 1 yr, 35 % 1-2 yrs, 10 % 3-4 yrs, 20 % 5-9 yrs, 10 % 10+ yrs	ˆPA behaviour	1 × 15 min sessions, IP	Print material (PA promotion)	Advised to continue on current PA levels	1) QoL 2) Health status 3) PA 4) Fatigue 5) Mental health 6) Self-efficacy 7) Feasibility	6, 12, 24	Measures taken for MI fidelity.
Turner (2019) [42] 3 arm RCT: 2 × IG (1 × MI, 1 × information) + 1 × CG	109	Combined IG and CG: <60 years = 49.1 %, >60 years = 50.9 %	Head and neck Ca	Survivors, time since tmt within 1 M	ˆSelf-efficacy, healthy behaviours and symptom management	1 × 60 min sessions, IP	Print material (information on survivorship issues)	Usual clinical care (no information resource)	1) QoL 2) Mental health 3) Self-efficacy	12, 24	
Vallance (2020) [39] (Lynch, 2019 for PA outcomes [47]) RCT	83	IG = 61.3, CG = 61.9	Breast Ca	Survivors, completed primary tmt (no values given)	ˆPA behaviour	6 × sessions, C	Pedometer and log book	Received a pedometer at wk 12 time-point	1) Fatigue 2) QoL 3) PA	12, 24	
Yang (2020) [46] RCT	68	IG = 59.97, CG = 63.62	Colorectal Ca	Survivors, immediately post surgery	ˆHealthy behaviour + symptom management	3 × sessions, IP	Print materials (colorectal cancer education handbook)	Print materials (colorectal cancer education handbook)	1) QoL 2) Mental health 3) Functional status 4) Healthy lifestyle	4, 12	
Zangeneh (2019) [40] RCT	60	IG = 43.7, CG = 45.9	Breast Ca	Survivors, completed mastectomy (no values given)	ˆSexual behaviour and body image	5 × 45 min sessions, IP	Group educational sessions	Nothing received	1) Sexual satisfaction 2) Body image	5	
Zuniga (2018) [41] RCT	153	IG = 55.3, CG = 58.4	Breast Ca	Survivors, mean time since tmt; <6 M: IG = 13.3 % CG = 12.3 % 6 M–24 M: IG = 21.7 % CG = 26.2 % >24 M: IG = 65 % CG = 61.5 %	ˆAdherence to dietary goals	6 × sessions, P	Group education sessions, individualised print materials and workbook	Monthly general health dietary information brochures	1) Adherence to diet 2) Spices and herbs intake 3) Nutrient analysis	24	

ˆ = increase/improve, BMI = body mass index, C = combined, Ca = cancer, CG = control group, Chemo = chemotherapy, FU = follow up measurement time points (baseline time point assumed), IG = intervention group, Info = information, IP = in-person, M = months, min = minutes, NRT = nicotine replacement therapy, P = phone, PA = physical activity, QoL = quality of life, RCT = randomised controlled trial, SCT = social cognitive theory, T0 = baseline, TPB = theory of planned behaviour, Tmt = treatment, TTM = trans-theoretical model, Wkly = weekly, Wks = weeks, Yrs = years.

of components of physical and mental health [39] or subject expectancy (with respect to group allocation) [46]. The risk of bias using the RoB 5.1.0 tool is summarised in Fig. 2 and using the ROBINS-I tool in Table 2.

3.7. Synthesis of results

3.7.1. Quality of life

When investigating the impact of MI on QoL outcomes, using the data from eight studies (with ten comparisons), there was no effect of MI on QoL compared to control groups (Fig. 3: SMD 0.09; 95 % confidence interval (CI) -0.05 to 0.23, p = 0.22, I^2 = 69 %, n = 789). The studies in this outcome were downgraded to low-quality due to risk of bias and inconsistency (Table 3).

3.7.2. Anxiety

There was no effect of MI on levels of anxiety, using the data from five studies (with six comparisons), compared to control groups (Fig. 4: SMD 0.09; 95 % CI -0.12 to 0.29, p = 0.23, I^2 = 28 %, n = 365). The five studies within this outcome were downgraded to a moderate quality of evidence due to risk of bias (Table 3).

