Journal of Happiness and Health
2023, Vol. 3, No. 2, 49–92
https://doi.org/10.47602/johah.v3i2.46
https://journalofhappinessandhealth.com

REVIEW ARTICLE

A New Lens on Improving Physical Health with Psychological Interventions: A Systematic Review

Lawrence Paddon[1] and Hanna Kampman[1]

Abstract

Increasingly health is recognised as a holistic construct that includes both mind and body. What is more, the bidirectional relationship between psychological wellbeing (PW) and physical health (PH) is becoming clearer. Psychological interventions have been shown to be effective at increasing PW and are widely accessible. However, there has not yet been a systematic synthesis of how improving PW using psychological interventions benefits PH. The aim of the study was to review the existing literature on how increasing PW via psychological interventions can improve PH, commenting on effectiveness and causal mechanisms, and suggesting directions for future research. A systematic review of peer reviewed studies was utilised. This took a broad search approach to include quantitative research concerning the impacts of psychological interventions on PH published between January 1998 and June 2022 in both clinical and non-clinical populations. From 1647 search results a total of 74 studies were included in the review with 10305 participants in total. Studies measured 139 individual PH outcomes for which 60 statistically significant effects were observed. Cognitive behavioural therapy-based interventions were most associated with both significant and non-significant effects, commonly impacting various self-report measures of PH. Positive psychology interventions (PPIs) also showed a higher proportion of significant effects. Mindfulness-based interventions had a clear link to reductions in cortisol, demonstrating significant effects in 2/3 studies. Pathways by which interventions improved PH broadly fell into three categories: 1) protect 2) reduce, and 3) produce. Within each category improvements were driven by biological, behavioural, or social support mechanisms. The present review supports the notion that psychological interventions can benefit PH and corroborates potential pathways that may drive this association. Future studies could benefit from defining PW better, thus unpacking the nuance in how targeting different areas of PW appears to impact different markers of PH.

Keywords: Psychological wellbeing, physical health, psychological intervention, positive psychology, systematic review

Our understanding of the interaction between the psychological and the physiological is developing rapidly (Steptoe, 2019a). Additionally, there is recognition that this relationship is bidirectional (Veenhoven, 2008). For example, physical illness or pain may reduce our capacity for happiness, and psychological depression or distress has been associated with ill health (Luppino et al., 2010; Richman et al., 2005). Until recently, a focus on treating dysfunction has been pervasive in the literature, but the paradigm is shifting, acknowledging the importance of positive processes in creating and protecting health and wellbeing (Kubzansky et al., 2015; Richman et al., 2005).

Epidemiological studies are beginning to unpack the association between happiness and physical health (PH). For the purposes of this review PH will be viewed in line with the World Health Organization's frequently cited definition as "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity" (World Health Organization, 2009, p. 1). A large number of reviews have summarised observational findings that show psychological wellbeing (PW) is correlated with improved mortality outcomes (Howell et al., 2007; Martín-María et al., 2017; Veenhoven, 2008). Research also demonstrates a benefit to morbidity. For instance,

[1]School of Psychology, University of East London, United Kingdom

Corresponding Author: Lawrence Paddon, School of Psychology, University of East London, Water Lane, E15 3LZ, London, UK.
Email: Lawrence.paddon@gmail.com

PW has been correlated with lower incidence of coronary heart disease (Boehm et al., 2011; Davidson et al., 2010; Surtees et al., 2010), stroke (Kim et al., 2013; Lambiase et al., 2015), reduced cognitive decline with aging (Boyle et al., 2010; Rawtaer et al., 2017), and greater resilience to upper respiratory infection (Cohen et al., 2006). Yet to date these findings have not been translated into practical applications to support PH.

Established behavioural recommendations on exercise, diet, and sleep hygiene are readily available for those who want to improve and optimise their PH (Dulloo et al., 2017). For example, the UK government issues guidelines on physical activity (Department of Health, 2019) and nutrition (Public Health England, 2016). Adding to the discourse in this arena is increased interest in PW as a means to improve PH. Further, the field positive health has been proposed (Seligman, 2008). This posits that optimising health in biological, subjective, and functional areas is needed, rather than only focusing on treating ill health.

There is growing research supporting psychological interventions that increase PW (van Agteren et al., 2021). It also appears that psychological interventions can benefit PH, but this has received less attention until recently. This is not to say that PW should be the focus of attempts to improve PH. Biological and behavioural pathways are almost certainly more important (Steptoe, 2019a). Moreover, PW is worth pursuing for its own sake. However, given that many psychological interventions are accessible and provide a low barrier to entry (Bolier et al., 2013), they have potential as a complementary route to improve and optimise PH.

Literature Review

Psychological Wellbeing

PW, as referred to in this review, combines several constructs. Whilst recognising the complex discussions within the literature around happiness, and subjective as well as psychological wellbeing (Dodge et al., 2012; Huppert, 2017), a broader view was required for this review to capture several ways PW might be understood and measured. These constructs include seminal concepts underpinning positive psychology, namely subjective wellbeing (Diener, 1984) and psychological wellbeing (Ryff, 1989). Building on this, Steptoe et al. (2015) conceptualise subjective wellbeing into three categories: evaluative wellbeing (or satisfaction with life), hedonic wellbeing (or affective wellbeing) and eudaimonic wellbeing (see Table 1). This paper takes a broad approach, viewing PW as a combination of all of these concepts, and should not be confused with Ryff's (1989) seminal work with a similar term PWB which focuses on eudaimonic wellbeing.

Table 1. Taxonomy of subjective wellbeing adapted from Steptoe (2019a)

Type	Description	Underpinning Theory
Evaluative wellbeing	How satisfied one is with their quality of life	Subjective wellbeing (SWB) consisting of high levels of positive affect, low levels of negative affect and high subjective life satisfaction (Diener, 1984)
Hedonic (affective) wellbeing	Experiencing positive feelings (cheerfulness, joy, happiness, pleasure, vitality) with little negative feeling (stress, low mood, sadness)	
Eudaimonic wellbeing	Presence of meaning and purpose in one's life	Psychological wellbeing (PWB) consisting of self-acceptance, personal growth, purpose in life, positive relationships, environmental mastery, and autonomy (Ryff, 1989)

Most often the different categories of PW are intercorrelated (Kashdan et al., 2008). However, it is possible to have meaning and purpose without feeling much pleasure and vice versa (Joshanloo, 2016). This speaks to the idea of complete mental health, which argues that though mental illness and mental health are related, they exist on two different continua (Keyes, 2003). Additionally, different areas of PW may benefit from different interventions and be associated with distinct biological correlates (Steptoe, 2019a). For example, Boehm & Kubzansky (2012) found that optimism and hedonic wellbeing were more closely related to positive cardiovascular disease outcomes than eudaimonic wellbeing. Because of these nuanced interactions it is important to draw distinction between different aspects of PW.

Numerous factors contribute to PW. These include stress exposure, social support, genetic factors and socioeconomic status (Steptoe 2019a). In depth discussion of these variables is beyond the scope of this piece. Most important for the purposes of the present review is the fact that PW is malleable (Lyubomirsky et al., 2005), for example, by using tools such as psychological interventions, meaning it can be modified in ways that may benefit health (Steptoe, 2019b).

Impact of Psychological Wellbeing on Physical Health

Veenhoven (2008) conducted a synthetic analysis of 30 follow-up studies to answer the question of whether happiness in good for PH. It was found that happiness has the same impact on longevity as that of smoking or not. However, it did not appear to heal those with ill health. In a similar review, Diener & Chan (2011) drew parallel conclusions, saying that positive affect was a bigger predictor of health and longevity than negative affect, but highlighted that positive affect elevated to manic levels may be detrimental to PH. Further, a later meta-analysis including 62 general population studies and over 1,250.000 participants found subjective wellbeing was protective to all-cause mortality (Martín-María et al., 2017). These findings suggest that PW could have a significant preventative role when it comes to PH.

However, there is not consensus on some points. A meta-analysis by Chida & Steptoe (2008) found that happiness did increase longevity in clinical groups. Moreover, a recent systematic review and meta-analysis of psychological interventions for improving mental wellbeing said that increasing PW is a route to both disease prevention and clinical recovery (van Agteren et al., 2021). On the other hand, large-scale research has also found no correlation between PW and mortality (Liu et al., 2016; Ortega et al., 2010). Again, where there is an association it seems to be more pronounced in non-clinical populations and varies based on disease (Aspinwall & Tedeschi, 2010). For example, PW has been found to have a weaker (Rasmussen et al., 2009) or nonsignificant (Chida & Steptoe, 2008) relationship with cancer mortality when compared to cardiovascular disease, HIV and renal failure. This makes it clear that there is nuance in the link between PW and PH.

A common challenge in the literature is isolating causality. Most studies are observational, meaning reverse causation cannot be ruled out (McGue et al., 2010). For example, individuals that are more likely to die may have existing health issues at the time they are assessed, which make them more prone to evaluate their PW poorly (Steptoe, 2019a). Confounding also comes into play, as several studies have shown that associations between PW and mortality are reduced when physical activity and baseline health are accounted for (Koopmans et al., 2010; Wiest et al., 2011). Some studies have addressed potential confounding. Sadler et al. (2011) used a twin design to observe the relationship between PW and mortality over nine years in 3,966 twins. They found that PW was predictive of mortality independent of gene and shared environmental factors. The complexity in the research highlights the need to better understand the association between PW and longevity.

Morbidity has received less systematic review than survival rates but is a complementary measure of PH. One notable meta-analysis found a small protective effect of PW on recovery from a range of ailments including coronary heart disease (CHD), heart failure and spinal cord injury (Lamers et al., 2012). Steptoe's (2019a) review synthesises many studies showing benefits. These include reduced cognitive decline and dementia risk (Boyle et al., 2010; Rawtaer et al., 2017), incidence of CHD independent of covariates (Boehm et al., 2011; Davidson et al., 2010; Surtees et al., 2010) and stroke risk that accounted for confounding variables (Kim et al., 2013; Lambiase et al., 2015; Ostir et al., 2001). One study has also found that positive emotions were associated with resistance to developing the common cold and influenza, or fewer symptoms when infections did occur (Cohen et al., 2006). These effects were independent of negative emotional states and self-reported health.

This is not to say that findings in the morbidity realm are conclusive either. Some studies on CHD have shown no correlation (Freak-Poli et al., 2015; Nabi et al., 2008). Another found no association when investigating positive affect and memory, executive function and processing speed in a 12-year follow-up study (Berk et al., 2017). Researchers also need to be cognisant of bidirectionality, as age related cognitive decline itself may lead to loss of purpose and consequently reduced PW (Wilson et al., 2013). Therefore, unpacking confounding factors and potential reverse causation is needed to understand how PW impacts PH.

Pathways Linking Psychological Wellbeing and Physical Health

What pathways could explain the link between PW and health? Steptoe (2019a) provides a useful framework to explore this question, categorising mechanisms into behavioural practices and biological correlates. Aspinwall &

Tedeschi (2010) corroborate this categorisation and provide a third pathway of social support. These mechanisms interact with each other. However, considering each individually gives a useful starting point for review.

Behavioural. The beneficial effects of physical activity as a positive health behaviour are well-established (Pedersen & Saltin, 2015). Whilst inactivity is associated with depression (Schuch et al., 2018), even modest amounts of physical activity (less than 150 minutes walking per week) decrease the incidence of depression (Mammen & Faulkner, 2013). Further, amount of light, moderate and vigorous activity measured via accelerometers has been associated with PW in older adults (Black et al., 2015; Buman et al., 2010). Domain of physical activity may be important. A meta-analysis including 98 studies found that PW was positively associated with transport and leisure time physical activity, but negatively correlated with work-related physical activity (White et al., 2017). Positive physical activity is thus an important health behaviour.

