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Review article

A systematic review of gratitude interventions: Effects on physical health and health behaviors

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ABSTRACT

Objective: Gratitude interventions are easy-to-deliver, offering promise for use in clinical-care. Although gratitude interventions have consistently shown benefits to *psychological* wellbeing, the effects on physical health outcomes are mixed. This systematic review aims to synthesize gratitude intervention studies which assessed physical health and health behavior outcomes, as well as evaluate study quality, comment on their efficacy, and provide directions for future research.

Methods: Relevant studies were identified through searches conducted in PsycINFO, MedLine, Embase and Cochrane Library databases, up until August 2019. Only studies that evaluated a gratitude intervention, randomly assigned participants to gratitude and control conditions, and assessed objective and subjective measures of physical health and health behaviors were included. The Revised Cochrane risk-of-bias (RoB2) tool was used to assess risk of bias.

Results: Of the 1433 articles found, 19 were included in the review. Subjective sleep quality was improved in 5/8 studies. Improvements in blood pressure, glycemic control, asthma control and eating behavior were understudied yet demonstrated improvements (all 1/1). Other outcome categories remain understudied and mixed, such as inflammation markers (1/2) and self-reported physical symptoms (2/8). The majority of studies showed some risk of bias concerns.

Conclusions: Although it was suggested gratitude interventions may improve subjective sleep quality, more research is still needed to make firm conclusions on the efficacy of gratitude interventions on improving health outcomes. Further research focusing on gratitude's link with sleep and causal mechanisms is needed, especially in patient populations where more 'clinically-usable' psychosocial interventions are urgently needed.

1. Introduction

Research surrounding the practice of gratitude – appreciating the things one has in life [1] – has thrived in the last decade, part of the growing evidence that positive psychology interventions may improve psychological well-being [2–4]. Gratitude is conceptualised as both a trait and state [5]. As a state, gratitude is found in individual moments of feeling grateful and appreciative for a positive outcome [6] while trait gratitude is a wider predisposition to notice and appreciate the world in a positive light [7,8]. Unlike many positive psychology interventions, gratitude interventions offer a straight-forward, easy-to-deliver intervention that can be completed individually, without a heavy resource cost. Thus, gratitude interventions, if shown to be effective, may offer a straight-forward and clinically usable intervention for patient populations and busy clinical settings, especially. Gratitude interventions have demonstrated consistent associations with improved psychological well-being including increased life satisfaction, mood, happiness and positive affect, and small effects on depression and anxiety [4].

Despite these promising findings with psychological outcomes, the association between gratitude and *physical* health is under-studied and findings to date are mixed. Observational research in both patient and non-patient populations has linked both state and trait gratitude with higher quality of life and more adaptive health behaviors [9–13]. In

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cardiac patients, for example, greater gratitude has been associated with better sleep, less fatigue, less depressed mood, better cardiac-specific self-efficacy, and lower levels of inflammatory biomarkers [12], as well as better self-reported adherence to medication, exercise, diet, stress reduction recommendations [11,14] and lower rates of cardiac re-admissions at 6-months [15]. In healthy adults, gratitude has been associated with better self-reported physical health, engagement in healthy activities, and willingness to seek help for health concerns [16]. Suffice to say, observational studies of gratitude consistently link it to better health outcomes.

Exactly why gratitude predicts better outcomes and the mechanisms explaining how it may influence physical health outcomes is less understood. Recently, an adaption of the *model of positive psychological wellbeing* [17] was proposed [18], providing a comprehensive overview of possible causal mechanisms. Although experimental studies have yet to begin testing pathways in this framework, increases in gratitude and positive affect are theorized to benefit physical health directly through improving biological processes (e.g., inflammation) and health behaviors (e.g., exercise and diet), and indirectly through increasing social support and decreasing stress.

1.1. Previous reviews

Despite promising observational findings and recent theory proposing mechanisms regarding how gratitude may influence physical health, surprisingly few studies have examined gratitude interventions and physical health or health behavior outcomes. A 2017 meta-analysis of 38 gratitude interventions found small to moderate effects for several *psychological* outcomes but findings were mixed for physical health [4]. Of note, while gratitude interventions appeared to improve well-being, happiness, life satisfaction, grateful mood, grateful disposition, positive affect and depressive symptoms, the evidence for effects on stress and negative affect was mixed and there was no clear effect on physical health outcomes (e.g., sleep or exercise). This review concluded that gratitude interventions do not influence physical health outcomes and that the potential benefits of gratitude may be over-emphasised in the research literature.

More recently, another review provided an updated summary on the observational, experimental, and intervention studies regarding gratitude published since 2010 [19]. This review concluded that gratitude interventions were of moderate benefit for many indices of mental well-being but were not necessarily associated with reduced psychopathology. In this work, gratitude interventions were seen as being of greatest benefit to cardiovascular parameters, inflammatory markers, and sleep quality but effects on other bodily functions, such as pain, did not differ to other active control conditions. This updated review suggested the evidence for gratitude interventions' effects on physical health may be more mixed than previously stated [4].

Importantly, while this last review [19] provided somewhat stronger evidence for the efficacy of gratitude interventions on physical health outcomes, the review itself has significant limitations. Of particular note are issues regarding the selection of studies for review and questions regarding intervention fidelity. Many of the gratitude interventions included in the review incorporated other psychological/therapeutic components, complicating interpretations since effects cannot be attributed to gratitude alone. As well as including observational and experimental research, the review [19] also included interventions lasting less than one week (potentially weakening the intervention), studies which failed to assess physical health outcomes at both pre- and post-intervention, and were restricted to studies published since 2010, limiting the scope of their conclusions. Risk of bias assessments were also not conducted in either the recent review [19] or previous meta-analysis [4].

1.2. The current review

To address concerns from the previous reviews and update the literature, the present work extends assessments regarding the potential efficacy of gratitude interventions on physical health outcomes and health behaviors by: (1) including eight new studies not included in previous reviews, (2) restricting inclusion to studies with a “pure” gratitude intervention, (3) systematically assessing the overall methodological quality of studies and the literature, (4) evaluating the possible effects of confounding variables including the nature of the comparison conditions, format (e.g., written lists, journaling or listing over the phone), and participant characteristics, and (5) excluding interventions lasting less than one week or which failed to assess outcomes at pre- and post-intervention. Given that gratitude interventions are not time intensive or costly to run, determining their efficacy in improving physical health outcomes is important to clarify to shed light on their potential clinical utility in patient populations.

2. Methods

The current systematic review was conducted according to the PRISMA guidelines [20]. The review protocol was prospectively registered in the International Prospective Register of Systematic Reviews (PROSPERO), an online database for systematic review protocols (CRD42018112070). See Fig. 1 for a flowchart of the literature search and article selection.