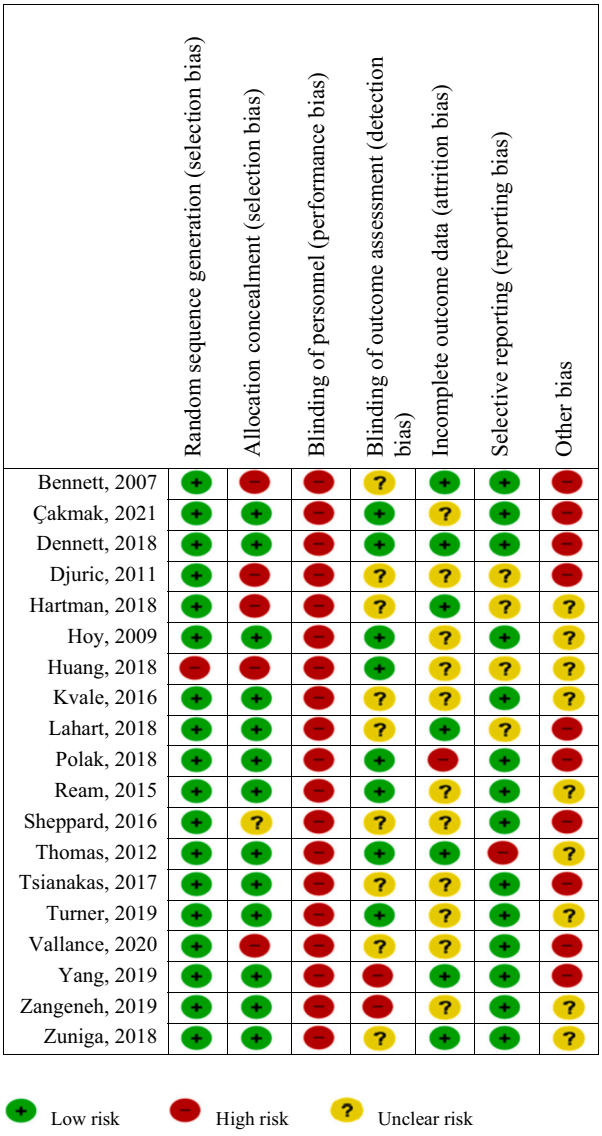

Fig. 2. The risk of bias assessment of randomised controlled studies using the RoB 5.1.0 tool summary.

3.7.3. Depression

There was a moderate effect of MI on levels of depression compared to control groups using the data from seven studies (with eight comparisons) (Fig. 5: SMD 0.38; 95 % CI 0.20 to 0.56, p < 0.0001, I^2 = 72 %, n = 502). The studies in this outcome were downgraded to very low-quality due to risk of bias, inconsistency and indirectness (Table 3).

3.7.4. Functional tasks

There was a large effect of MI on functional task (6 minute walk test) outcomes compared to control groups using the data from three studies (Fig. 6: MD 50.24; 95 % CI 22.04 to 78.44, p = 0.0005, I^2 = 83 %, n = 111). The studies in this outcome were downgraded to very low-quality due to risk of bias, inconsistency and imprecision (Table 3).

3.7.5. Body mass index and body weight

MI had a moderate effect on BMI and body weight outcomes compared to control groups using the data from six studies (with seven comparisons) (Fig. 7: SMD 0.25; 95 % CI 0.14 to 0.37, p < 0.0001, I^2 = 0 %, n = 1241). The studies in this outcome were downgraded to moderate-quality due to risk of bias (Table 3).

3.7.6. Physical activity

There was a moderate effect of MI on total PA outcomes compared to control groups (Fig. 8, 6.1.1: SMD 0.35; 95 % CI 0.12 to 0.58, p = 0.003, I^2 = 42 %, n = 304). There was a moderate effect of MI on step count compared to control groups (Fig. 8, 6.1.2: SMD 0.62, 95 % CI 0.25 to 0.99, p = 0.001, I^2 = 0 %, n = 119).