Preventative behaviours, risk taking, coping, appraisal of stressors and approach to health risks have all been positively associated with PW (Arslan, 2017; Aspinwall & MacNamara, 2005; Cohen & Rodriguez, 1995; Taylor & Sherman, 2004). A large-scale study of adults over the age of 50 spanning six years found that greater purpose in life was associated with use of preventative healthcare services such as cholesterol tests and mammograms (Kim et al., 2014). Emerging research also links fruit and vegetable intake to PW (Blanchflower et al., 2013; Mujcic & Oswald, 2016), though there is evidence that enhanced PW is caused by eating these foods, rather than the other way around (Conner et al., 2017; Veenhoven, 2021). This highlights that both psychosomatic (influence of the mind on the body) and somatopsychic (influence of the body on the mind) pathways play a role in PH (Hefferon, 2013).

Low PW has been associated with destructive health behaviours like smoking, excess alcohol consumption and unsafe sexual activity (Grant et al., 2009), as well as attempted suicide and violence-related injuries (Borowsky et al., 2009). Conversely, unrealistic optimism, the underestimation of some risks and overestimation of others (Avvenuti et al., 2016), can also lead to increased all-cause mortality due to unfounded expectations of positive outcomes or neglecting to mitigate relevant threats (Craig et al., 2021). In contrast, healthy levels of optimism have been linked to preventative health behaviours and self-care (Aspinwall & Tedeschi, 2010), as well as adherence to medical advice (Cooper et al., 1999) and better coping with threatening information (Aspinwall & Brunhart, 1996).

Biological. Researchers have found consistent evidence linking greater PW with lower levels of cortisol, a stress hormone that has negative impacts on health if chronically elevated (Adam et al., 2017). Further, systemic inflammation – mechanisms within the body that fight against potential infections or toxins and heal injuries – may also be influenced by PW (Sin et al., 2015). Acute inflammation is normal, however chronic inflammation has been linked to numerous negative health outcomes and is the most significant cause of death globally (Pahwa et al., 2018). Studies have observed reduced inflammation in individuals who are optimistic and have frequent positive experiences (Roy et al., 2010; Sin et al., 2015). Potential bidirectionality provides complication, as inflammation and associated neuroendocrine processes may also reduce PW (Miller & Raison, 2016).

There are several other distinct health markers that have been found to benefit from PW. These include improved glucose control (Hafez et al., 2018) and healthier cholesterol levels (Steptoe et al., 2012). Significantly, allostatic load – a measure of dysfunction aggregated across physiological systems – was shown to be lower in individuals with higher PW in two large-scale analyses that controlled for age, sex, health behaviour and negative affect (Schenk et al., 2018; Zilioli et al., 2015). Furthermore, Ryff et al. (2006) found associations with cardiovascular health indicators like waist-hip ratio and weight, but these varied depending on the measure of PW used.

Social Support. Interpersonal relationships are one of the most important factors for human survival (Berscheid, 2003) and their importance in health and wellbeing is well documented (Holt-Lunstad et al., 2010; Slatcher & Selcuk, 2017; Stadler et al., 2012). Those who show greater optimism and positive affect have been found to have higher perceived social support, as well as better quality and more regular social interactions (Brissette et al., 2002; Lyubomirsky et al., 2005; Pressman & Cohen, 2005; Srivastava et al., 2006). Fredrickson's (1998) seminal broaden-and-build theory may serve as explanation, since positive states widen individual's thought-action repertoires, facilitating the creation and maintenance of social networks (Veenhoven, 2008). This is important, as those with more social relationships have greater longevity, less age-related cognitive decline, higher immune function and better prognoses to illnesses (Cohen & Janicki-Deverts, 2009). However, social connections are not always beneficial. For instance, substance abuse is often mediated by the norms of social groups that individuals identify

with (Dingle et al., 2015). The nature of interpersonal relationships should therefore be considered when investigating links to PH.

There is growing evidence that positive resonance – a kind of interpersonal connection defined by shared pleasant emotions, mutual nonverbal care and both behavioural and biological synchrony (Fredrickson, 2016) – is associated with prosocial tendencies, PW and beneficial health behaviours. Most recently, high positive resonance has been linked to greater psychological resilience (Prinzing et al., 2020) and hygiene behaviours such as mask wearing and handwashing during the COVID-19 pandemic (West et al., 2021). Further, a longitudinal study of 154 married couples found that greater positive resonance predicted less health decline over time and increased longevity (Wells et al., 2022). From this it seems probable that social support is a significant pathway linking PW and PH.

Looking at the available evidence it appears that PW benefits PH through a variety of mechanisms. The above pathways may provide some explanation, but we do not yet know their relative importance and interactions (Sanders et al., 2022; Veenhoven, 2008). Moreover, it is likely that these pathways are reciprocal and influence each other (Aspinwall & Tedeschi, 2010). Unpacking these points will be important to utilising these mechanisms for health benefit through psychological interventions.

Psychological Interventions

Psychological interventions are deliberate activities (singular or composite) with strong empirical foundations that aim to positively change emotional states, feelings and behaviours (Hodges et al., 2011). Related to positive psychology specifically, positive psychology interventions (PPIs) are treatment modalities or intentional activities that cultivate and consolidate positive thoughts, feelings and behaviours, rather than treating or healing pathologies (Sin & Lyubomirsky, 2009). The latter point makes PPIs distinct from other psychological interventions that focus on treating dysfunction.

It is worth noting that there is a divide in the literature between terms positive psychology interventions and positive psychological interventions (e.g., see Sin & Lyubomirsky, 2009: Bolier et al., 2013; Schueller et al., 2014), and earlier meta-analyses that had some challenges around clear definitions and subsequently excluded interventions from other fields (such as physical activity). Schueller et al. (2014) has suggested that this is restrictive, and explorations would benefit from including any psychological interventions that are still in line with the theoretical underpinnings of positive psychology. Therefore, this review uses the later term to guide study selection similar to a recent mega-analysis of meta-analysis by Carr et al. (2023).

A large amount of literature concerning how psychological interventions impact wellbeing is focused on PPIs. One highly cited meta-analysis shows that PPIs can significantly increase wellbeing ($r = .29$) and reduce depression ($r = .31$) (Sin & Lyubomirsky, 2009), a bigger effect than another influential review that showed lower impacts on subjective wellbeing ($r = .17$), PW ($r = .10$) and depression ($r = .11$) respectively (Bolier et al., 2013). However, a recent meta-analysis sought to re-examine these two studies accounting for small sample size bias and directly extracting effect sizes from the primary research (White et al., 2019). The authors found that this decreased PPI's impact on depression to generally less than significant levels, and reduced the effect on wellbeing, though it was still significant ($r = .10$). This underlines the need for more studies with larger sample sizes (White et al., 2019), but PPIs still show promise for increasing wellbeing (Hendriks et al., 2020).

Research outside of the western world is adding to the discourse. A systematic review and meta-analysis of 28 randomised controlled trails (RCTs) by Hendriks et al. (2018) found that PPIs had a greater impact in non-western countries than the previously mentioned studies (subjective wellbeing $r = .48$; PW $r = .40$; depression $r = .62$). The authors caution that this could be due to the lower quality of studies included, but also may be explained by PPIs having a better cultural fit. Other developing frontiers include the use of PPIs in the age of COVID-19, particularly through digital delivery and as a means of combating loneliness (Parks & Boucher, 2020), highlighting their evolving utility.

Though PPIs comprise most of the research on increasing PW, it would be remiss not to include other interventions. A recent systematic review and meta-analysis unified interventions from different theoretical backgrounds and confirmed that psychological interventions in general can improve mental illness and PW (van Agteren et al., 2021). Out of 419 RCTs comprising 53,288 clinical and non-clinical individuals, mindfulness-based and multi-component PPIs showed the highest efficiency, with reminiscence interventions, cognitive and behavioural therapy-based interventions, acceptance and commitment therapy-based interventions, and singular PPIs also impactful. Based on

this evidence, psychological interventions show potential to improve PW both in general population and patient groups. Thus, there is also a rationale to investigate if they can be used to benefit PH.

Research Question

This research reviews the existing literature concerning how increasing PW via psychological interventions can improve PH, deriving relevant causal mechanisms.

Three key questions were prioritised:

1. What are the impacts of psychological interventions on PH?
2. What mechanisms explain these impacts?
3. Which psychological interventions are most beneficial to PH?

A systematic review was utilised to answer these questions. This was possible due to the large amount of primary research on the topic (Diener & Tay, 2017). The systematically structured approach offers a critical overview of the field and allows comments to be made on the effectiveness of interventions, as well as identifying avenues for future research.

Method

This systematic literature review of interventions leans on well utilised and recognised Cochrane methodology (Chandler et al., 2022). The systematic review aimed to identify all empirical evidence fitting the pre-specified inclusion and exclusion criteria (see section 'eligibility criteria'), focusing on randomised studies due their rigorous research design (Chandler, et al., 2022). More specifically, the aim was to synthesise the existing findings from 1998 onwards, in a transparent and systematic way (Snyder, 2019). Conducting a meta-analysis of results was considered. However, large variability in outcomes, methodologies, and interventions was observed across studies. Pooling data to derive statistical significance was therefore deemed inappropriate.

Informed by the rigorous Cochrane methodology, this review followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009). The synthesis took a broad approach, including studies that investigated the impacts of psychological interventions on PH. Figure 1 shows the literature search and study selection process.

Eligibility Criteria

Studies included in the present review met the following inclusion criteria: 1) were original quantitative research including RCTs, cohort, case-controlled and cross-sectional studies, 2) measured the impact of PW on PH using objective or self-report measures, 3) were published in peer-reviewed journals, and 4) were written in English. Articles were excluded if they were unpublished, grey literature or conference proceedings.

Participants comprised adults of any gender, race, and ethnicity. Both non-clinical and clinical populations were included. Participants were not actively restricted by geography, though the available literature may have had an impact, as a western bias has been noted in positive psychology research (Zyl et al., 2021), and the psychological sciences at large (Cheon et al., 2020).

Search dates were January 1998 to June 2022. This timeframe maps to the period positive psychology has been considered a distinct field (Seligman, 2002). In accordance with the latest findings on psychological interventions (e.g., van Agteren et al., 2021) the review included clinical populations to enable a broader understanding of how PW can benefit PH.

Information Sources and Search Strategy

The following electronic sources were searched: EBSCO (Academic Search Ultimate, APA PsycArticles, APA PsycInfo, SPORTDiscus with Full Text and CINAHL), Scopus, ScienceDirect, The Cochrane Library (PubMed, MEDLINE and EMBASE) and JSTOR. Search strategy was informed by consulting with an academic librarian. Truncation was used to find synonyms of terms, along with wildcards for variations in spelling. Limiters were applied to databases when available (e.g., only return quantitative studies). The following terms were used, combined using Boolean Operators:

1. Happiness OR well*being OR "Psych* health" OR "Psychological well*being" OR "Subjective well*being" OR "Life satisfaction" OR Flourishing OR "Positive affect"