2.1. Search strategy

PsycINFO, MedLine, Embase and Cochrane Library were searched for relevant peer-reviewed articles on the 9th of August 2019. Google Scholar was searched as an additional check. Search strategies were compiled with the assistance of an academic librarian. The ‘Gratitude’ subheading was included when applicable, and the following broad search terms were used ‘Gratitude intervention’ OR ‘diary’ OR ‘diaries’ OR ‘journal’ OR ‘letter’ OR ‘list writing’ OR ‘exercise’ OR ‘promotion’ OR ‘practice’ (see the Appendix for the full search term listing used for each database). Synonyms of gratitude, such as counting blessing and thankfulness, were considered for inclusion, but produced too many irrelevant results. Objective and subjective physical health and health behavior search terms were also not included to enable a more thorough search of the literature. Additionally, reference lists of included articles were searched for new studies.

It should also be noted that while conducting the review as a meta-analysis was considered, this approach was deemed inappropriate due to the large variability in outcomes and because only 1 or 2 studies have been conducted for most outcomes [21].

2.2. Eligibility

Articles were included in the review if they satisfied the following criteria: (1) assessed a gratitude intervention lasting longer than one week, as interventions lasting less than one week were thought to not be a strong or comparable manipulation (e.g., [10,22,23]), (2) included objective and/or subjective measures of physical health or health behaviors as an outcome measure, such as physical symptomatology and physiological outcomes, (3) randomly or quasi-randomly assigned participants to one of two or more experimental conditions, (4) assessed physical health or health behavior outcomes at both pre- and post-intervention, and (5) were available in English. Articles were excluded from the review if the gratitude intervention was conducted in conjunction with or as part of a broader positive psychology intervention (e.g., [10,24,25]), as effects could not be solely attributed to the gratitude component.

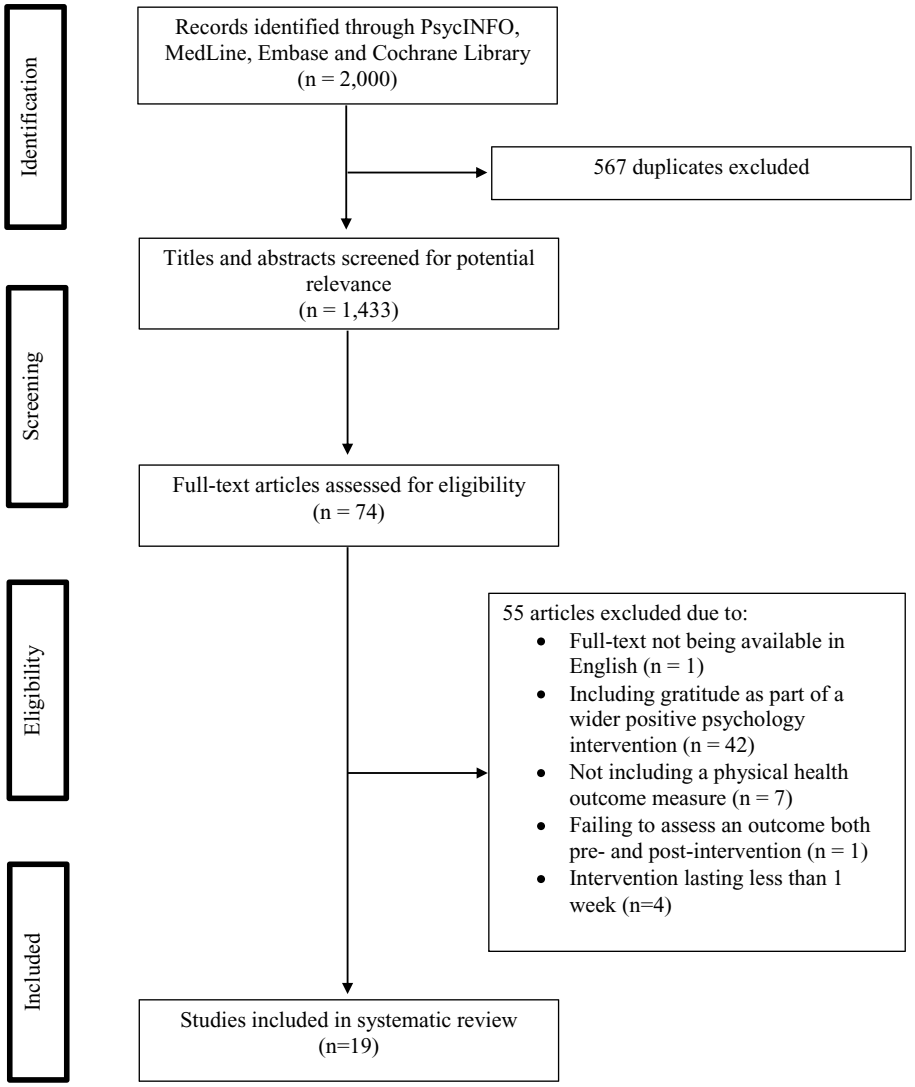

Fig. 1. Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) flowchart of the literature search and article selection.

2.3. Data extraction

Once duplicates were removed using Endnote, titles and abstracts were screened for inclusion by two of the authors (A.B and J.B·P) using Rayyan [26], a web and mobile app for systematic reviews. The full text of potentially relevant articles was then obtained and reviewed against the inclusion criteria. When disagreements occurred between the two researchers, a meeting was organised to discuss and resolve discrepancies.

Data were extracted using a pre-designed spreadsheet and included: [1] randomization method, [2] study aim, [3] type of gratitude intervention (type, description, frequency), [4] participant characteristics (sample size, age, gender), [5] type of comparison condition(s), [5] outcome measures and assessment tools, and [6] statistical significance of findings and effect sizes. Effect sizes were calculated for the studies which demonstrated significant improvements and where sufficient statistical detail was provided.

2.4. Risk of bias assessment

The methodological quality of studies was assessed using the Revised Cochrane risk-of-bias tool for randomized trials (RoB2) [27]. The tool assesses five areas of potential bias including: (1) randomization, (2) deviations from the intended interventions (effect of assignment to intervention), (3) missing outcome data, (4) the measurement of the outcome, and (5) the selection of the reported result. Each domain assessed and each study overall is shown to have either a low risk of bias, some concerns relating to the risk of bias, or a high risk of bias, as determined by a validated a priori algorithm. Journal articles were screened, as well as clinical trial registry records when referred to in the text. Two researchers (A.B and J.B·P) worked independently to conduct the assessment, reaching 100% agreement.

3. Results

3.1. Study selection

The search across databases produced a total of 2000 articles. After duplicates were removed, 1433 articles remained. After review, a total of 19 studies were included. Table 1 provides a summary of the 19 studies included in the review.

3.2. Study outcomes

Physical health and health behavior outcomes were divided into the following subgroups: objective health outcomes, self-reported physical symptoms and health status, and self-reported health behaviors, shown in Table 2.

Table 1
Studies included in systematic review.