Combined, there was a moderate effect of MI on overall PA compared to control groups (Fig. 8: SMD 0.42; 95 % CI 0.23 to 0.62, p < 0.0001, I^2 = 32 %, n = 423). The studies in this outcome (both sub-categories and overall) were downgraded to moderate-quality due to risk of bias (Table 3).

3.7.7. Self-efficacy

MI had a moderate effect on self-efficacy outcomes compared to control groups from a total of eight studies (ten comparisons) (Fig. 9: SMD 0.33; 95 % CI 0.19 to 0.48, p < 0.0001, I^2 = 78 %, n = 746). The studies in this outcome were downgraded to very low-quality due to risk of bias, inconsistency and indirectness (Table 3).

3.7.8. Fatigue

There was no effect of MI on fatigue outcomes compared to control groups from a total of five studies (Fig. 10: SMD 0.25; 95 % CI -0.01 to 0.52, p = 0.06, I^2 = 66 %, n = 233). The studies in this outcome were downgraded to very low-quality due to risk of bias, inconsistency, and indirectness (Table 3).

4. Discussion

This review and meta-analysis provides new evidence that MI can positively impact, to varying degrees, the levels of PA, depression, functional tasks, BMI and self-efficacy, in populations of cancer patients and survivors. These results are somewhat reflected in other comparable analyses. In one meta-analysis of eight RCT's, there was a statistically significant improvement in PA levels, following an MI intervention, in populations with chronic diseases (multiple sclerosis, cardiovascular disease and obesity) immediately post-intervention however not sustained at longer term (three months post-intervention) [24]. However, the analysis (using data from two studies) did not show a significant improvement in functional tasks (using the same measure as in this analysis) and cardiovascular fitness. The authors reported that these results could be due to either; overestimation of PA levels whereby only two of the eight studies used objective measures or the improvements in PA levels were not great enough to produce an improvement in functional and fitness outcomes [24]. This may be a rational explanation for the PA and functional tasks results in this analysis as five of the six

Table 2
The risk of bias assessment of included studies using the ROBINS-I tool summary. Red shading: Serious risk of bias, Yellow: Moderate risk of bias, Green: Low risk of bias, Blue: Inadequate information to assess.

		Coolbrandt, 2018 [44]	Frawley, 2020 [45]
Pre-intervention	**Bias due to confounding**	Serious risk	Serious risk
	Bias in selection of participants into the study	Moderate risk	Moderate risk
At intervention	**Bias in classification of interventions**	Low risk	Low risk
Post-intervention	**Bias due to deviations from intended interventions**	Serious risk	Serious risk
	Bias due to missing data	Low risk	No information
	Bias in measurement of outcomes	No information	No information
	Bias in selection of the reported result	Low risk	Serious risk
Overall risk of bias		Serious risk	Serious risk

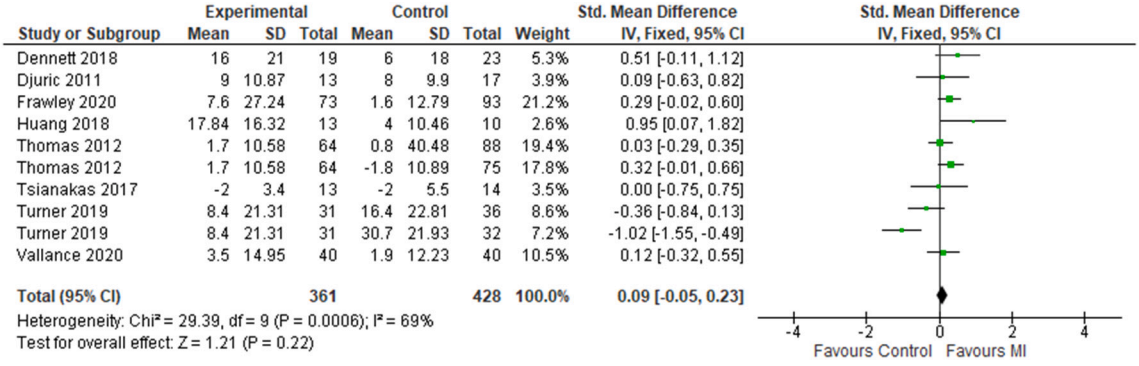

Fig. 3. Forest plot of the effects of MI on QoL.