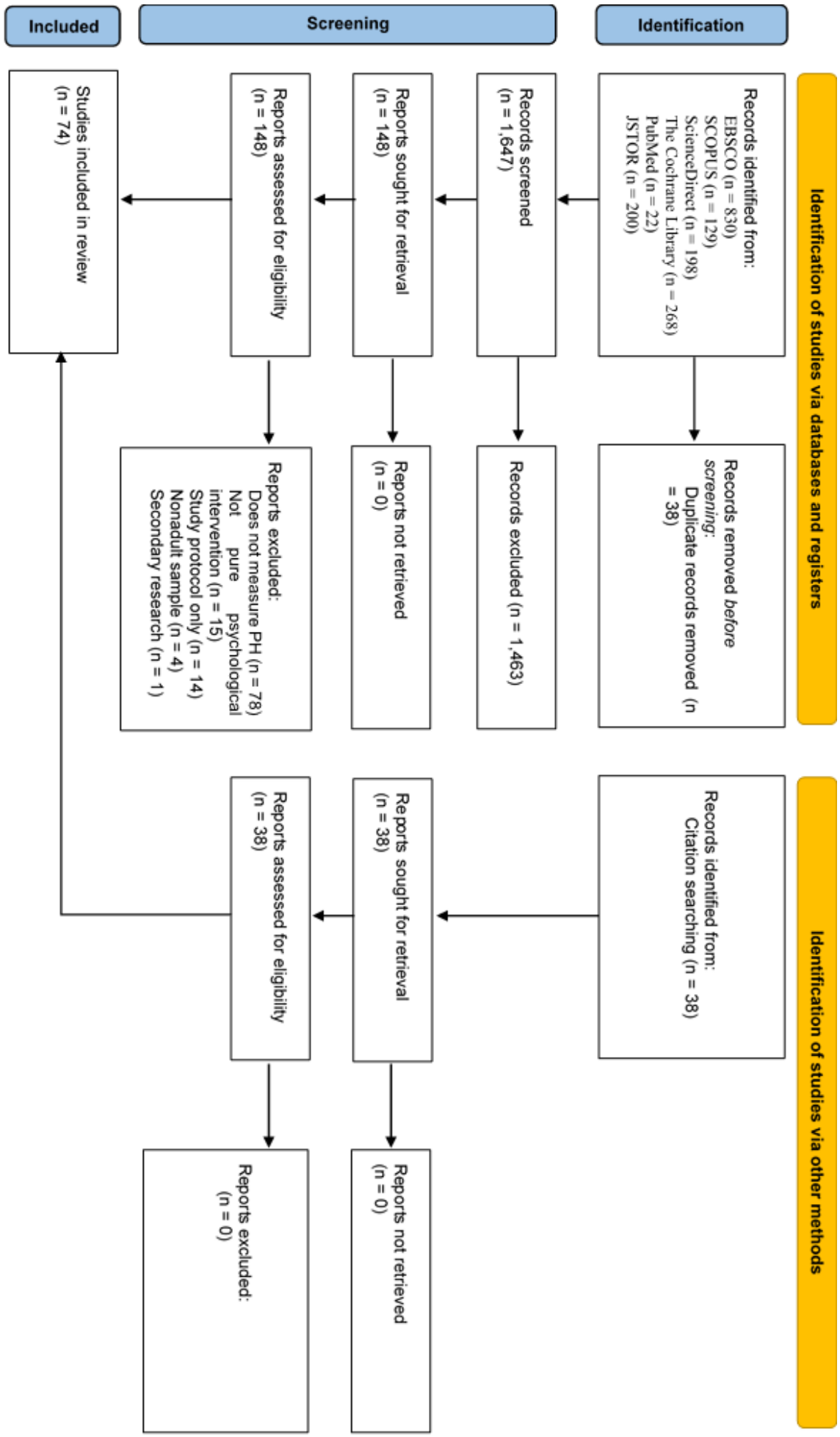

Figure 1. Preferred reporting items for systematic reviews and meta-analyses (Prisma) flowchart

Table 2. Summary of studies included in systematic review

Study	Aim	Study design	Intervention type	Physical health measure	Participants	Effect significance
Kabat-Zinn et al. (1998)	To assess if stress reduction from mindfulness mediation can positively impact the rate of psoriasis clearing in patients undergoing phototherapy or photochemotherapy	RCT	Mindfulness meditation-based stress reduction (13 weeks)	Psoriasis skin clearing	37 psoriasis patients	Significant (halfway clearing point p = .013 and clearing point p = .033)
Emmons & McCullough (2003), study one	To investigate the effect of a grateful outlook on psychological and physical wellbeing	Randomised intervention	Gratitude journaling (10 weeks)	Self-report physical symptoms Self-report health behaviours	192 university students	NR. Improvements in physical symptoms and hours spent exercising. Effect size not reported.
Emmons and McCullough (2003), study two	"	Randomised intervention	Gratitude journaling (2 weeks)	Self-report physical symptoms Hours slept Self-report sleep quality Amount of pain relief, coffee, and alcohol usage	166 university students	NS
Emmons and McCullough (2003), study three	"	RCT	Gratitude journaling (3 weeks)	Self-report physical symptoms Self-report sleep quality Self-report hours spent exercising Self-report pain	65 neuromuscular disease patients	NR.
Carlson et al. (2004)	To examine the relationship between mindfulness-based stress reduction meditation for early-stage breast and prostate cancer patients and quality of life, mood, stress symptoms and levels of cortisol, dehydroepiandrosterone-sulphate (DHEAS) and melatonin	Intervention study	Mindfulness-based stress reduction (8 weeks)	Self-report health behaviours Levels of cortisol, dehydroepiandrosterone-sulfate (DHEAS) and melatonin	42 breast and prostate cancer patients	NS
Van Der Ven et al. (2005)	To investigate the effects of cognitive behavioural group training on glycaemic control, diabetes self-efficacy and wellbeing in Type 1 diabetes patients	RCT	Cognitive behavioural group training (6 weeks)	Blood sugar markers (HbA1c)	107 Type 1 diabetes patients	NS
Claesson et al. (2006)	To test if improvements in psychosocial wellbeing from a cognitive-behavioural intervention benefit biomarkers associated with cardiovascular risk	RCT	Cognitive-behavioural stress management programme (12 months)	Blood markers (C-reactive protein, leptin, glucose, and insulin) Blood pressure Waist to height	159 women with ischaemic heart disease	NS
Shaw et al. (2006)	To investigate how insightful disclosure in a computer-mediated support group for women with breast cancer impacts breast cancer-related concerns, emotional wellbeing, and self-reported physical wellbeing	Observational	Computer-mediated social support (5 months)	Self-report physical wellbeing	144 breast cancer patients	NS
Gregg et al. (2007)	To study the impact of acceptance and commitment therapy on diabetes self-management	RCT	Acceptance and commitment therapy (1-day workshop)	Blood glucose markers (HbA1C) Self-report diabetes self-management	81 diabetes patients	Significant improvement in diabetes control (p = .009) Significant improvement in self-management (p = .07)
Wiltink et al. (2007)	To identify predictors of long-term weight loss following inpatient psychodynamic or behavioural psychotherapy of obese patents	Longitudinal intervention study	Behavioural or psychodynamic psychotherapy (7 weeks)	Self-report physical complaints Self-report eating behaviour Blood pressure Bodyweight	267 obese individuals	Improved predictors of weight loss - life satisfaction (p =.001) and self-efficacy (p =.036)
Papousek & Schulter (2008)	To test the efficacy of a newly developed intervention designed to improve psychological wellbeing and subjective health by enhancing cheerfulness	RCT	Cheerfulness Training (7 months)	Blood pressure ECG recording Heart rate variability	58 general population individuals	(NR) Reduction in systolic blood pressure. No impacts to HRV. Improvement in subjective health.

Martínez-Martí et al. (2010)	To assess if a gratitude intervention repeats of Emmons and McCullugh (2003) in a Spanish sample	RCT	Gratitude journaling (2 weeks)	Self-report physical symptoms Self-report sleep quality Amount of pain relief use	105 university students	NS
Digdon & Koble (2011)	To evaluate three self-help interventions (constructive worry, imagery distraction and a gratitude intervention) effects on sleep problems	RCT	One of three self-help interventions (constructive worry, imagery distraction and a gratitude intervention, 1 week)	Self-report sleep quality Daily sleep log	41 university students	Significant improvements in sleep quality (p = .001) and sleep log total sleep time (p = .02)
Lu et al. (2012)	To test the cultural fit, feasibility, and health benefits of an expressive writing intervention on Chinese-speaking breast cancer survivors	Intervention study	Expressive writing (3 weeks)	Self-report physical symptoms	19 cancer survivors	Medium to large effects on the decreasing fatigue at 3-month (partial Eta squared .066) and 6-month (partial Eta squared .066) follow-up.
Ogedegbe et al. (2012)	To assess if a patient education intervention combined with positive-affect induction and self-affirmation was more effective than patient education alone in positively impacting medical adherence and blood pressure in hypertensive African Americans	RCT	Positive affect and self-affirmation intervention (12 months)	Blood pressure and medication adherence	256 hypertensive African Americans	Significantly higher medication adherence (p = .049) No significant difference in blood pressure
Peterson et al. (2012)	To test if a positive affect intervention can be used to motivate cardiac patients to increase energy expenditure to > 336 kcal/wk at 12-month follow-up	RCT	Positive affect intervention (12 months)	Self-report physical activity (the Paffenbarger Index)	242 cardiac patients	Significantly more patients in the PA group achieved target kcal/wk output (p = .007)
Davis & Zautra (2013)	To compare an online intervention aimed at socioemotional regulation via mindful awareness and acceptance with an attention control treatment	RCT	Mindful socioemotional intervention (6 weeks)	Fibromyalgia Impact Questionnaire; Pain and Pain Coping Efficacy	79 fibromyalgia patients	Significant improvements in coping efficacy for pain (p = 0001)
Kok et al. (2013)	To investigate if positive social connections account for the upward spiral between positive emotions and vagal tone	RCT	Loving-kindness meditation (6 weeks)	Vagal tone via spectral frequency analysis of heart rate	65 general population	Increased social connections significantly predicted improvements in vagal done (p = .03)
Moore et al. (2013)	To evaluate the efficacy of a behavioural activation intervention designed to reduce cardiovascular disease risk and depressive symptoms in dementia caregivers	RCT	Behavioural Activation intervention (6 weeks)	Blood clotting and inflammation (D-dimer and Interleukin-6)	45 general population individuals	Significant reduction in interleukin-6 (p =.040)
Rosenkranz et al. (2013)	To compare an 8-week Mindfulness-Based Stress Reduction (MBSR) intervention to a matched control intervention, the Health Enhancement Program (HEP) in reducing psychological stress and experimentally-induced inflammation	RCT	Mindfulness-Based Stress Reduction (8 weeks)	Self-report physical symptoms Quantity of tumour necrosis factor alpha, interleukin-8, and inflammation flare size Salivary cortisol	49 general population individuals	Reduction in cortisol response (p = .03), self-report psychological distress (p = .007) and physical symptoms (p = .007)
Wicksell et al. (2013)	To assess the efficacy of acceptance and commitment therapy for helping fibromyalgia patients and the role of psychological inflexibility in mediating improvements	RCT	Acceptance and commitment therapy (12 weeks)	Pain Disability Index (PDI); Fibromyalgia Impact Questionnaire (FIQ); ort Form-36 Health Survey (SF-36) is a 36-item measure assessing health-related quality of life (Ware and Sherbourne, 1992); Pain intensity	40 fibromyalgia patients	Significant improvements in pain-related functioning (p = .001) and FM impact (p = .049)
Hausmann et al. (2014)	To investigate if positive activities in daily life produce long-term reductions in self-reported bodily pain	RCT	Positive activities (6 weeks)	Bodily pain	417 general population	Significant improvements in bodily pain (p = < .05)
Kaplan et al. (2014)	To assess the effectiveness of two interventions (gratitude and social connectedness) for improving wellbeing	RCT	Gratitude journaling or increasing social	Absence due to illness	67 university staff	NS