Study	Aim	Type of gratitude intervention	Participants	Comparison group(s)	Physical health outcomes	Results (between-group, unless otherwise stated)	Risk of bias
1. Bai et al. (2019)	To assess whether a gratitude intervention would improve psychological distress in women undergoing fertility treatment	4-week gratitude intervention, 1-h sessions each week and 3 daily gratitude journal prompts	234 women undergoing fertility treatment	Positive comparison condition (mindfulness); non-active control condition	Self-reported sleep quality	NS	Some concerns
2. Bartlett & Arpin (2019)	To assess whether a gratitude intervention would improve loneliness and health in older adults	3-week gratitude intervention, listing three things to be grateful for	42 older adults	Non-active control condition	Self-reported physical symptoms	Improvements to physical symptoms (NR)	High risk
3. Cook, Woessner & White (2018)	To assess whether a gratitude intervention would improve asthma control	4-week gratitude intervention, recording at least 5 entries per week of people, places, things, circumstances for which they were grateful	25 individuals with asthma	Neutral comparison condition (non-focused journaling)	Self-reported control of asthma symptoms Forced expiratory volume (FEV_1)	Improvements in asthma control (NR) NS	High risk
4. Digdon & Koble (2011)	To assess whether a gratitude, imagery distraction or constructive worry intervention would improve sleep quality in university students	1-week gratitude intervention, journaling about a recent or anticipated positive event daily	41 university students	Non-active control condition; negative comparison condition (constructive worry); positive comparison condition (imagery distraction)	Self-reported sleep quality Total sleep time	Improvements in sleep quality** *(within-group)* Improvements in total sleep time* *(within-group)*	Some concerns
5. Emmons & McCullough (2003), study one	To assess whether a gratitude intervention would improve subjective well-being across three differing studies	10-week gratitude intervention, writing a list of five things they were grateful for weekly	201 university students	Negative comparison condition (hassles); neutral comparison condition (neutral life events)	Self-reported physical symptoms Hours spent exercising	Improvements to physical symptoms (NR) Improvements to hours spent exercising (NR)	Some concerns
6. Study two	"	2-week gratitude intervention, writing a list of five things they were grateful for daily	166 university students	Negative comparison condition (hassles); positive comparison condition (downward social comparison)	Self-reported physical symptoms Hours spent exercising Hours slept Self-reported sleep quality Amount of pain relievers, coffee and alcohol consumed daily	NS NS NS NS NS	Some concerns
7. Study three	"	3-week gratitude intervention, writing a list of five things they were grateful for	65 individuals with neuromuscular disease	Non-active control condition	Self-reported sleep quality Self-reported physical pain Self-reported physical symptoms Self-reported hours spent exercising	Significant improvements in sleep quality (NR) NS NS NS	High risk
8. Froh, Sefick, & Emmons (2008)	To assess whether a gratitude intervention would improve subjective well-being in adolescents	2-week gratitude intervention, listing five things they were grateful for five times a week	221 adolescent school children	Negative comparison condition (hassles); non-active control condition	Self-reported physical symptoms	NS	Some concerns
9. Heckendorf, Lehr, Ebert & Freund (2019)	To assess whether an online gratitude intervention would improve repetitive negative thinking	5-week gratitude intervention, combining an weekly online gratitude training with a daily mobile gratitude app	262 community participants	Non-active control condition	Self-reported sleep quality	Improvements in sleep quality* (d = 0.34) *(at both post-intervention & 3-month follow-up)*	Some concerns
10. Kaplan et al. (2014)	To assess whether positive psychology interventions would improve employee wellbeing	2-week gratitude intervention, listings things they were grateful for about their job at least three times per week	67 university employees	Positive comparison condition (social connectedness)	Workplace absence due to illness	NS Improvement observed within group (*at both post-intervention & 4-week follow-up*)	Some concerns
	To assess whether a gratitude intervention would improve	2-week gratitude intervention, journaling about previously	119 female university students and staff		Self-reported sleep quality	Improvements in sleep quality (NR)	Some concerns

(*continued on next page*)

Table 1 (*continued*)

Study	Aim	Type of gratitude intervention	Participants	Comparison group(s)	Physical health outcomes	Results (between-group, unless otherwise stated)	Risk of bias
11. Jackowska, Brown, Ronaldson & Steptoe (2016)	cardiovascular and neuroendocrine functioning and sleep	unappreciated people and things in their lives		Neutral comparison condition (everyday event reporting); non-active control condition	Blood pressure Cortisol Heart rate	Improvements in ambulatory blood pressure (NR) NS NS	
12. Lai & O'Carroll (2017)	To assess whether gratitude intervention would improve subjective well-being	3-week gratitude intervention, listing three things to be grateful for	108 university students	Non-active control condition	Self-reported physical symptoms	NS	Some concerns
13. Martínez-Martí, Avia, & Hernández-Lloreda (2010)	To assess whether the effects of Emmons and McCullough's intervention would replicate in a Spanish sample	2-week gratitude intervention, listing five things to be grateful for	159 Spanish university students	Negative comparison condition (hassles); neutral comparison condition (everyday events reporting)	Self-reported physical symptoms Self-reported sleep quality Amount of pain relief used	NS NS NS	Some concerns
14. Moieni et al. (2018)	To assess whether a gratitude intervention would reduce inflammatory outcomes	6-week gratitude intervention, with different prompts given once a week and participants were asked to review their writing later on in the week as a booster	76 female community participants	Neutral comparison condition (neutral writing)	Inflammation markers (IL-6 and TNF-alpha)	NS	Some concerns
15. Redwine et al. (2016)	To assess whether gratitude journaling would improve biomarkers related to heart failure diagnosis	8-week gratitude intervention, listing three to five things they were grateful for daily	70 Stage B asymptomatic heart failure/ cardiac patients	Non-active control condition	Heart Rate Variability Inflammatory biomarker index	NS Improvements in inflammatory makers* (d = 1.03)	Low risk
16. Schache, Hofman, & Serlachius (2019)	To assess whether a gratitude intervention would improve psychological well-being and glycaemic control in adolescents with type 1 diabetes	8-week gratitude intervention, listing three things they were grateful for daily	60 adolescents with type 1 diabetes	Non-active control condition	Glycaemic control	Improvements in glycaemic control at 12-weeks follow-up (NR)	Low risk
17. Schnitker & Richardson (2018)	To assess whether framing gratitude journaling as prayer would amplify its effect on well-being	5-week gratitude intervention, listing 10 things they were grateful for once a week	196 university students	Positive comparison conditions (social journaling condition, prayer journaling condition)	Self-reported physical symptoms	NS	Some concerns
18. Southwell & Gould (2017)	To assess whether a gratitude diary would improve depression, anxiety, stress and sleep in individuals with anxiety disorders and depression	3-week gratitude intervention, listing five things they were grateful for at least three times a week	109 individuals with anxiety disorder and/or depression	Non-active control condition	Self-reported sleep quality	Improvement in sleep quality* (d = 0.81) at post-intervention (*within-group*) (*NS at 3-week follow-up*)	Some concerns
19. Wolfe & Patterson (2017)	To assess the efficacy of a gratitude intervention compared to cognitive restructuring for women with dysfunctional eating and body dissatisfaction	2-week gratitude intervention, listing the things they were grateful for daily	140 female undergraduate students	Positive comparison condition (cognitive restructuring); non-active control	Disordered eating behavior	Improvements in eating disordered behavior* (d = 0.23)	Some concerns

*NS = not significant, NR = effect size not reported.
* $p < .05$.
** $p < .0$.