Table 3
Quality of evidence classification.

Outcome	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall quality
Quality of life	Yes	Yes	No	No	No	Low
Anxiety	Yes	No	No	No	No	Moderate
Depression	Yes	Yes	Yes	No	No	Very low
Functional tasks	Yes	Yes	No	Yes	No	Very low
Body mass index and body weight	Yes	No	No	No	No	Moderate
Physical activity - Total	Yes	No	No	No	No	Moderate
Physical activity - Step count	Yes	No	No	No	No	Moderate
Physical activity - overall	Yes	No	No	No	No	Moderate
Self-efficacy	Yes	Yes	Yes	No	No	Very low
Fatigue	Yes	Yes	Yes	No	No	Very low

studies included in the analysis for PA outcomes included exercise sessions (or recommendations) that achieved the minimum required threshold (<150 min of moderate intensity PA per week) required to achieve significant improvements in health outcomes in healthy [48] and cancer [10] adult populations. In contrast, a meta-analysis that used data from two RCT's found that there whilst there was a significant improvement in PA levels, they failed to achieve the recommended PA levels (as described previously) in populations of overweight and hypertensive patients [49]. However, there was a significant improvement in BMI outcomes in both studies which was explained by the inclusion of dietary components within the intervention [49]. Again, this rationale aligns with the significant improvements in BMI that were seen in this

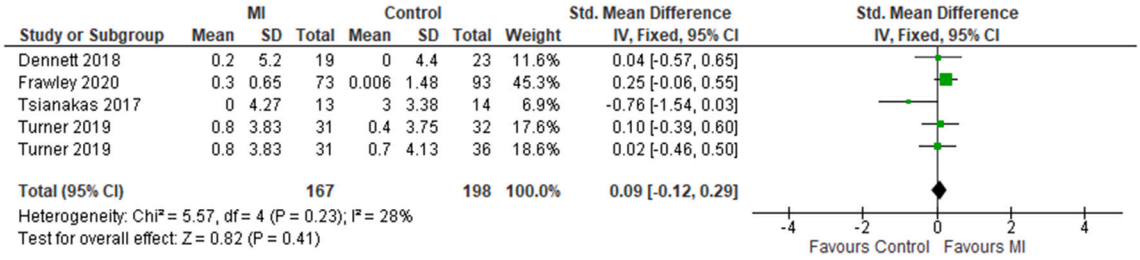

Fig. 4. Forest plot of the effects of MI on anxiety.

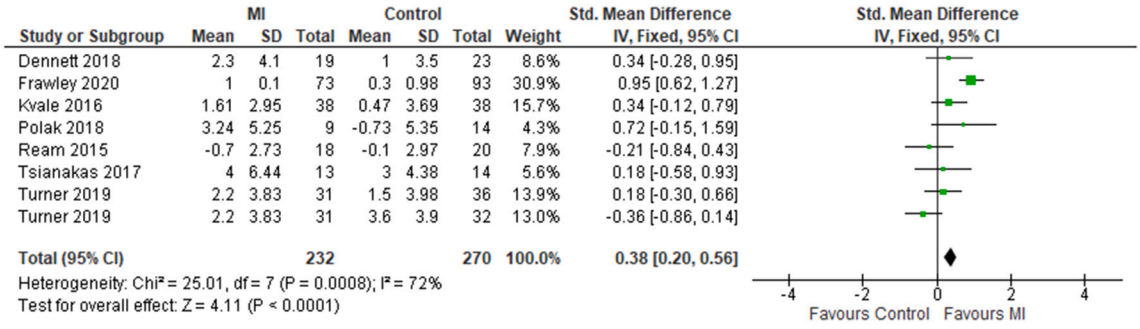

Fig. 5. Forest plot of the effects of MI on depression.