			connectedness (2 weeks)			
Luciano et al. (2014)	To investigate the effectiveness of acceptance and commitment therapy for functional status and pain acceptance as a mediator of treatment outcomes in fibromyalgia symptoms	RCT	Acceptance and commitment therapy (eight 2.5 h sessions)	Fibromyalgia Impact Questionnaire; pain catastrophising scale; pain acceptance and pain	156 fibromyalgia patients	Significant improvements in fibromyalgia impact (Cohen's d = 2.35) and pain catastrophising (Cohen's d = 0.89)
Carlson et al. (2015)	To compare the effects of mindfulness-based cancer recovery and supportive-expressive group therapy with a control intervention (1-day stress management seminar) on telomere length in distressed breast cancer survivors	RCT	Mindfulness-based cancer recovery and supportive-expressive group therapy (8 weeks)	Telomere length; health behaviour (daily physical activity level, alcohol and nicotine intake, quality of diet and sleep	88 breast cancer survivors	Not significant effect on telomere length maintenance (p = .054)
Lambert D'raven et al. (2015)	To determine whether positive psychological interventions would improve physical and mental health in a primary health care setting	Intervention study	Multiple positive psychology interventions (6 week)	Self-report health-related quality of life	35 primary healthcare patients	Reduction in perception of pain sustained at 6-month follow-up (p = .008)
Boutin-Foster et al. (2016)	To test the effectiveness of combining positive affect and self-affirmation strategies with motivational interviewing to aid blood pressure control in hypertensive African Americans	RCT	Positive affect with self-affirmation intervention and motivational interviewing (every 2 months for 1 year)	Blood pressure	238 hypertensive African Americans	NS
Chiavarino et al. (2016)	To investigate the efficacy of a cognitively orientated psychological interventions in improving psychological wellbeing and physical health in patients with acute coronary syndrome	RCT	Cognitive psychological intervention in small groups (4-session)	Blood pressure Heart rate Left ventricular ejection fraction Low-density lipoprotein and High-Density lipoprotein cholesterol Triglycerides Glycemia Creatinine Body mass index	65 acute coronary syndrome patients	Significant reduction in systolic blood pressure (p = .019); Significant improvement in heart rate (p = .023) significant effects to left ventricular ejection fraction (p = .021), LDL (p < .001) and HDL (p < .001) cholesterol and triglycerides (p = .047)
Imamura et al. (2016)	To investigate the effectiveness of a behavioural activation programme in improving psychological distress and physical symptoms in mothers with preschool children living in Fukushima-prefecture 3 years after the Fukushima Daiichi Nuclear Power Plant accident	RCT	Behavioural activation (group-based, two 90-minute workshops)	Self-report physical symptoms	37 general population individuals	Marginally significant improvement in physical symptoms (p = .07)
Jackowska et al. (2016)	To examine if a gratitude intervention would have positive impacts on cardiovascular and neuroendocrine function and sleep	RCT	Gratitude journaling (2 weeks)	Self-report sleep quality; blood pressure; cortisol, heart rate; self-report physical symptoms	119 university students and staff	NR
Müller et al. (2016)	To investigate the feasibility, acceptability, and efficacy of a computer-based positive psychology intervention in people with physical disability and chronic pain	Randomly controlled feasibility study	Individually tailored positive psychology intervention (8 weeks)	Self-report pain	96 physical disability and chronic pain patients	Significant improvements in pain control (p <.01), pain intensity (p <.05), pain interference (p <.01) and pain catastrophizing (p <.01)
Nikrahan et al. (2016)	To study the effect of three different positive psychology interventions on risk biomarkers in cardiac patients	RCT	One of three positive psychology interventions (6 weeks)	Inflammatory markers (C-reactive protein, IL-1, and IL-6)	69 cardiac patients	Significantly lower high-sensitivity C-reactive protein (P = .02 and .04) Significantly lower cortisol awakening response (P = .04)

Redwine et al. (2016)	To examine if gratitude journaling improved heart failure related biomarkers	RCT	Gratitude journaling (8 weeks)	Leisure-Time Exercise Questionnaire the (LTEQ); HRV; inflammatory biomarker index	70 cardiac patients	Significant improvements in inflammatory biomarkers (p = .004)
van Beugen et al. (2016)	To investigate the effects of a therapist-lead, individually tailored internet-based cognitive behavioural therapy intervention in psoriasis patients	RCT	Individually tailored internet-based cognitive behavioural therapy (25 weeks)	Physical functioning and impact on daily activities (composite scores)	131 psoriasis patients	Significant improvements in physical functioning (p = .03) and impact on daily activities (p = .04)
Ferwerda et al. (2017)	To investigate if a tailored-guided internet-based cognitive-behavioural intervention can improve psychological and physiological functioning for rheumatoid arthritis patients	RCT	Tailored-guided internet-based cognitive behavioural intervention (26 weeks)	Physical functioning was assessed by the pain scale of the IRGL21 and the fatigue scale of the Checklist Individual Strength (CIS)	133 rheumatoid arthritis patients	NS
Hausmann et al. (2017)	To test an intervention designed to develop positive psychological skills to reduce osteoarthritis symptom severity	RCT	Positive psychological skill-building programme (6 weeks). Topic areas included gratitude, kindness, optimism, mindfulness, and others	Self-report physical symptoms	42 osteoarthritis patients	Significant improvement in osteoarthritis symptom severity (p = .02, Cohen's d = .86)
Koschwanez et al. (2017)	To examine if presurgical expressive writing improves surgical wound healing	RCT	Writing about daily activities (3 days)	Wound healing inflammatory response and collagen content	61 waitlists for bariatric surgery	Significantly improved wound healing inflammatory response (p = .020) and collagen content (p = .022)
Lai & O'Carroll (2017)	To study the 'count-your-blessings' gratitude intervention for promoting physical and psychological wellbeing.	RCT	Gratitude journaling (3 weeks)	Physical symptoms checklist (Emmons & McCullough, 2003)	81 university students	NS
Matvienko-Sikar & Dockray (2017)	Pilot study to investigate the effect of a gratitude and mindfulness-based intervention on prenatal stress, cortisol levels and wellbeing	RCT	A dual component online gratitude diary and mindfulness listening intervention (2 weeks)	Salivary cortisol	36 prenatal women	Significant reductions in self-reported prenatal stress (p = .04) and waking and evening cortisol level (p = .004)
Nelson-Coffey et al. (2017)	To investigate changes in a leukocyte gene expression linked to longevity from prosocial behaviour interventions	RCT	Prosocial intervention (acts of kindness, 4 weeks)	Gene expression response linked to disease development	159 general population	Significant improvements in gene express (p = .02) in kindness to others group
Peters et al. (2017)	To investigate the use of an online positive psychology self-help programme for patients with chronic musculoskeletal pain compared to an internet-based cognitive-behavioural programme	RCT	Positive psychology intervention aimed at promoting positive behaviours, emotions, and cognitions (7 to 16 weeks)	Self-report physical impairments and pain	276 patients with chronic musculoskeletal pain	NS
Robinson et al. (2017)	To study if expressive writing can speed the healing of punch biopsy wounds when writing is performed after wounds are made	RCT	Expressive writing (3 days)	Wound healing; sleep quality	122 general population	Significant between group differences in wound healing (p = .032)
Southwell & Gould (2017)	To investigate the efficacy of gratitude diaries in the treatment of anxiety and depression symptoms and sleep quality	RCT	Gratitude journaling (3 weeks)	Subjective sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI)	109 depression or anxiety patients	NS
Wolfe & Patterson (2017)	To investigate the efficacy of a gratitude intervention on body dissatisfaction, dysfunctional eating, negative mood, and depressive symptoms	RCT	Gratitude journaling (2 weeks)	Eating behaviour was measured using the Eating Attitudes Test-26 (EAT) and the Binge Eating Scale (BINGE)	108 university staff	Significant improvement in dysfunctional eating (p < .01)

Celano et al. (2018)	To investigate optimal components of a positive psychology-based intervention to promote post-acute coronary syndrome physical activity	Randomised factorial trial	PPI (various, 16 weeks)	Amount of moderate to vigorous physical activity via accelerometer; self-report health behaviours (physical activity, medication, and diet)	128 acute coronary syndrome patients	NS
Cook et al. (2018)	To investigate if a gratitude intervention would improve asthma control	RCT	Gratitude journaling (4 weeks)	Asthma Control Test (self-report); Forced expiratory volume	25 asthmatics	Significant improvement in asthma control ($p = .007$)
Jiang et al. (2018)	To investigate the impact of a positive psychology intervention (fun activities combined with positive mental health education) on well-being, 2-week illness prevalence and salivary immunoglobulin A of empty nesters	RCT	Positive psychology intervention aimed at fun activities combined with positive metal health education (7 months)	2-week illness prevalence Salivary immunoglobulin A	92 empty nesters	NS
Bai et al. (2019)	To assess the impacts of two guided self-administered interventions (mindfulness and gratitude-based) on women with infertility	RCT	Gratitude journaling and mindfulness (4 weeks)	Sleep quality via the Pittsburgh Sleep Quality Index; biochemical pregnancy rate via blood test	234 IVF patients	Significant improvements in sleep quality for mindfulness intervention ($p = .001$)
Bartlett & Arpin (2019)	To investigate if a gratitude intervention reduced loneliness and improved health in older adults	RCT	Gratitude journaling (3 weeks)	Subjective health via a single-item probing participants' perception of their health each day; 3-item checklist to assess participants' daily physical symptoms	42 retirement independent living residents	NR
Carrico et al. (2019)	To test the efficacy of a positive affect intervention in reducing viral load in sexual minority men living with HIV who use methamphetamine	RCT	Positive affect intervention (3 months)	HIV viral load	110 HIV positive men	Medium to small reduction in HIV viral load at six, twelve and fifteen months (Cohen's d 0.89 to 0.43)
Duque et al. (2019)	To investigate if optimism and positive affect benefit adherence to health behaviours following an acute coronary syndrome using positive psychology interventions	Intervention study	Phone-based positive psychology intervention aimed to promote physical activity (8-week)	Self-report health behaviours	128 acute coronary syndrome patients	Positive affect was associated with greater adherence to health behaviours ($p = .006$) and physical activity ($p = .004$)
Garland et al. (2019)	To investigate the impact of Mindfulness-Oriented Recovery Enhancement (MORE) on reducing opioid misuse by reducing symptoms in chronic pain patients	RCT	Mindfulness-Oriented Recovery Enhancement (8 weeks)	Self-report pain Opioid misuse	95 chronic pain patients	Significant reduced pain severity ($p = .03$) and opioid misuse ($p = .03$)
Heckendorf et al. (2019)	To measure a 5-week internet and app-based gratitude intervention in decreasing repetitive negative thinking	RCT	Gratitude training and daily activities (5 weeks)	Insomnia severity was measured with the Insomnia Severity Index (ISI; Morin, Belleville, Belanger, & Ivers, 2011)	262 general population	Significant improvements in sleep quality ($p = .0.$) and total sleep time ($p = .05.$)
Huffman et al. (2019)	To examine a combined positive psychology-motivational interviewing intervention to promote physical activity in acute coronary syndrome patients	RCT	Combined positive psychology-motivational interviewing intervention (12 weeks)	Amount of physical activity via accelerometer, health behaviours	47 acute coronary syndrome patients	Significant effect on daily steps ($p = .030$) and greater moderate-vigorous activity ($p = .026$)
Majumdar & Morris (2019)	To assess the efficacy of group-based acceptance and commitment therapy in stroke survivors	RCT	Group-based acceptance and commitment therapy (4 weeks)	Self-reported health	53 stroke survivors	Medium increase ($p = .057$) in self-rated health