Table 2
Type and efficacy of physical health or health behavior outcomes.

Type of physical health outcome	Study citation	
Objective physical health		3 of 8
Blood pressure	Jackowska, Brown, Ronaldson, & Steptoe (2016)	✓
Cortisol	Jackowska, Brown, Ronaldson, & Steptoe (2016)	✗
Forced Expiratory Volume (FEV1)	Cook, Woessner, & White (2018)	✗
Glycaemic control	Schache, Hofman & Serlachius (2019)	✓
Heart rate or heart rate variability	Jackowska, Brown, Ronaldson, & Steptoe (2016)	✗
	Redwine et al. (2016)	✗
Inflammation markers	Moieni et al. (2018)	✗
	Redwine et al. (2016)	✓
Self-reported symptoms/ health status		4 of 11
Asthma Control Test (ACT)	Cook, Woessner, & White (2018)	✓
Self-reported physical symptoms	Bartlett & Arpin (2019)	✓
	Emmons & McCullough (2003) study one	✓
	Emmons & McCullough (2003) study two	✗
	Emmons & McCullough (2003) study three	✗
	Froh, Sefick, & Emmons (2008)	✗
	Lai & O'Carroll (2017)	✗
	Martínez-Martí, Avia, & Hernández-Lloreda (2010)	✗
	Schnitker & Richardson (2017)	✗
Self-reported physical pain	Emmons & McCullough (2003) study three	✗
Workplace absence due to illness	Kaplan et al. (2014)	✓
Self-reported health behaviors		7 of 15
Sleep quality	Bai et al. (2019)	✗
	Digdon & Koble (2011)	✓
	Emmons & McCullough (2003) study two	✗
	Emmons & McCullough (2003) study three	✓
	Heckendorf, Lehr, Ebert & Freund (2019)	✓
	Jackowska, Brown, Ronaldson & Steptoe (2016)	✓
	Martínez-Martí, Avia, & Hernández-Lloreda, (2010)	✗
	Southell & Gould (2017)	✓
Hours spent exercising	Emmons & McCullough (2003) study one	✓
	Emmons & McCullough (2003) study two	✗
	Emmons & McCullough (2003) study three	✗
Use of pain medication	Emmons & McCullough (2003) study two	✗
	Martínez-Martí, Avia, & Hernández-Lloreda, (2010)	✗
Use of coffee and alcohol	Emmons & McCullough (2003) study two	✗
Eating behavior	Wolfe & Patterson (2017)	✓

✓ = significant improvement, ✗ = no significant improvement.

3.2.1. Objective health outcomes

For objective health outcomes, significant improvements (between groups) were found for blood pressure [28] and glycaemic control [29]. Results for inflammatory markers were mixed with one study finding improvements in CRP, TNF-α, IL-6 and sTNFr1 [30] and the other reporting non-significant changes in terms of IL-6 and TNF-α [31]. Significant improvements to cortisol [28], forced expiratory volume [32] and heart rate variability [28,30] were not found.

3.2.2. Self-reported physical symptoms and health status

The findings were similarly mixed for self-reported physical symptoms and health status. Four of 11 studies showed improvements in self-reported physical symptoms [7,33], asthma symptom control [32] and workplace absence due to illness [34]. No significant improvements were observed for self-reported pain, investigated in Emmons and McCullough's [7] third study.

3.2.3. Self-reported health behaviors

Findings were similarly mixed for self-reported health behaviors, with seven [7,28,35–38] of the 15 studies returning significant effects in this area. Most studies (5 of 8) assessing sleep quality found improvements [7,28,35–37], although two [35,37] reported within-group improvements only. Of the three studies testing this question, Emmons and McCullough's [7] first study was the only study to find significant improvement for hours spent exercising. Changes in the use of pain medication, coffee, and alcohol were non-significant [7,39]. Despite only one study assessing eating behavior, a significant improvement to dysfunctional eating was shown [38].

3.3. Effect sizes

Five out of the 10 studies of health behaviors reported significant improvement between groups and either stated the effect sizes or provided sufficient detail to calculate them [30,35–38]. Reported effect sizes varied from d = 0.22 to d = 1.36 (Cohen's d), across sleep quality, inflammatory markers, and disordered eating outcome measures. Although there were three reported effect sizes for sleep quality, studies used distinct self-report indices and it was deemed inappropriate to calculate the average efficacy across studies.

3.4. Possible confounding factors

Given a clear pattern in which findings vary considerably across gratitude interventions, it is important to consider possible moderating factors that may influence any possible effects on physical health outcomes:

3.4.1. Participant characteristics

A total of 2361 participants took part in the 19 studies, with sample sizes ranging from 25 to 262 (M = 124.26, SD = 72.60). The average age reported was 34.50 years (SD = 17.99), with average ages varying from 12.2 to 73 years. Most studies had a larger percentage of females than males, ranging from 40.7% to 100% (M = 78.04%, SD = 17.79), with four studies only recruiting female participants [28,31,38,40].

The majority of studies, eight out of 19, used a university sample [7,28,35,38,39,41,42], with one additional study also using a university staff sample [34] and another an adolescent school sample [43].

The remaining studies utilised an adult female only sample [31], older adults [33], samples with identified repetitive negative thinking [36], anxiety or depression [37] and patient samples, including women undergoing fertility treatment [40], asthma patients [32], patients with neuromuscular disease [7], heart failure patients [30] and adolescents with type 1 diabetes [29]. To this point, there do not appear to be any systematic differences in significant results between age groups or sample characteristics.

3.4.2. Intervention characteristics

Interventions varied significantly in length, with the shortest interventions included here running for one-week and the longest for ten-weeks ($M = 4$, $SD = 2.49$). Six studies incorporated a follow-up assessment, ranging from two-weeks [39] or three-weeks [37] to four-weeks [34] and three-months [29,36]. In "gratitude listing" interventions, participants were most commonly asked to list five things they were grateful for, with seven studies listing five things, four listing three, one listing ten, and two not specifying the number. Testament to the importance of "dose" in gratitude interventions, nine of the ten interventions involving participation daily or at least three or five days a week showed effects, whereas only two of eight studies involving weekly participation were significant. See Table 3 for the differing types of gratitude interventions and the proportion of studies showing statistically significant effects per category.

As suggested by the Dickens [4] review, the experimental conditions against which gratitude conditions were contrasted were categorised as positive, negative, or neutral (see Table 3. Most (10 of 19) studies included one comparison condition, with eight incorporating two comparison conditions and one study incorporating neutral, positive, and negative comparison conditions [35]. As illustrated in Table 3, two of five studies with negative comparison conditions showed improvements and three of six incorporating a positive comparison condition also showed improvements. As might be expected, neutral comparison conditions showed a more favourable ratio, with 11 of 16 studies showing significant improvements.