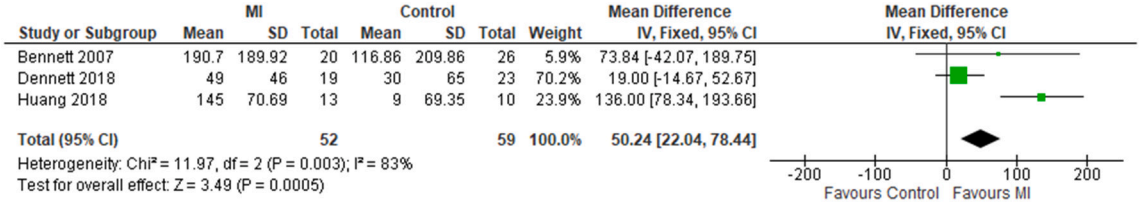

Fig. 6. Forest plot of the effects of MI on functional tasks.

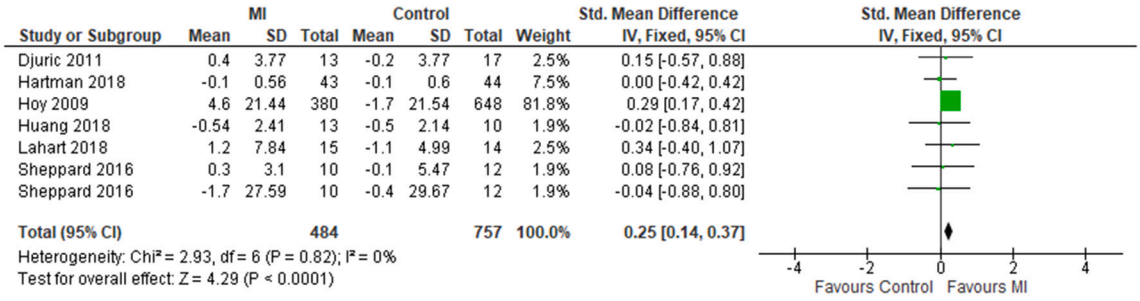

Fig. 7. Forest plot of the effects of MI on body mass index and body weight.

analysis whereby five of the six included studies contained a dietary component to the intervention.

Significant improvements in self-efficacy, as a result of MI, were also illustrated in the outcomes of the analysis of seven studies of populations of patients with various conditions such as cancer, diabetes or cardiovascular disease when approaching changes in behaviour such as smoking, diet and exercise [16]. It is suggested that whilst this finding may be a direct result of the MI process itself, which enhances an individual's sense of control over their approach to change, it also may be due to the associated positive changes that are made [50].

In objectively measured health factors, such as BMI and functional tasks, there is a clearer link between motivation and outcomes, mediated by PA, compared to the impact of MI on subjectively measured health outcomes such as QoL, mental health and fatigue, is not as clearly defined [10,17]. An analysis of data from six RCT's showed significant improvements in worry, anxiety, depression, pain and global QoL outcomes as a result of interventions with combined dietary, exercise and healthy lifestyle programs in a mixed population of adults with diagnoses of diabetes, stroke and chronic heart failure [16]. A more recent systematic review in cancer populations found that there were improvements in certain health outcomes such as fatigue, symptom distress and pain in studies when MI was focused on management of the specific outcome such as how to manage pain levels [17]. However, the results of this analysis suggested that the particular focus of the MI did not seem to influence the effects. For example, the only study included in this analysis which contained an MI intervention specifically targeting