Moieni et al. (2019)	To investigate if a gratitude intervention could reduce inflammation and if this occurred through increased support giving	RCT	Gratitude journaling (6 weeks)	Inflammatory markers (IL-6 and TNF-alpha)	68 general population	NS
Sato et al. (2019)	To investigate the effect of an internet-based computerised cognitive behavioural therapy programme in insomnia patients	RCT	Internet-delivered computerised cognitive behavioural therapy (6 weeks)	Sleep quality (via Pittsburgh Sleep Quality Index)	23 insomnia patients	Significant improvements in quality of sleep (p − .001)
Schnitker & Richardson (2019)	To investigate the impact of framing gratitude journaling as a form of prayer and if this amplifies its benefits	RCT	Gratitude journaling (5 weeks)	Self-report physical symptoms	196 university students	NS
Celano et al. (2020)	To test the feasibility and results of a 12-week phone-delivered combined positive psychology and motivational interviewing intervention to promote wellbeing and adherence to physical activity, diet, and medications in patients with heart failure	RCT	Combined positive psychology and motivational interviewing intervention (12 weeks)	Health behaviours (physical activity via accelerometer; self-report sodium intake; self-report medication adherence) Self-report health-related quality of life	45 coronary artery disease patients	NS. The intervention led to medium effect-size improvements in moderate to vigorous physical activity (Cohen's d − .41-.74) and medication adherence (Cohen's d − .48-.78)
El-Mokadem et al. (2020)	To examine the efficacy of a psychospiritual mental health education intervention in improving psychological and physical health in individuals with chronic fatigue syndrome	RCT	Psycho-spiritual mental health education intervention (8 weeks)	Self-report fatigue and pain	22 chronic fatigue patients	Significant improvements in physical wellbeing (Cohen's d = 1.74), reduction in fatigue (Cohen's d − 1.73), and pain interference (Cohen's d − 0.96)
Huffman et al. (2020)	To evaluate the feasibility and impact of a combined positive psychology-motivational interviewing intervention to promote physical activity in type 2 diabetics	Controlled trail	Combined positive psychology-motivational interviewing intervention (8 weeks)	Amount of physical activity via accelerometer, moderate to vigorous physical activity and steps, Additional functional, behavioural, and medical outcome measures included physical function and exercise self-efficacy (Self Efficacy for Exercise scale), as well as blood pressure	80 type 2 diabetes patients	Significant improvements in moderate to vigorous physical activity (p − .009)
Keng et al. (2020)	To investigate the effects of mindfulness-based stress reduction (MBSR) versus music-based stress reduction on trait mindfulness, self-compassion, and other psychological wellbeing measures, as well as leukocyte telomere length	RCT	Mindfulness-based stress reduction (8 weeks)	Biological age and disease risk (leukocyte telomere length)	158 general population	NS
Kushlev et al. (2020)	to investigate if a three-month positive psychology intervention increases both happiness and physical health in a nonclinical population	RCT	Multi-component positive psychology intervention (12 week)	Self-report behavioural risk factors Blood pressure Body mass index	100 general population	Significant. Half as many sick days as control Modest effect on lowering blood pressure (p − .168 and preventing weight gain (p = .013)
Marciniak et al. (2020)	To find the feasibility and effect of mindfulness-based stress reduction (MBSR) on depression, cognition, and immunity in mild cognitive impairment (MCI)	RCT	Mindfulness-based stress reduction (8 weeks)	Immune markers from blood sample (immunophenotyping, Phagocytosis Assay and Plasma Analysis – Enzyme-Linked Immunosorbent Assay, TNF-a IL-6 and CRP)	20 mild cognitive impairment patients	NS
Schakel et al. (2020)	To examine the effect of guided internet-based cognitive behavioural therapy combined with a serious gaming intervention in improving self-reported psychophysiological and immunological health	RCT	Internet-based cognitive behavioural therapy combined with serious gaming interventions (6 weeks)	Self-report health related quality of life and sleep problems Heart rate Heart rate variability Salivary cortisol and alpha amylase	60 general population men	Some self-reported sleep problems reduced significantly (p =.027) Increased immunoglobulin antibody responses at follow-up (p <.05)

	endpoints in response to psychophysiological and immune-related challenges			Immunity via cytokines and chemokines analysis Inflammation (C-reactive protein and immunoglobulin G antibody)		
von Känel et al. (2020)	To investigate if biological mechanisms linking dementia caregiving with increased risk for coronary heart disease can be influenced by psychosocial interventions	RCT	Behavioural activation intervention (12 weeks)	Biological age and disease risk (leukocyte telomere length)	158 general population individuals	NS
Hazlett et al. (2021)	To examine if gratitude activates a neural 'caregiving system' which could downregulate threat responding, and cellular inflammation linked to health	RCT	Gratitude writing sessions (6 weeks)	Inflammatory markers (cytokines)	61 general population women	NS
Steffen et al. (2021)	To assess if a 12-week group-based compassion focused therapy intervention would improve heart rate variability	Intervention study	Compassion focused group-based therapy	Heart rate variability via biofeedback system	31 university students	NS
Suh et al. (2021)	To investigate a psychological intervention effect in decreasing bedtime procrastination	Intervention study	Psychological intervention to reduce bedtime procrastination (4 weeks)	Self-report sleeps and fatigue	20 general population individuals	Bedtime procrastination reduced significantly ($p < .0005$); Bedtime procrastination duration (mins) significantly reduced from ($p < .0005$); sleep efficacy increased ($p = .01$) from 82% to 87%; Insomnia severity decreased significantly ($p = .004$)
Errazuriz et al. (2022)	To investigate the effects of mindfulness-based stress reduction on psychological distress in non-physician health workers, including secondary measures of impact on cortisol levels	RCT	Mindfulness-based stress reduction (8 weeks)	Salivary cortisol	105 health workers	Significant decreased cortisol awakening response by 23% ($p < 0.05$)
Kalisch et al. (2022)	To test if positive psychology interventions can be used to benefit suffers of Ehlers-Danlos-Syndromes	RCT	One of 10 different online positive psychology interventions (5 weeks)	Self-report pain	132 Ehlers-Danlos-Syndromes patients	NS
Mahoney et al. (2022)	To examine the uptake and effectiveness of online cognitive behavioural therapy for insomnia during the COVID-19 pandemic	Observational, unmatched, pre-post treatment study	Online cognitive behavioural therapy for insomnia (4 sessions)	Self-report sleep	2694 general population individuals	Significantly large effect size, improving insomnia symptom severity (gs = 86-1.09)
Mates et al. (2022)	To investigate the mechanisms of change underlying compassionate mind training, including heart rate variability	RCT	Compassionate mind training (2 weeks)	Heart rate variability	93 general population individuals	(NR) Increased HRV
Sadlonova et al. (2022)	To investigate the feasibility, acceptability and efficacy of a group-based positive psychology intervention compared with group-based cognitive-behavioural therapy in patients with coronary heart disease	RCT	Tailored positive psychology intervention focused on hope, resilience, meaning, personal growth, and virtue (8 week)	C-reactive protein	84 coronary heart disease patients	NS

**NS = not significant, NR = Effect size not reported*

2. Health OR "phy* health" OR "phy* fitness" OR Longevity OR "Phys* function*" OR "Biological health" OR Mortality OR Morbidity OR Disease OR "Disease risk" OR "Health status" OR "Self*report health"
3. "Positive psych* intervention*" OR PPI* OR "Psych* intervention*" OR "Behaviour* intervention*" OR "Cognitive activit*" OR "Positive psych* activit*" OR "Psych* activit*" OR "Cognitive tool*"

PW terms (1), PH terms (2) and psychological interventions terms (3) were linked by the "AND" function.

Selection Process and Data Extraction

Search results were downloaded and saved to Zotero reference management software. Initially, titles and abstracts were compared against eligibility criteria and duplicates were removed. Studies were sifted into folders for exclusion or inclusion. Following this basic assessment, remaining articles were read in detail to confirm eligibility before they were included. The reference lists of eligible articles were searched, and relevant studies included. The authors worked collaboratively when making study inclusion and exclusion decisions.

The PICOT framework (Population, Intervention, Comparison, Outcome and Time) guided data extraction as an effective way of summarising studies that investigate the effects of interventions (Elias et al., 2015). Data were extracted from each study to a pre-designed spreadsheet with the following fields: 1) reference, 2) study aim, 3) study design (including control conditions when present), 4) intervention (type, description, frequency, duration), 5) measure of PW, 6) measure of PH, 7) outcomes (including follow-up and statistical effect size), 8) discussion of potential mechanisms, 9) participant characteristics (sample size, country, gender, education level, age, health status and ethnicity), and 10) study key recommendations.

Risk of Bias Assessment

The Revised Cochrane Risk-of-bias tool for randomised trials (RoB2) (Sterne et al., 2019) was used to assess bias in RCTs. The Risk of Bias in Non-randomised Studies – of Interventions (ROBINS-I) (Sterne et al., 2016) for Cochrane reviews was used for non-randomised studies. Both tools give a "low", "some concerns", or a "high" risk of bias assessment rating.

Results

Study Selection

Database searches produced 1647 results. Removal of duplicates reduced this to 1611 articles. After applying the study eligibility criteria, a total of 36 studies remained. The reference lists of these articles were searched revealing a further 21 articles. An additional 17 eligible studies from a review of gratitude interventions (Boggiss et al., 2020) where found when searching for supporting background literature. Therefore, at total of 74 articles are included in this review. These are summarised in Table 2.

Study Characteristics

Participants totalled 10305 across the 74 included studies. Sample sizes ranged from 19 to 2695 (M = 139, SD = 310). Studies only recruiting female participants numbered 12 and two solely included men. Most studies had a larger proportion of female participants than male (M = 69.65%, SD = 27). Average participant age was 46 (SD = 15) and ranged from 18 to 74 years old.

Ethnicity was underreported, with only 33 studies providing participant ethnic heritage. Most studies were based in the USA (36), Canada (4), Europe (19) Australia and New Zealand (4) with seven from Asia, two from the Middle East, one from South America and two mixed. Participant education was reported in 34 studies with 68.8% having received undergraduate education or higher.

Non-clinical populations made up 31 studies. Clinical populations comprised the remaining 43 studies, ranging from diabetes, cardiac and chronic pain patients, to breast cancer survivors, HIV positive men and prenatal women. Interventions broadly fell into six categories:

1. Cognitive and behavioural
2. Gratitude
3. Mindfulness-based
4. Multi-component
5. PPIs
6. Other interventions

Table 3. Intervention type and efficacy

Intervention type	Study	Potential mechanisms	Potential pathways	Protect, Reduce, Produce	Effect significance
Cognitive and Behavioural interventions					**11 of 15**
Cognitive behavioural group training (6 weeks)	Van Der Ven et al. (2005)	Group accountability and education promoted health behaviours that benefit glycaemic control	Behavioural	Protect	NS
Cognitive-behavioural stress management programme (12 months)	Claesson et al. (2006)	Not suggested	Not suggested	Not suggested	NS
Acceptance and commitment therapy (1-day workshop)	Gregg et al. (2007)	Less distress and avoidance and passive coping leading to positive self-management behaviours	Behavioural	Reduce	S
Behavioural or psychodynamic psychotherapy (7 weeks)	Wiltink et al. (2007)	Positive health behaviours (physical activity and cognitive control of eating). Higher self-efficacy could be a contributing factor	Behavioural	Produce	S
Behavioural Activation intervention (6 weeks)	Moore et al. (2013)	Reduction in stress (reduced sympathetic arousal)	Biological	Reduce	S
Acceptance and commitment therapy (12 weeks)	Wicksell et al. (2013)	Changes in psychological inflexibility found to mediate pre- to follow-up improvements in outcome variables Could be caused by activation of the ventrolateral prefrontal/lateral orbitofrontal cortex, allowing executive cognitive control to reappraise pain	Biological	Reduce	S
Acceptance and commitment therapy (eight 2.5 h sessions)	Luciano et al. (2014)	Not suggested	Not suggested	Not suggested	S
Cognitive psychological intervention in small groups (4-session)	Chiavarino et al. (2016)	Maintenance of physical activity	Behavioural	Protect	S
Behavioural activation (group-based, two 90-minute workshops)	Imamura et al. (2016)	Reduction in stress (reduced sympathetic arousal)	Biological	Reduce	S
Individually tailored internet-based cognitive behavioural therapy (25 weeks)	van Beugen et al. (2016)	Not suggested	Not suggested	Not suggested	S
Tailored-guided internet-based cognitive behavioral intervention (26 weeks)	Ferwerda et al. (2017)	Not suggested	Not suggested	Not suggested	NS
Group-based acceptance and commitment therapy (4 weeks)	Majumdar and Morris (2019)	Not suggested	Not suggested	Not suggested	S
Internet-delivered computerised cognitive behavioural therapy (6 weeks)	Sato et al. (2019)	Not suggested	Not suggested	Not suggested	S
Behavioural activation intervention (12 weeks)	von Känel et al. (2020)	Not suggested	Not suggested	Not suggested	NS
Online cognitive behavioural therapy for insomnia (4 sessions)	Mahoney et al. (2022)	Not suggested	Not suggested	Not suggested	S
Gratitude					**6 of 18**
Gratitude journaling (10 weeks)	Emmons and McCullough (2003), study one	Building of psychological, social, and spiritual resources, facilitating coping with stress	Social support	Protect	NR
Gratitude journaling (3 weeks)	Emmons and McCullough (2003), study three	"	Social support	Protect	NR
Gratitude journaling (2 weeks)	Emmons and McCullough (2003), study two	"	Social support	Protect	NS
Gratitude journaling (2 weeks)	Martínez-Martí et al. (2010)	Not suggested	Not suggested	Not suggested	NS
One of three self-help interventions (constructive worry, imagery distraction and a gratitude intervention, 1 week)	Digdon and Koble (2011)	Not suggested	Not suggested	Not suggested	S