3.5. Study quality

As evaluated by the Revised Cochrane risk-of-bias tool for randomized trials (RoB2), the majority of studies included (16 of 19), showed some concerns across all domains and three studies demonstrated a high risk of potential bias (see Table 4). The domain 'selection of the reported result' showed that 16 of 19 warranted some concern due to failing to report employing a pre-specified analysis plan. Outcome measures also suggested a need for caution, with 15 of 19 studies showing concerns due to outcome assessors remaining unblinded or the possibility that knowledge of the intervention may have influenced self-reported outcomes. Most (14 of 19) studies suggested low bias as a result of missing outcome data, but three studies suggested high bias in this area and two showed some concerns. These issues related to studies where more than 5% of participants were lost to follow-up or had missing data, yet analyses to compare those lost to follow-up were not conducted. Deviations from the intended intervention were low, with 11 of 19 studies evaluated as being at low risk, seven with some concerns, and one with high risk, relating to using per-protocol analyses or providing no information as to whether per-protocol analyses were used. Risk of bias due to randomization showed 13 of 19 studies as low risk and 6 studies revealing some concern due to not reporting baseline differences between groups.

Also of interest, 15 of 19 studies included gratitude as an outcome. One of the 19 studies incorporated statistical analyses of a potential mediator [31], in which researchers tested whether support-giving was associated with changes in inflammation.

Table 3
Types of gratitude intervention and comparison conditions.

Type of intervention condition	Number of studies	Proportion significant
Gratitude interventions		11 of 18
Weekly listing of things for which they were grateful for	Emmons & McCullough (2003) study one, study two and study three; Froh, Sefick & Emmons (2008); Martínez-Martí, Avia, & Hernández-Lloreda (2010); Schnitker & Richardson (2018);	3 of 6
Weekly gratitude sessions, with daily gratitude exercises	Bai et al. (2019); Heckendorf, Lehr, Ebert, & Freund (2019), conducted online	1 of 2
Weekly journaling	Moieni et al. (2018)	0 of 1
Daily listing of things for which they were grateful for	Bartlett & Arpin (2019); Lai & O'Carroll (2017); Kaplan et al. (2014), at least 3 times a week; Redwine et al. (2016); Schache, Hofman, & Serlachius (2019); Southwell & Gould (2017), at least 3 times a week; Wolfe & Patterson (2017)	6 of 7
Daily journaling about a recent or anticipated event	Digdon & Koble (2011)	1 of 1
Journaling at least 5 times per week of people, places, things, circumstances for which they were grateful	Cook, Woessner, & White (2018); Jackowska, Brown, Ronaldson, & Steptoe (2016)	2 of 2
Neutral/ control comparison conditions		11 of 16
Non-active control condition (e.g., treatment as usual or waitlist condition)	Bai et al. (2019); Bartlett & Arpin (2019); Digdon & Koble (2011); Emmons & McCullough (2003) study three; Froh, Sefick, & Emmons (2008); Heckendorf, Lehr, Ebert & Freund (2019); Jackowska et al. (2016); Lai & O'Carroll (2017); Redwine et al. (2016); Schache, Hofman, & Serlachius (2019); Southwell & Gould (2017); Wolfe & Patterson (2017)	9 of 12
List of daily/ weekly life events	Emmons & McCullough (2003) study one; Jackowska et al. (2016); Martínez-Martí, Avia, & Hernández-Lloreda (2010)	2 of 3
Non-focused journaling	Cook, Woessner, & White (2018); Moieni et al. (2018)	1 of 2
Negative comparison conditions		2 of 5
Constructive worry	Digdon & Koble (2011)	1 of 1
List of daily/ weekly hassles	Emmons & McCullough (2003) study one and two; Froh, Sefick, & Emmons (2008); Martínez-Martí, Avia, & Hernández-Lloreda (2010)	1 of 4
Positive comparison conditions		3 of 6
Cognitive restructuring	Wolfe & Patterson (2017)	1 of 1
Downward social comparison	Emmons & McCullough (2003) study two	0 of 1
Imagery distraction	Digdon & Koble (2011)	1 of 1
Mindfulness	Bai et al. (2019)	0 of 1
Prayer journaling	Schnitker & Richardson (2019)	0 of 1
Social connectedness	Kaplan et al. (2014)	1 of 1

Table 4
Risk of bias, assessed by the Revised Cochrane risk-of-bias tool for randomized trials (RoB2).

Study	Randomization	Deviations from intended intervention	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall
1. Bai et al. (2019)	Low	Low	Low	Some concerns	Some concerns	Some concerns
2. Bartlett & Arpin (2019)	Low	Low	High	Some concerns	Some concerns	High
3. Cook, Woessner, & White (2018)	Some concerns	Some concerns	High	Low	Some concerns	High
4. Digdon & Koble (2011)	Low	Low	Low	Some concerns	Some concerns	Some concerns
5. Emmons & McCullough (2003), study one	Some concerns	Low	Low	Some concerns	Some concerns	Some concerns
6. Emmons & McCullough (2003), study two	Some concerns	Low	Low	Some concerns	Some concerns	Some concerns
7. Emmons & McCullough (2003), study three	Some concerns	High	High	Some concerns	Some concerns	High
8. Froh, Sefick, & Emmons (2008)	Low	Some concerns	Low	Some concerns	Low	Some concerns
9. Heckendorf, Lehr, Ebert, & Freund (2019)	Low	Low	Low	Some concerns	Some concerns	Some concerns
10. Kaplan et al. (2014)	Low	Some concerns	Low	Some concerns	Some concerns	Some concerns
11. Jackowska, Brown, Ronaldson, & Steptoe (2016)	Low	Low	Low	Some concerns	Some concerns	Some concerns
12. Lai & O'Carroll (2017)	Some concerns	Low	Low	Some concerns	Some concerns	Some concerns
13. Martínez-Martí, Avia, & Hernández-Lloreda (2010)	Low	Some concerns	Low	Some concerns	Some concerns	Some concerns
14. Moieni et al. (2018)	Some concerns	Low	Some concerns	Low	Some concerns	Some concerns
15. Redwine et al. (2016)	Low	Some concerns	Low	Low	Low	Some concerns
16. Schache, Hoffman, & Serlachius (2019)	Low	Low	Some concerns	Low	Low	Some concerns
17. Schnitker & Richardson (2018)	Low	Some concerns	Low	Some concerns	Some concerns	Some concerns
18. Southwell & Gould (2016)	Low	Some concerns	Low	Some concerns	Some concerns	Some concerns
19. Wolfe & Patterson (2017)	Low	Low	Low	Some concerns	Some concerns	Some concerns

4. Discussion

The current systematic review identified 19 studies investigating the effects of gratitude interventions on physical health or health behavior outcomes, including 8 new studies not included in previous reviews. Overall, findings regarding the potential efficacy of gratitude interventions in improving physical health and health behaviors outcomes were more mixed than previously suggested for "pure" gratitude interventions. While the available data provide cautious support for the notion that gratitude interventions may improve subjective sleep quality specifically, other outcome categories remain understudied and findings are mixed. Altogether, the review adds to the literature by updating current understanding of the efficacy and quality of gratitude intervention studies in this area and provides suggestions for the future direction of gratitude research.