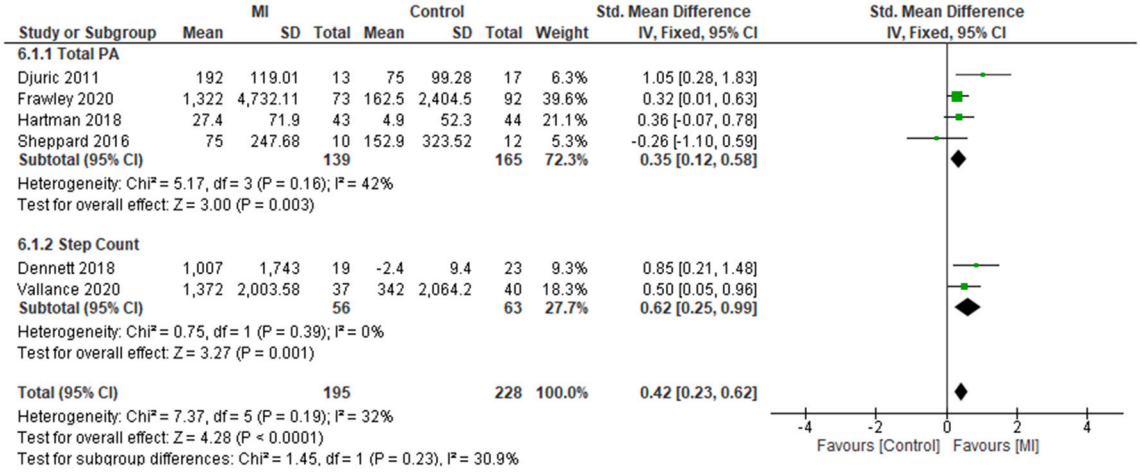

Fig. 8. Forest plot of the effects of MI on physical activity.

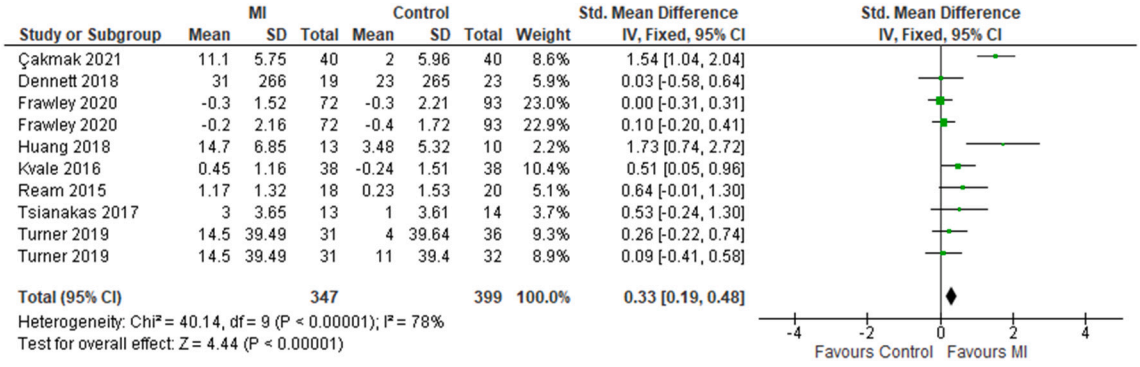

Fig. 9. Forest plot of the effects of MI on self-efficacy.

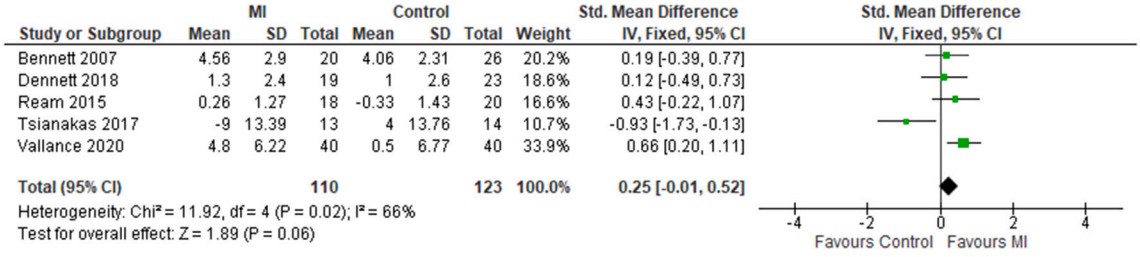

Fig. 10. Forest plot of the effects of MI on fatigue.

management of fatigue symptoms produced a significant improvement [36]. However, the study that produced the greatest effect size of MI on fatigue outcomes was a study using MI focused on improving PA behaviour [39]. Research has shown that improving self-efficacy is key to predicting successful PA behavioural change in cancer survivors [51] and a major factor in management of adverse symptoms [52]. This suggests that MI may be more likely to generate improvements in subjectively measured health outcomes if: 1) there is an element of self-efficacy to symptom management within the MI; and 2) PA levels achieve a minimum threshold enough to produce changes.