Gratitude journaling or increasing social connectedness (2 weeks)	Kaplan et al. (2014)	Not discussed	Not suggested	Not suggested	NS
Gratitude journaling (2 weeks)	Jackowska et al. (2016)	Not suggested	Not suggested	Not suggested	NR
Gratitude journaling (8 weeks)	Redwine et al. (2016)	Not suggested	Not suggested	Not suggested	S
Gratitude journaling (3 weeks)	Lai and O'Carroll (2017)	Not suggested	Not suggested	Not suggested	NS
Gratitude journaling (3 weeks)	Southwell and Gould (2017)	Not suggested	Not suggested	Not suggested	NS
Gratitude journaling (2 weeks)	Wolfe and Patterson (2017)	Positive feelings and improved mood changing the relative importance of body appearance	Behavioural	Produce	S
Gratitude journaling (4 weeks)	Cook et al. (2018)	Change in affect, improved positive coping strategies and broadening and building of resources to be used in stressful times. Also, improved medication adherence	Behavioural	Produce	S
Gratitude journaling and mindfulness (4 weeks)	Bai et al. (2019)	Reduction in stress (reduced sympathetic arousal)	Biological	Reduce	S
Gratitude journaling (3 weeks)	Bartlett and Arpin (2019)	Reduction in loneliness	Social support	Reduce	NR
Gratitude training and daily activities (5 weeks)	Heckendorf et al. (2019)	Not suggested	Not suggested	Not suggested	S
Gratitude journaling (6 weeks)	Moieni et al. (2019)	Hypothesised mammalian caregiving system that leads to support-giving and reduced psychological stress may be a route by which gratitude can reduce inflammation	Social support	Reduce	NS
Gratitude journaling (5 weeks)	Schnitker and Richardson (2019)	Not suggested	Not suggested	Not suggested	NS
Gratitude writing sessions (6 weeks)	Hazlett et al. (2021)	Gratitude may benefit through threat-reducing neural pathways	Biological	Reduce	NS
Mindfulness-based					**6 of 10**
Mindfulness meditation-based stress reduction (13 weeks)	Kabat-Zinn et al. (1998)	Not suggested	Not suggested	Not suggested	S
Mindfulness-based stress reduction (8 weeks)	Carlson et al. (2004)	Improvements in health behaviours (quality and hours sleeping and amount of exercise)	Behavioural	Produce	NS
Mindful socioemotional intervention (6 weeks)	Davis and Zautra (2013)	Building and maintaining positive relationships combined with strengthening of networks associated with positive emotions and weakening those related to negative emotion	Social support	Produce	S
Loving-kindness meditation (6 weeks)	Kok et al. (2013)	Increased vagal tone and positive perceptions of social connections act in an upward spiral to improve physical health	Biological	Produce	S
Mindfulness-Based Stress Reduction (8 weeks)	Rosenkranz et al. (2013)	Reduction in stress (reduced sympathetic arousal)	Biological	Reduce	S
Mindfulness-based cancer recovery and supportive-expressive group therapy (8 weeks)	Carlson et al. (2015)	Not suggested	Not suggested	Not suggested	NS
Mindfulness-Oriented Recovery Enhancement (8 weeks)	Garland et al. (2019)	Increases in positive affect and savoring hypothetically may elicit release of endogenous opioids in corticothalamic and limbic-striatal brain circuits integral to pain processing and hedonic regulation	Biological	Produce	S
Mindfulness-based stress reduction (8 weeks)	Keng et al. (2020)	Not suggested	Not suggested	Not suggested	NS
Mindfulness-based stress reduction (8 weeks)	Marciniak et al. (2020)	Not suggested	Not suggested	Not suggested	NS
Mindfulness-based stress reduction (8 weeks)	Errazuriz et al. (2022)	Reduction in stress (reduced sympathetic arousal)	Biological	Reduce	S
Multi-component					**6 of 7**
Multiple positive psychology interventions (6 week)	Lambert D'raven et al. (2015)	Not suggested	Not suggested	Not suggested	S
Positive affect with self-affirmation intervention and motivational interviewing (every 2 months for 1 year)	Boutin-Foster et al. (2016)	Not suggested	Not suggested	Not suggested	NS

A dual component online gratitude diary and mindfulness listening intervention (2 weeks)	Matvienko-Sikar and Dockray (2017)	Reduction in stress (reduced sympathetic arousal)	Biological	Reduce	S
Combined positive psychology-motivational interviewing intervention (12 weeks)	Huffman et al. (2019)	Integration of positive psychology skills into everyday life	Behavioural	Produce	S
Combined positive psychology-motivational interviewing intervention (8 weeks)	Huffman et al. (2020)	Not suggested	Not suggested	Not suggested	S
Multi-component positive psychology intervention (12 week)	Kushlev et al. (2020)	Not suggested	Not suggested	Not suggested	S
Internet-based cognitive behavioural therapy combined with serious gaming interventions (6 weeks)	Schakel et al. (2020)	Possible optimisation of the response of the sympathetic-adrenal-medullar axis	Biological	Reduce	S
Other interventions					**5 of 8**
Computer-mediated social support (5 months)	Shaw et al. (2006)	Not suggested	Not suggested	Not suggested	NS
Expressive writing (3 weeks)	Lu et al. (2012)	Not suggested	Not suggested	Not suggested	S
Writing about daily activities (3 days)	Koschwanez et al. (2017)	Not suggested	Not suggested	Not suggested	S
Expressive writing (3 days)	Robinson et al. (2017)	Positive affect's impact on wound healing through glucocorticoid and catecholamine production	Biological	Produce	S
Psycho-spiritual mental health education intervention (8 weeks)	El-Mokadem et al. (2020)	Reduction in stress (reduced sympathetic arousal)	Biological	Reduce	S
Compassion focused group-based therapy	Steffen et al. (2021)	Not suggested	Not suggested	Not suggested	NS
Psychological intervention to reduce bedtime procrastination (4 weeks)	Suh et al. (2021)	Improvement in sleep hygiene practices and perception of staying up as 'a reward for a hard day'	Behavioural	Produce	S
Compassionate mind training (2 weeks)	Matos et al. (2022)	Increased vagal tone and parasympathetic activation	Biological	Reduce	NR
Positive psychology interventions					**9 of 16**
Cheerfulness Training (7 months)	Papousek and Schulter (2008)	Reduction in stress (reduced sympathetic arousal)	Biological	Reduce	NR
Positive affect and self-affirmation intervention (12 months)	Ogedegbe et al. (2012)	Greater self-efficacy and behavioural activation, enhancing ability to adhere to medications	Behavioural	Produce	S
Positive affect intervention (12 months)	Peterson et al. (2012)	Positive affect attenuate physiologic stress reactivity and may activate the central nervous system for improved neuroendocrine, inflammatory, and immune responses	Biological	Protect	S
Positive activities (6 weeks)	Hausmann et al. (2014)	Not suggested	Not suggested	Not suggested	S
Individually tailored positive psychology intervention (8 weeks)	Müller et al. (2016)	Not suggested	Not suggested	Not suggested	S
One of three positive psychology interventions (6 weeks)	Nikrahan et al. (2016)	Not suggested	Not suggested	Not suggested	S
Positive psychological skill-building programme (6 weeks). Topic areas included gratitude, kindness, optimism, mindfulness, and others	Hausmann et al. (2017)	Broaden-and-build by widening attention and increasing the range for thoughts and actions patients pursue. Possible change in perceptions of symptoms to be judged less severe	Behavioural	Produce	S
Prosocial intervention (acts of kindness, 4 weeks)	Nelson-Coffey et al. (2017)	Modulation of neural and endocrine signaling pathways	Biological	Reduce	S
Positive psychology intervention aimed at promoting positive	Peters et al. (2017)	Not suggested	Not suggested	Not suggested	NS

behaviours, emotions, and cognitions (7 to 16 weeks)					
PPI (various, 16 weeks)	Celano et al. (2018)	Not suggested	Not suggested	Not suggested	NS
Positive psychology intervention aimed at fun activities combined with positive metal health education (7 months)	Jiang et al. (2018)	Reduction in stress (reduced sympathetic arousal)	Biological	Reduce	NS
Positive affect intervention (3 months)	Carrico et al. (2019)	Not suggested	Not suggested	Not suggested	S
Phone-based positive psychology intervention aimed to promote physical activity (8-week)	Duque et al. (2019)	Increased physical activity adherence driven by increase positive affect experience of physical activity acting as a reward for these behaviours	Behavioural	Produce	S
Combined positive psychology and motivational interviewing intervention (12 weeks)	Celano et al. (2020)	Promotion of self-care activities	Behavioural	Protect	NS
One of 10 different online positive psychology interventions (5 weeks)	Kalisch et al. (2022)	Not suggested	Not suggested	Not suggested	NS
Tailored positive psychology intervention focused on hope, resilience, meaning, personal growth, and virtue (8 week)	Sadlonova et al. (2022)	Not suggested	Not suggested	Not suggested	NS

**NR = Not reported, NS = Not significant, S = Significant*

Theoretical underpinning varied and included cognitive behavioural therapy (CBT), acceptance and commitment therapy, and mindfulness-based stress reduction (MBSR). Intervention length was also heterogeneous, ranging from one day to one year (M = 10 weeks, SD = 12). Follow-up assessments were included in 42 studies, with follow-up time ranging from two weeks to three years. Delivery was in-person for 27 studies and in-person groups for 11 studies. Online delivery was used in 19 studies, phone delivery in four and mailed written instructions in two. Nine studies used written instructions, one audio tape and one did not specify means of delivery. Randomly controlled methodology design made up 63 studies. The remaining 11 intervention studies did not include a control group. Significant effects were found in 41 of the 74 studies, 27 showed non-significant effects and six did not report effects statistically. See Table 3 for intervention types and the proportion of statistically significant effects within each intervention category.

Risk of Bias Assessment

The RoB2 was applied to the 63 RCTs included, and the ROBINS-I was used for the 11 non-controlled studies. All studies scored low for risk of bias, other than four non-controlled studies that displayed some concerns under the ROBINS-I rating. These included failure to account for potential confounding factors (Lu et al., 2012; Mahoney et al., 2022), attrition of participants to follow-up (Lambert D'raven et al., 2015; Mahoney et al., 2022) and small sample size (Shaw et al., 2006). Three randomly controlled feasibility studies were included in the review but did not show significant risks of bias.

Study Outcomes

Across studies 186 PW outcomes were recorded. Measures used varied substantially. The most utilised tool was the Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988) used in 21 studies. The second most common measure was the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983) used in eight papers, followed by the Life Orientation Test (Scheier & Carver, 1985) used in seven studies. These small numbers relative to the total number of PW measures reflects the sizable heterogeneity of measures used.

Overall, studies measured 139 individual PH outcomes. Of those, 60 significant effects were recorded. The largest proportion of these were associated with CBT-based interventions (17). PPIs had the second highest proportion with 12 significant effects. Nine significant outcomes were associated with mindfulness-based interventions, and eight significant effects with both multi-component and other interventions respectively, with the remaining six significant outcomes linked to gratitude-based interventions. Clinical populations made up 40 of these significant effects, with the remaining 20 being non-clinical. The 63 outcomes that did not show significant effects were most often associated with gratitude interventions (16) and CBT-based interventions (15), followed by PPIs (11). Nine non-significant effects were linked to both mindfulness-based and multi-component interventions respectively, with

three associated with other interventions. Of the non-significant outcomes 44 were recorded in clinical populations and 19 were in non-clinical populations. Significance for 16 outcomes was not reported. Participants for these studies were all non-clinical. Table 4 summarises study outcomes across three categories: objective health measures, self-report symptoms or health status measures, and self-report health behaviours measures.

Objective Health Measures

Objective health measures showed the second highest number of improvements out of the three categories. Statistically significant effects were found in 24 out of 63 outcomes. Significant improvements were observed in two out of 17 cardiovascular markers, six out of 10 stress markers, and 16 out of 36 other objective measures.