Unlike previous reviews, an established systematic risk of bias assessment was conducted here and suggested some broad concerns in gratitude research. Most studies (16/19) showed some risk of bias concerns. Common methodological weaknesses including failing to describe baseline differences, not employing intention-to-treat analyses, not describing the characteristics of participants lost to follow-up, failing to use a pre-specified analysis plan, and failing to blind participants to expectation. Thus, future research in this field needs to give careful considerations to these issues and follow the Consolidated Standards Of Reporting Trials (CONSORT) guidelines [44]. In addition, sample sizes and participant characteristics remain similar to those seen in prior reviews [4], with a similar average sample size (M = 129.26) and a higher proportion of females (M = 78.04%). Following earlier suggestions [4], all seven studies published since this time compared a gratitude intervention condition to a neutral comparison group, perhaps implying that overall methodological quality may be improving as this nascent research field develops.

The current review further adds to the literature by demonstrating areas of physical health outcomes for which gratitude interventions show the most promise. Broadly, the greatest promise was seen for subjective sleep quality, suggesting this area is suitable for more research and that gratitude *may be efficacious* to use in samples experiencing sleep difficulty. Results for inflammatory markers and cardiovascular parameters [19,45] were more mixed than previously indicated in both prior reviews [4,19]. Physical symptom reduction showed less promising results, suggesting caution for gratitude's efficacy in these areas. Improvements to dysfunctional eating behavior, asthma control and glycaemic control appear promising, however this suggestion is limited as only one study assessed each outcome.

Clearly, these findings should be interpreted with caution due to several limitations. Firstly, due to publication bias there is likely an over-representation of positive findings in the literature. Secondly, due to the nature of gratitude interventions, the blinding of participants is often unable to occur as intervention instructions reference phrases such as gratitude, thankfulness or counting blessings. This is an important consideration in interpreting results of gratitude interventions and is a source of greater bias for studies utilising subjective measures, such as subjective sleep quality. For example, a participant knowing they are participating in a gratitude intervention may be more likely to provide a biased assessment of the effectiveness of the intervention in their reporting of subjective measures [46]. Thirdly, the use of subjective measures also contains further potential for bias. For example, research comparing subjective and objective measures of sleep quality have shown moderate associations between subjective and objective measures, however, people often report errors, such as underestimating their true sleep time [47] and older adults show more difficulty with accuracy [48].

Despite these caveats, the suggestion that gratitude interventions may improve subjective sleep quality is consistent with cross-sectional gratitude research showing a strong relationship between gratitude and better sleep quality [45]. Earlier studies suggest the relationship

between gratitude and sleep quality may be mediated by more positive and less negative pre-sleep cognitions [49]. In patients with chronic pain, sleep quality has been shown to mediate the relationship between gratitude and anxiety [45]. This may imply that gratitude has a more immediate effect on pre-sleep cognitions, influencing sleep quality, and providing a possible explanation for the promising results reported for sleep quality over other physical health outcomes reviewed. Importantly, sleep quality may also be a health behavior mechanism underlying the association between gratitude and enhanced biological processes, as reflected by the wealth of research demonstrating the effect of sleep quality on physical health [50], notably the links between negative cognitions, sleep quality, and inflammation [51,52].

Nonetheless, more research is needed to understand possible mechanisms underlying gratitude's link with physical health. Experimental studies which include and test proposed mediators from the adapted *model of positive psychological wellbeing* [18] (i.e., specific health behaviors, biological processes (e.g., inflammation), social support and stress) and further model development are both needed in this area. Of note, only one of the studies [31] included in the current review examined possible mediators of the relationship between gratitude and physical health, highlighting the strong need for assessing potential mediators in future studies. Future studies examining causal mechanisms should employ best practices by utilising objective measures when possible, ensuring adequately-powered sample sizes and prospective designs rather than continuing to rely on cross-sectional studies [53].

In addition, the results of our review and the greater number of studies linking gratitude with better sleep imply that research might profitably examine sleep parameters as potential mechanisms. As gratitude has been shown to impact pre-sleep cognitions and sleep quality (both of which have a flow-on effect on inflammation), these variables should be tested as causal health behavior and biological process mechanisms in testing the adapted *model of positive psychological wellbeing* [18]. Further, gratitude's impact on sleep quality may be especially relevant to study in patient populations. As the review highlights, gratitude research in patient populations is lacking despite the need for more clinically usable interventions. As patient populations may also yield larger effect sizes and reduce ceiling effects [18], patient populations may represent an important opportunity to clarify causal mechanisms.

In conclusion, this systematic review has demonstrated that the efficacy of published “pure” gratitude interventions across different physical health and health behavior outcomes is more mixed than previously indicated. Although low study volume precluded our comparing of the efficacy of gratitude interventions across specific outcomes or between specific comparison groups, the examination of outcomes and methodological quality across studies offers valuable insight into the current state of the literature for gratitude interventions. More research is needed to make firm conclusions on the efficacy of gratitude interventions on improving health outcomes, especially for sleep-related outcomes and for patient populations where more cost-effective and clinically usable interventions are sorely needed.

Authors contributions

A.B and A.S came up with the conception and structure of the review. A.B and J.B·P conducted the search and study quality assessment. A.B wrote the manuscript, with the assistance of A.S and N·C. P.H. and J.B·P reviewed and edited the manuscript.

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Appendix A. Database search terms

PsycInfo

1. gratitude/
2. (gratitude adj2 (intervention* or diary or diaries or journal* or letter* or list* or writing* or exercise* or promot* or practice*)).ti,ab,id.
3. 1 OR 2

Embase

1. (gratitude adj2 (intervention* or diary or diaries or journal* or letter* or list* or writing* or exercise* or promot* or practice*)).ti,ab,kw.

Medline

1. (gratitude adj2 (intervention* or diary or diaries or journal* or letter* or list* or writing* or exercise* or promot* or practice*)).ti,ab,kf.