Three meta-analyses reported that measures taken within studies to ensure fidelity of the delivery of the MI intervention was a moderator of improved outcomes [16,24,49]. However, this was not shown to be a potential influential factor within our results as the nine studies included within our analysis that incorporated methods to ensure fidelity of the MI intervention, [28,29,31–33,36,38,43,44] showed varying effects in a range of outcomes. Other proposed moderating factors shown to increase the MI effect are: higher number of sessions [50], higher qualification of the interviewer [49], self-reporting outcome measures [16] and use of other additional motivational strategies, such as pedometers and print materials [13], which may have positive impacts on outcomes.

Whilst the aim of this review was to evaluate mixed cancer populations, its findings may require adaptation in specific oncological settings. The majority of the studies included in this review were in either mixed populations, or breast cancer survivors. Importantly, the largest component of the mixed population work was also breast cancer, making the results particularly applicable to that setting. The use of mixed cancer populations allows broad applicability to many oncological settings, however it is likely that for maximal impact, the interventions should be tailored to patient specifics, as factors such as symptoms of the cancer, and effects of the gold standard treatment are likely to have an effect on outcomes. MI delivered to patients should be practically focused on the individual and their physical and

psychological condition, in order to increase efficacy and adherence.

The quality of evidence for four of the eight outcomes within this analysis was from very low-quality studies, and so results should be interpreted with care. All studies suffered from the inability to blind personnel, an unavoidable bias for studies that incorporate behavioural and psychological interventions, and so it has been suggested that this does not indicate low quality research in these fields [53]. In our analysis, removal of this criteria from overall risk of bias assessment, would upgrade five studies to low risk of bias [31,33,36,41,42]. However, this did not result in a difference to the overall quality of evidence for any of the outcomes.

A strength of this review is its focus on cancer populations which can reduce the heterogeneity between literature as highlighted in other research [16,49]. In addition, included studies within this review have not been included in previous analyses which may shed new light on the improved refinement and application of MI interventions in research.

Limitations include the small numbers of studies, low sample sizes and low quality of evidence; these mean that the findings should be interpreted with caution. Additionally, a large majority of these studies were feasibility studies or studies that were not adequately powered to detect a response to the intervention. Publication bias was another limitation with the use of four databases and selecting studies that are only published in English. Furthermore, several studies did not publish outcome data in the format that could be used within the meta-analysis and authors did not respond with requests for further information.

Whilst this review had a focus on cancer populations, future research may benefit from further focus into the effect of MI on behavioural change and associated health outcomes within specific cancer types and stages as well as identification of potential moderators via regression analyses.

5. Conclusion

This systematic review and meta-analysis found that MI has positive effects on various health behaviours and health outcomes including PA behaviour, BMI, depression, functional tasks and self-efficacy in cancer populations. Given the unique barriers and health challenges these individuals face as a result of diagnosis and treatment, MI is a feasible intervention that can be used by various health professionals to optimise clinical outcomes in cancer patients and survivors. Implementing routine MI into care of cancer survivors could significantly improve both QoL, and clinical outcomes. Further research into specific populations and moderating factors of MI, or any adjunct methods, that ensure its success in producing improved outcomes, will help to inform clinical guidelines and study design.

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Contributors

Katherine Harkin contributed to the conceptualisation, formal analysis, methodology, writing of the original draft and review and editing of the paper.

Vasso Apostolopoulos contributed to supervision, review and editing of the paper.

Kathy Tangalakis contributed to supervision, review and editing of the paper.

Susan Irvine contributed to supervision, review and editing of the paper.

Nicholas Tripodi contributed to supervision, formal analysis, methodology, review and editing of the paper.

Jack Feehan contributed to supervision, methodology, formal analysis, review and editing of the paper.

All authors read and agreed to the published version of the manuscript.

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Declaration of competing interest

The authors declare that they have no competing interest.

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