Self-Report Symptoms or Health Status Measures

Self-report symptoms or health status measures showed the highest number of significant outcomes. Significant effects were found in 27 out of 56 outcomes. These were observed in fatigue, health, health behaviours, pain, physical impairments, physical symptoms, physical wellbeing, and sleep. Self-report pain and self-report sleep accounted for 15 out of the 27 significant effects.

Self-Report Health Behaviours Measures

Self-report health behaviours were the smallest measure category. Out of 20 self-report health behaviours outcomes 9 showed significant effect. Statistically significant improvements were reported for opioid misuse, physical activity, diabetes self-management, eating behaviours and medication adherence.

Table 4. Physical Health Outcome and Efficacy

Type of Physical Health Outcome Objective Health Measures	Study	intervention type	Improvement significance 24 of 63
Cardiovascular markers			
Blood pressure	Claesson et al. (2006)	Cognitive-behavioural stress management programme (12 months)	NS
	Wiltink et al. (2007)	Behavioural or psychodynamic psychotherapy (7 weeks)	NS
	Papousek and Schulter (2008)	Cheerfulness Training (7 months)	NR
	Ogedegbe et al. (2012)	Positive affect and self-affirmation intervention (12 months)	NS
	Chiavarino et al. (2016)	Cognitive psychological intervention in small groups (4-session)	S
	Boutin-Foster et al. (2016)	Positive affect with self-affirmation intervention and motivational interviewing (every 2 months for 1 year)	NS
	Jackowska et al. (2016)	Gratitude journaling (2 weeks)	NR
	Kushlev et al. (2020)	Multi-component positive psychology intervention (12 week)	NS
Heart rate	Chiavarino et al. (2016)	Cognitive psychological intervention in small groups (4-session)	NS
	Jackowska et al. (2016)	Gratitude journaling (2 weeks)	NR
	Schakel et al. (2020)	Internet-based cognitive behavioural therapy combined with serious gaming interventions (6 weeks)	NS
Heart rate variability	Papousek and Schulter (2008)	Cheerfulness Training (7 months)	NR
	Redwine et al. (2016)	Gratitude journaling (8 weeks)	NS
	Schakel et al. (2020)	Internet-based cognitive behavioural therapy combined with serious gaming interventions (6 weeks)	NS
	Steffen et al. (2021)	Compassion focused group-based therapy	NS
	Matos et al. (2022)	Compassionate mind training (2 weeks)	NR
Left ventricular ejection fraction	Chiavarino et al. (2016)	Cognitive psychological intervention in small groups (4-session)	S
Stress markers			
Cortisol	Carlson et al. (2004)	Mindfulness-based stress reduction (8 weeks)	NS
	Rosenkranz et al. (2013)	Mindfulness-Based Stress Reduction (8 weeks)	S
	Jackowska et al. (2016)	Gratitude journaling (2 weeks)	NR
	Nikrahan et al. (2016)	One of three positive psychology interventions (6 weeks)	S
	Matvienko-Sikar and Dockray (2017)	A dual component online gratitude diary and mindfulness listening intervention (2 weeks)	S

	Schakel et al. (2020)	Internet-based cognitive behavioural therapy combined with serious gaming interventions (6 weeks)	NS
	Errazuriz et al. (2022)	Mindfulness-based stress reduction (8 weeks)	S
Inflammation markers	Redwine et al. (2016)	Gratitude journaling (8 weeks)	S
	Moieni et al. (2019)	Gratitude journaling (6 weeks)	NS
Vagal tone	Kok et al. (2013)	Loving-kindness meditation (6 weeks)	S
Other objective markers			
Body mass index	Chiavarino et al. (2016)	Cognitive psychological intervention in small groups (4-session)	NS
	Kushlev et al. (2020)	Multi-component positive psychology intervention (12 week)	NS
Bodyweight	Wiltink et al. (2007)	Behavioural or psychodynamic psychotherapy (7 weeks)	S
Creatinine	Chiavarino et al. (2016)	Cognitive psychological intervention in small groups (4-session)	NS
Dehydroepiandrosterone-sulfate	Carlson et al. (2004)	Mindfulness-based stress reduction (8 weeks)	NS
Forced expiratory volume	Cook et al. (2018)	Gratitude journaling (4 weeks)	NS
Gene expression response	Nelson-Coffey et al. (2017)	Prosocial intervention (acts of kindness, 4 weeks)	S
Glycaemic control	Van Der Ven et al. (2005)	Cognitive behavioural group training (6 weeks)	NS
	Claesson et al. (2006)	Cognitive-behavioural stress management programme (12 months)	NS
	Gregg et al. (2007)	Acceptance and commitment therapy (1-day workshop)	S
	Chiavarino et al. (2016)	Cognitive psychological intervention in small groups (4-session)	NS
Immunity markers	Jiang et al. (2018)	Positive psychology intervention aimed at fun activities combined with positive metal health education (7 months)	NS
	Carrico et al. (2019)	Positive affect intervention (3 months)	S
	Marciniak et al. (2020)	Mindfulness-based stress reduction (8 weeks)	NS
	Schakel et al. (2020)	Internet-based cognitive behavioural therapy combined with serious gaming interventions (6 weeks)	S
	Hazlett et al. (2021)	Gratitude writing sessions (6 weeks)	NS
Inflammation markers	Claesson et al. (2006)	Cognitive-behavioural stress management programme (12 months)	NS
	Moore et al. (2013)	Behavioural Activation intervention (6 weeks)	S
	Rosenkranz et al. (2013)	Mindfulness-Based Stress Reduction (8 weeks)	S
	Nikrahan et al. (2016)	One of three positive psychology interventions (6 weeks)	S
	von Känel et al. (2020)	Behavioural activation intervention (12 weeks)	NS
	Sadlonova et al. (2022)	Tailored positive psychology intervention focused on hope, resilience, meaning, personal growth, and virtue (8 week)	NS
Leukocyte telomere length	Carlson et al. (2015)	Mindfulness-based cancer recovery and supportive-expressive group therapy (8 weeks)	NS
	Keng et al. (2020)	Mindfulness-based stress reduction (8 weeks)	NS
Low-density lipoprotein and high-density lipoprotein cholesterol	Chiavarino et al. (2016)	Cognitive psychological intervention in small groups (4-session)	S
Melatonin	Carlson et al. (2004)	Mindfulness-based stress reduction (8 weeks)	NS
Physical activity via accelerometer	Celano et al. (2018)	PPIs (various, 16 weeks)	NS
	Huffman et al. (2019)	Combined positive psychology-motivational interviewing intervention (12 weeks)	S
	Huffman et al. (2020)	Combined positive psychology-motivational interviewing intervention (8 weeks)	S
Psoriasis skin clearing	Kabat-Zinn et al. (1998)	Mindfulness meditation-based stress reduction (13 weeks)	S
Sickness absence	Kaplan et al. (2014)	Gratitude journaling or increasing social connectedness (2 weeks)	NS
	Kushlev et al. (2020)	Multi-component positive psychology intervention (12 week)	S
Triglycerides	Chiavarino et al. (2016)	Cognitive psychological intervention in small groups (4-session)	S
Waist to height	Claesson et al. (2006)	Cognitive-behavioural stress management programme (12 months)	NS
Wound healing	Koschwanez et al. (2017)	Writing about daily activities (3 days)	S
	Robinson et al. (2017)	Expressive writing (3 days)	S
	Self-report symptoms or health status		**27 of 56**
Self-report fatigue	El-Mokadem et al. (2020)	Psycho-spiritual mental health education intervention (8 weeks)	S
	Suh et al. (2021)	Psychological intervention to reduce bedtime procrastination (4 weeks)	S

Self-report health	Lambert D'raven et al. (2015)	Multiple positive psychology interventions (6 week)	NS
	Bartlett and Arpin (2019)	Gratitude journaling (3 weeks)	NR
	Majumdar and Morris (2019)	Group-based acceptance and commitment therapy (4 weeks)	S
	Celano et al. (2020)	Positive affect intervention (3 months)	NS
	Schakel et al. (2020)	Internet-based cognitive behavioural therapy combined with serious gaming interventions (6 weeks)	NS
Self-report pain	Emmons and McCullough (2003), study three	Gratitude journaling (3 weeks)	NR
	Davis and Zautra (2013)	Mindful socioemotional intervention (6 weeks)	S
	Wicksell et al. (2013)	Acceptance and commitment therapy (12 weeks)	S
	Hausmann et al. (2014)	Positive activities (6 weeks)	S
	Luciano et al. (2014)	Acceptance and commitment therapy (eight 2.5 h sessions)	S
	Lambert D'raven et al. (2015)	Multiple positive psychology interventions (6 week)	S
	Müller et al. (2016)	Individually tailored positive psychology intervention (8 weeks)	S
	Ferwerda et al. (2017)	Tailored-guided internet-based cognitive behavioral intervention (26 weeks)	NS
	Ferwerda et al. (2017)	Tailored-guided internet-based cognitive behavioral intervention (26 weeks)	NS
	Peters et al. (2017)	Positive psychology intervention aimed at promoting positive behaviours, emotions, and cognitions (7 to 16 weeks)	NS
	Garland et al. (2019)	Mindfulness-Oriented Recovery Enhancement (8 weeks)	S
	El-Mokadem et al. (2020)	Psycho-spiritual mental health education intervention (8 weeks)	S
	Kalisch et al. (2022)	One of 10 different online positive psychology interventions (5 weeks)	NS
Self-report pain relief use	Emmons and McCullough (2003), study two	Gratitude journaling (2 weeks)	NS
	Martínez-Martí et al. (2010)	Gratitude journaling (2 weeks)	NS
Self-report physical symptoms	Emmons and McCullough (2003), study one	Gratitude journaling (10 weeks)	NR
	Emmons and McCullough (2003), study two	Gratitude journaling (2 weeks)	NS
	Emmons and McCullough (2003), study three	Gratitude journaling (3 weeks)	NR
	Martínez-Martí et al. (2010)	Gratitude journaling (2 weeks)	NS
	Davis and Zautra (2013)	Mindful socioemotional intervention (6 weeks)	NS
	Wicksell et al. (2013)	Acceptance and commitment therapy (12 weeks)	S
	Luciano et al. (2014)	Acceptance and commitment therapy (eight 2.5 h sessions)	S
	Jackowska et al. (2016)	Gratitude journaling (2 weeks)	NR
	Lai and O'Carroll (2017)	Gratitude journaling (3 weeks)	NS
	Cook et al. (2018)	Gratitude journaling (4 weeks)	S
	Bartlett and Arpin (2019)	Gratitude journaling (3 weeks)	NR
	Schnitker and Richardson (2019)	Gratitude journaling (5 weeks)	NS
Self-report physical wellbeing	Shaw et al. (2006)	Computer-mediated social support (5 months)	NS
	Wiltink et al. (2007)	Behavioural or psychodynamic psychotherapy (7 weeks)	NS
	Lu et al. (2012)	Expressive writing (3 weeks)	S
	Rosenkranz et al. (2013)	Mindfulness-Based Stress Reduction (8 weeks)	S
	Imamura et al. (2016)	Behavioural activation (group-based, two 90-minute workshops)	S
	Hausmann et al. (2017)	Positive psychological skill-building programme (6 weeks). Topic areas included gratitude, kindness, optimism, mindfulness, and others	S
	El-Mokadem et al. (2020)	Psycho-spiritual mental health education intervention (8 weeks)	S
Self-report physical impairments	van Beugen et al. (2016)	Individually tailored internet-based cognitive behavioural therapy (25 weeks)	S
	Peters et al. (2017)	Positive psychology intervention aimed at promoting positive behaviours, emotions, and cognitions (7 to 16 weeks)	NS