Google scholar

1. allintitle: gratitude intervention OR interventions OR diary OR diaries OR journal OR journals OR journaling OR letter OR letters OR list OR lists OR listing OR writing OR exercise OR excercises OR promotion OR promoting OR practice

Cochrane library

1. gratitude NEAR/2 (intervention* or diary or diaries or journal* or letter* or list* or writing* or exercise* or promot* or practice*)

References

[1] R.A. Sansone, L.A. Sansone, Gratitude and well being: the benefits of appreciation, Psychiatry (Edgmont) 7 (11) (2010) 18–22.
[2] L. Bolier, M. Haverman, G.J. Westerhof, H. Riper, F. Smit, E. Bohlmeijer, Positive psychology interventions: a meta-analysis of randomized controlled studies, BMC Public Health 13 (1) (2013) 119, https://doi.org/10.1186/1471-2458-13-119.
[3] A. Casellas-Grau, A. Font, J. Vives, Positive psychology interventions in breast cancer. A systematic review, Psycho-Oncology. 23 (1) (2014) 9–19, https://doi.org/10.1002/pon.3353.
[4] L.R. Dickens, Using gratitude to promote positive change: a series of meta-analyses investigating the effectiveness of gratitude interventions, Basic Appl. Soc. Psychol. 39 (4) (2017) 193–208, https://doi.org/10.1080/01973533.2017.1323638.
[5] M.E. McCullough, R.A. Emmons, J.-A. Tsang, The grateful disposition: a conceptual and empirical topography, J. Pers. Soc. Psychol. 82 (1) (2002) 112–127, https://doi.org/10.1037/0022-3514.82.1.112.
[6] R.A. Emmons, Thanks!: How the New Science of Gratitude Can Make you Happier: Houghton Mifflin Harcourt, (2007).
[7] R. Emmons, M. McCullough, Counting blessings versus burdens, J. Pers. Soc. Psychol. 84 (2) (2003) 377–389, https://doi.org/10.1037/0022-3514.84.2.377.
[8] A.M. Wood, J.J. Froh, A.W. Geraghty, Gratitude and well-being: a review and theoretical integration, Clin. Psychol. Rev. 30 (7) (2010) 890–905, https://doi.org/10.1016/j.cpr.2010.03.005.
[9] R. Eaton, G. Bradley, S. Morrissey, Positive predispositions, quality of life and chronic illness, Psychol. Health Med. 19 (4) (2014) 473–489, https://doi.org/10.1080/13548506.2013.824593.
[10] M.M. Fritz, C.N. Armenta, L.C. Walsh, S. Lyubomirsky, Gratitude facilitates healthy eating behavior in adolescents and young adults, J. Exp. Soc. Psychol. 81 (2019) 4–14, https://doi.org/10.1016/j.jesp.2018.08.011.
[11] S.R. Legler, E.E. Beale, C.M. Celano, S.R. Beach, B.C. Healy, J.C. Huffman, State gratitude for one’s life and health after an acute coronary syndrome: prospective associations with physical activity, medical adherence and re-hospitalizations, J. Posit. Psychol. 14 (3) (2019) 283–291, https://doi.org/10.1080/17439760.2017.1414295.
[12] P.J. Mills, L. Redwine, K. Wilson, M.A. Pung, K. Chinh, B.H. Greenberg, et al., The role of gratitude in spiritual well-being in asymptomatic heart failure patients, Spirit. Clin. Pract. 2 (1) (2015) 5–17, https://doi.org/10.1037/scp0000050.
[13] F.M. Sirois, A.M. Wood, Gratitude uniquely predicts lower depression in chronic

illness populations: a longitudinal study of inflammatory bowel disease and arthritis, Health Psychol. 36 (2) (2017) 122–132, https://doi.org/10.1037/hea0000436.
[14] R.A. Millstein, C.M. Celano, E.E. Beale, S.R. Beach, L. Suarez, A.M. Belcher, et al., The effects of optimism and gratitude on adherence, functioning and mental health following an acute coronary syndrome, Gen. Hosp. Psychiatry 43 (2016) 17–22, https://doi.org/10.1016/j.genhosppsych.2016.08.006.
[15] J.C. Huffman, E.E. Beale, C.M. Celano, S.R. Beach, A.M. Belcher, S.V. Moore, et al., Effects of optimism and gratitude on physical activity, biomarkers, and readmissions after an acute coronary syndrome: the gratitude research in acute coronary events study, Circu: Cardiovasc. Quality Outcomes. 9 (1) (2016) 55–63, https://doi.org/10.1161/CIRCOUTCOMES.115.002184.
[16] P.L. Hill, M. Allemand, B.W. Roberts, Examining the pathways between gratitude and self-rated physical health across adulthood, Personal. Individ. Differ. 54 (1) (2013) 92–96, https://doi.org/10.1016/j.paid.2012.08.011.
[17] J.K. Boehm, L.D. Kubzansky, The heart's content: the association between positive psychological well-being and cardiovascular health, Psychol. Bull. 138 (4) (2012) 655–691, https://doi.org/10.1037/a0027448.
[18] K. Schache, N. Consedine, P. Hofman, A. Serlachius, Gratitude–more than just a platitude? The science behind gratitude and health, Br. J. Health Psychol. 24 (1) (2019) 1–9, https://doi.org/10.1111/bjhp.12348.
[19] L. Jans-Beken, N. Jacobs, M. Janssens, S. Peeters, J. Reijnders, L. Lechner, et al., Gratitude and health: an updated review, J. Posit. Psychol. (2019) 1–40, https://doi.org/10.1080/17439760.2019.1651888.
[20] A. Liberati, D.G. Altman, J. Tetzlaff, C. Mulrow, P.C. Gøtzsche, J.P. Ioannidis, et al., The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration, PLoS Med. 6 (7) (2009) 1–9, https://doi.org/10.1016/j.jclinepi.2009.06.006 e1000100.
[21] L. Shamseer, D. Moher, M. Clarke, D. Ghersi, A. Liberati, M. Petticrew, et al., Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation, BMJ 349 (2015) g7647, https://doi.org/10.1136/bmj.g7647.
[22] C.M. Karns, W.E. Moore III, U. Mayr, The cultivation of pure altruism via gratitude: a functional MRI study of change with gratitude practice, Front. Hum. Neurosci. 11 (2017) 599, https://doi.org/10.3389/fnhum.2017.00599.
[23] S. Salzmann, F. Euteneuer, J. Strahler, J.A. Laferton, U.M. Nater, W. Rief, Optimizing expectations and distraction leads to lower cortisol levels after acute stress, Psychoneuroendocrinology. 88 (2018) 144–152, https://doi.org/10.1016/j.psyneuen.2017.12.011.
[24] H.J. Baxter, M.H. Johnson, D. Bean, Efficacy of a character strengths and gratitude intervention for people with chronic back pain, Australian J. Rehabil. Counsel. 18 (2) (2012) 135–147, https://doi.org/10.1017/jrc.2012.14.
[25] J.T. Moskowitz, A.W. Carrico, L.G. Duncan, M.A. Cohn, E.O. Cheung, A. Batchelder, et al., Randomized controlled trial of a positive affect intervention for people newly diagnosed with HIV, J. Consult. Clin. Psychol. 85 (5) (2017) 409–423, https://doi.org/10.1037/ccp0000188.
[26] M. Ouzzani, H. Hammady, Z. Fedorowicz, A. Elmagarmid, Rayyan—a web and mobile app for systematic reviews, Syst. Rev. 5 (1) (2016) 210, https://doi.org/10.1186/s13643-016-0384-4.
[27] J.A. Sterne, J. Savović, M.J. Page, R.G. Elbers, N.S. Blencowe, I. Boutron, et al., RoB 2: a revised tool for assessing risk of bias in randomised trials, BMJ 366 (2019) l4898, https://doi.org/10.1136/bmj.l4898.
[28] M. Jackowska, J. Brown, A. Ronaldson, A. Steptoe, The impact of a brief gratitude intervention on subjective well-being, biology and sleep, J. Health Psychol. 21 (10) (2016) 2207–2217, https://doi.org/10.1177/1359105315572455.
[29] K. Schache, P. Hofman, A. Serlachius, A pilot randomized controlled trial of a gratitude intervention for adolescents with type 1 diabetes, Diabet. Med. (2019), https://doi.org/10.1111/dme.14078.
[30] L.S. Redwine, B.L. Henry, M.A. Pung, K. Wilson, K. Chinh, B. Knight, et al., Pilot randomized study of a gratitude journaling intervention on heart rate variability and inflammatory biomarkers in patients with stage B heart failure, Psychosom. Med. 78 (6) (2016) 667–676, https://doi.org/10.1097/psy.0000000000000316.
[31] M. Moieni, M.R. Irwin, K.E.B. Haltom, I. Jevtic, M.L. Meyer, E.C. Breen, et al., Exploring the role of gratitude and support-giving on inflammatory outcomes, Emotion 19 (6) (2018) 939–949, https://doi.org/10.1037/emo0000472.
[32] K.A. Cook, K.M. Woessner, A.A. White, Happy asthma: improved asthma control with a gratitude journal, J Allergy Clin Immunol Pract 6 (6) (2018) 2154–2156, https://doi.org/10.1016/j.jaip.2018.04.021.
[33] M.Y. Bartlett, S.N. Arpin, Gratitude and loneliness: enhancing health and well-being in older adults, Res. Aging. 41 (8) (2019) 772–793, https://doi.org/10.1177/0164027519845354.
[34] S. Kaplan, J.C. Bradley-Geist, A. Ahmad, A. Anderson, A.K. Hargrove, A. Lindsey, A test of two positive psychology interventions to increase employee well-being, J. Bus. Psychol. 29 (3) (2014) 367–380, https://doi.org/10.1007/s10869-013-9319-4.
[35] N. Digdon, A. Koble, Effects of constructive worry, imagery distraction, and gratitude interventions on sleep quality: a pilot trial, Appl. Psychol.: Health Well-Being. 3 (2) (2011) 193–206, https://doi.org/10.1111/j.1758-0854.2011.01049.x.
[36] H. Heckendorf, D. Lehr, D.D. Ebert, H. Freund, Efficacy of an internet and app-based gratitude intervention in reducing repetitive negative thinking and mechanisms of change in the intervention's effect on anxiety and depression: results from a randomized controlled trial, Behav. Res. Ther. 103415 (2019), https://doi.org/10.1016/j.brat.2019.103415.
[37] S. Southwell, E. Gould, A randomised wait list-controlled pre–post–follow-up trial of a gratitude diary with a distressed sample, J. Posit. Psychol. 12 (6) (2017) 579–593, https://doi.org/10.1080/17439760.2016.1221127.
[38] W.L. Wolfe, K. Patterson, Comparison of a gratitude-based and cognitive restructuring intervention for body dissatisfaction and dysfunctional eating behavior in college women, Eat. Disord. 25 (4) (2017) 330–344, https://doi.org/10.1080/10640266.2017.1279908.
[39] M.L. Martínez-Martí, M.D. Avia, M.J. Hernández-Lloreda, The effects of counting blessings on subjective well-being: a gratitude intervention in a Spanish sample, Spanish J. Psychol. 13 (2) (2010) 886–896, https://doi.org/10.1017/S1138741600002535.
[40] C.-F. Bai, N.-X. Cui, X. Xu, G.-L. Mi, J.-W. Sun, D. Shao, et al., Effectiveness of two guided self-administered interventions for psychological distress among women with infertility: a three-armed, randomized controlled trial, Hum. Reprod. 34 (7) (2019) 1235–1248, https://doi.org/10.1093/humrep/dez066.
[41] S.T. Lai, R.E. O'Carroll, 'The three good things'-the effects of gratitude practice on wellbeing: a randomised controlled trial, Health Psychol Update. 26 (2017) 10–18.
[42] S.A. Schnitker, K.L. Richardson, Framing gratitude journaling as prayer amplifies its hedonic and eudaimonic well-being, but not health, benefits, J. Posit. Psychol. 14 (4) (2019) 427–439, https://doi.org/10.1080/17439760.2018.1460690.
[43] J.J. Froh, W.J. Sefick, R.A. Emmons, Counting blessings in early adolescents: an experimental study of gratitude and subjective well-being, J. Sch. Psychol. 46 (2) (2008) 213–233, https://doi.org/10.1016/j.jsp.2007.03.005.
[44] D. Rennie, CONSORT revised—improving the reporting of randomized trials, Jama. 285 (15) (2001) 2006–2007, https://doi.org/10.1001/jama.285.15.2006.
[45] M.-Y. Ng, W.-S. Wong, The differential effects of gratitude and sleep on psychological distress in patients with chronic pain, J. Health Psychol. 18 (2) (2013) 263–271.
[46] P.J. Karanicolas, F. Farrokhyar, M. Bhandari, Blinding: who, what, when, why, how? Can. J. Surg. 53 (5) (2010) 345.
[47] C.J. Chen, G. McHugh, M. Campbell, K. Luker, Subjective and objective sleep quality in individuals with osteoarthritis in Taiwan, Musculoskeletal Care. 13 (3) (2015) 148–159, https://doi.org/10.1002/msc.1094.
[48] G.J. Landry, J.R. Best, T. Liu-Ambrose, Measuring sleep quality in older adults: a comparison using subjective and objective methods, Front. Aging Neurosci. 7 (2015) 166, , https://doi.org/10.3389/fnagi.2015.00166.
[49] A.M. Wood, S. Joseph, J. Lloyd, S. Atkins, Gratitude influences sleep through the mechanism of pre-sleep cognitions, J. Psychosom. Res. 66 (1) (2009) 43–48, https://doi.org/10.1016/j.jpsychores.2008.09.002.
[50] O. Itani, M. Jike, N. Watanabe, Y. Kaneita, Short sleep duration and health outcomes: a systematic review, meta-analysis, and meta-regression, Sleep Med. 32 (2017) 246–256, https://doi.org/10.1016/j.sleep.2016.08.006.
[51] A. Alkozei, R. Smith, W.D. Killgore, Grateful people are happy and healthy—but why, Front. Young Minds. 5 (2017) 1–9, https://doi.org/10.3389/frym.2017.00055.
[52] G.M. Slavich, M.R. Irwin, From stress to inflammation and major depressive disorder: a social signal transduction theory of depression, Psychol. Bull. 140 (3) (2014) 774–815, https://doi.org/10.1037/a0035302.
[53] A.J. Fairchild, H.L. McDaniel, Best (but oft-forgotten) practices: mediation analysis, Am. J. Clin. Nutr. 105 (6) (2017) 1259–1271, https://doi.org/10.3945/ajcn.117.152546.