	Huffman et al. (2020)	Combined positive psychology-motivational interviewing intervention (8 weeks)	NS
Self-report sleep	Emmons and McCullough (2003), study three	Gratitude journaling (3 weeks)	NR
	Emmons and McCullough (2003), study two	Gratitude journaling (2 weeks)	NS
	Martínez-Martí et al. (2010)	Gratitude journaling (2 weeks)	NS
	Digdon and Koble (2011)	One of three self-help interventions (constructive worry, imagery distraction and a gratitude intervention, 1 week)	S
	Jackowska et al. (2016)	Gratitude journaling (2 weeks)	NR
	Robinson et al. (2017)	Expressive writing (3 days)	NS
	Southwell and Gould (2017)	Gratitude journaling (3 weeks)	NS
	Bai et al. (2019)	Gratitude journaling and mindfulness (4 weeks)	S
	Heckendorf et al. (2019)	Gratitude training and daily activities (5 weeks)	S
	Sato et al. (2019)	Internet-delivered computerised cognitive behavioural therapy (6 weeks)	S
	Schakel et al. (2020)	Internet-based cognitive behavioural therapy combined with serious gaming interventions (6 weeks)	S
	Suh et al. (2021)	Psychological intervention to reduce bedtime procrastination (4 weeks)	S
	Mahoney et al. (2022)	Online cognitive behavioural therapy for insomnia (4 sessions)	S
Self-report health behaviours			**9 of 20**
Opioid misuse	Garland et al. (2019)	Mindfulness-Oriented Recovery Enhancement (8 weeks)	S
Self-report caffeine and alcohol use	Emmons and McCullough (2003), study two	Gratitude journaling (2 weeks)	NS
Self-report diabetes self-management	Gregg et al. (2007)	Acceptance and commitment therapy (1-day workshop)	S
Self-report eating behaviours	Wiltink et al. (2007)	Behavioural or psychodynamic psychotherapy (7 weeks)	NS
	Wolfe and Patterson (2017)	Gratitude journaling (2 weeks)	S
	Duque et al. (2019)	Phone-based positive psychology intervention aimed to promote physical activity (8-week)	S
	Celano et al. (2020)	Positive affect intervention (3 months)	NS
Self-report health behaviours	Emmons and McCullough (2003), study one	Gratitude journaling (10 weeks)	NR
	Carlson et al. (2004)	Mindfulness-based stress reduction (8 weeks)	NS
	Carlson et al. (2015)	Mindfulness-based cancer recovery and supportive-expressive group therapy (8 weeks)	NS
	Huffman et al. (2019)	Combined positive psychology-motivational interviewing intervention (12 weeks)	S
Self-report medication adherence	Ogedegbe et al. (2012)	Positive affect and self-affirmation intervention (12 months)	S
	Duque et al. (2019)	Phone-based positive psychology intervention aimed to promote physical activity (8-week)	S
	Celano et al. (2020)	Positive affect intervention (3 months)	NS
Self-report physical activity	Emmons and McCullough (2003), study three	Gratitude journaling (3 weeks)	NR
	Peterson et al. (2012)	Positive affect intervention (12 months)	S
	Redwine et al. (2016)	Gratitude journaling (8 weeks)	NS
	Duque et al. (2019)	Phone-based positive psychology intervention aimed to promote physical activity (8-week)	S
	Celano et al. (2020)	Positive affect intervention (3 months)	NS

**NR = Not reported, NS = Not significant, S = Significant*

Potential Mechanisms and Pathways

Potential mechanisms for improvements in PH were discussed in 37 out of 74 studies. Reduced sympathetic nervous system arousal was most common, cited in 14 studies. One study theorised that opioid release may change pain processing and positive affect (Garland et al., 2019), and another said that gratitude may benefit threat-reducing

neural pathways (Hazlett et al., 2021). Other mechanisms discussed were behavioural or social support related. These centred on maintenance and change of physical activity, dietary and sleep behaviours.

In line with suggestions from Steptoe (2019b) and Aspinwall & Tedeschi, (2010), potential pathways were categorised as behavioural, biological or social support. Out of the 37 studies that discussed pathways, 13 proposed behavioural mechanisms, 18 biological and six social supports. Table 3 details this categorisation.

Three broad themes by which psychological interventions act to improve PH were observed. These were to protect, reduce, and produce. This categorisation is supported in the extended literature under different terminology. For instance, resilience (Lim et al., 2020; Nath & Pradhan, 2012), remediation (Monferrer et al., 2021) and promotion (Pai & McGrady, 2014). To give examples for each area, cognitive behavioural group training fell into the protect category, as group accountability acted to encourage health behaviours protective of glycaemic control, mindfulness-based stress reduction programmes reduce sympathetic nervous system arousal, and gratitude interventions may produce increased positive affect, broadening the thoughts and actions taken towards improving health. Seven studies fell into the protect category, 17 into reduce, and 13 into the produce category. It is important to note that these three categories describe key themes, but do not operate in isolation to each other. Figure 2 depicts this categorisation, termed the "PRP" framework, which includes interventions archetypal of each category. The authors recognise that theirs is only one interpretation and others may categorise and represent interventions differently.

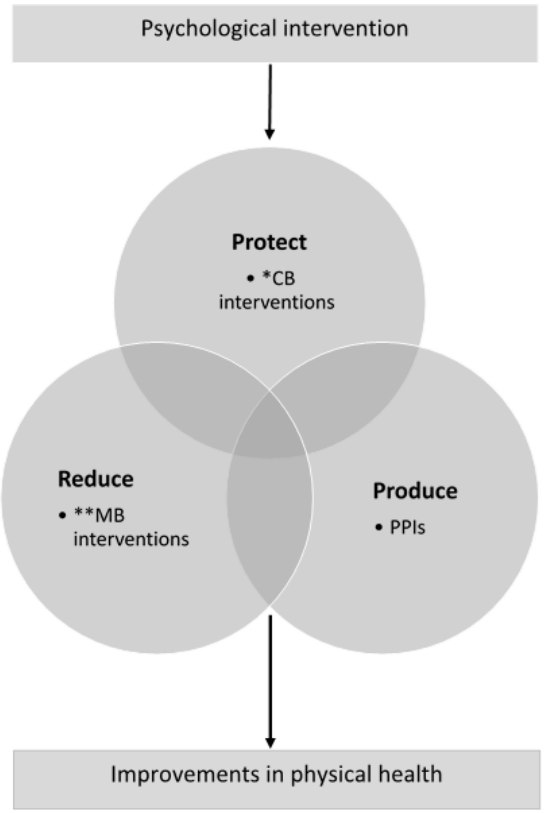

Figure 2. The Protect, Reduce and Produce (PRP) framework with intervention architypes

*Note. *Cognitive behavioural-based interventions, **Mindfulness-based interventions*

Discussion

This review aimed to systematically synthesis studies that investigate how increasing PW through psychological interventions can improve PH, and to identify causal mechanisms. It also intended to determine which psychological interventions are effective at increasing PH. Findings support those of previous research into the impact of PW on PH and potential explanatory pathways, though significant effects were only reported for 43% of outcomes. Additionally, the review highlights that different areas of PW may impact different aspects of PH and we are only at the beginning of unpacking the subtleties of these interactions. A novel framework by which psychological interventions improve health is suggested. The present review provides an interpretation of the literature, discusses limitations, and gives suggestions for future research.

Finding show that increased PW caused by psychological interventions can positively impact measures of PH. Particularly evident were reductions in cortisol, where significant improvements were observed in four out of seven studies measuring this outcome. This corroborates observations from several studies (Lindfors & Lundberg, 2002; Ryff et al., 2004; Steptoe et al., 2005, 2008) linking higher PW with lower cortisol levels. It may also reflect common use of cortisol as a stress marker due to its relative ease of use and low cost (Olivera-Figueroa et al., 2015). Positive impacts on cortisol were most frequently linked to mindfulness-based interventions, contrasting reviews that have so far found inconsistent results for mindfulness-based approaches (O'Leary et al., 2016). Inflammation also significantly improved in four out of eight studies. This aligns with other research that has found an association between reduced inflammatory markers and PW (Friedman et al., 2007; Steptoe & Fancourt, 2019). Interventions that utilised cognitive and behavioural aspects were associated with the most significant effects, but also the second largest proportion of non-significant findings. This may reflect the high volume of empirical research on CBT-based interventions (Butler et al., 2006). CBT-based interventions impacted a mix of both objective and self-report measures.

Self-report measures had a larger proportion of statistically significant effects compared to objective measures, particularly for PPIs, with common markers being self-report pain, self-report physical wellbeing and self-report sleep. Notably, improvements in self-report sleep quality linked to PW has showed promise in a recent review of gratitude interventions (Boggiss et al., 2020). However, it should be noted that out of 35 outcomes linked to gratitude interventions in this review, only six significant effects were reported.

The higher proportion of improvement in self-report measures may be due to bias in these subjective instruments, including socially desirable responding where respondents tend to present a favourable image of themselves (Johnson & Fendrich, 2005). That being said, positive perceptions can also aid behavioural change and adherence to health behaviours (Boehm et al., 2018), though more research is needed in this area (Broadbent, 2010). Therefore, these subjective changes are not insignificant. Furthermore, understanding the mechanisms underlying positive changes may allow for more targeted approaches.

Findings on potential pathways by which PW improves PH agree with suggestions from previous studies. Behavioural and biological pathways (Steptoe, 2019b) were most common, with a minority of studies suggesting social support (Aspinwall & Tedeschi, 2010) as a potential mechanism. This could reflect the fact that only 12 studies assessed interventions that included aspects of group interaction. Since the association between social support and PH is well documented (Cohen & Janicki-Deverts, 2009) this may highlight a gap in the literature.

Whilst evidence for the positive impact of PW on PH was observed, it was not ubiquitous. Of the 139 individual PH outcomes measured across all studies, 43% reported statistically significant effects. This means over half were ineffective or not reported. Both clinical and non-clinical populations showed around a 50% success rate. This reflects the discourse around whether PW is both protective and restorative of PH.

The largest proportion of significant effects were linked to interventions that influenced cognitive and behavioural aspects, consistent with reviews of CBT's effectiveness (Butler et al., 2006). However, as previously mentioned, cognitive and behavioural approaches also had the second largest number of non-significant effects, meaning that observations may reflect the number of articles, rather than necessarily their efficacy. PPIs reported the second highest number of significant outcomes. This adds to a recent review by van Agteren et al. (2021) that found PPIs to be effective in improving PW. However, it should be noted 54% of outcomes linked to PPIs also did not report significant effects. Mindfulness-based interventions showed significant effects in 50% of studies that measured them and were associated with reduced cortisol in two out of three studies that recorded this outcome. This aligns with reviews linking mindfulness-based interventions with improved cortisol regulation (O'Leary et al., 2016; Sanada et al., 2016), though these articles admit further RCTs are needed to strengthen findings. However, high variability in study design and interventions utilised means caution should be applied when making inferences about which interventions were most effective.

Key themes linking psychological interventions to improvements in PH can be divided into three broad categories: 1) protect, 2) reduce, and 3) produce. This provides a conceptual framework by which psychological attempts to improve embodied health can be structured (the PRP framework). Each category interacts with the others but are considered individually below.

Protect

The protect category links to a wider theme in the literature that says there is more evidence PW is protective of PH rather than restorative (Steptoe, 2019a; Veenhoven, 2008). Interventions in this category tended to impact participant thinking and behaviours. For instance, maintenance of physical activity, engagement with self-care activities and positive sleep hygiene practices.

The present review found cognitive and behavioural interventions were often effective, with an even split between objective and subjective measures. Impacts to objective outcomes may underline a causal chain: changes in cognitions drive positive health behaviours which then impact biological markers of health, endorsing a CBT-based perspective (Beck, 1970; Ellis, 1962). The impact of emphasising behavioural change could also be seen in PPIs. For example, gratitude writing sessions did not show significant effects in Hazlett et al. (2021), whereas Hausmann et al. (2017) used a positive psychology skill-building intervention that may have enabled behavioural changes, leading to the statistically significant effects on PH observed in the study. Interventions that leverage PW to impact health behaviours could be a key theme that warrants further study.

Social support was under studied in papers included in the present review. One study (Van Der Ven et al., 2005) found that group accountability combined with education on health behaviours benefited glycaemic control. Linking to theory, it could be that positive resonance (Fredrickson, 2016) within this group intervention contributed to adoption of protective health behaviours. Similarly, a group intervention that focused on training in benefit-finding showed reductions in cortisol (Antoni et al., 2009). This demonstrates the potential link between social support, behaviours, and biological outcomes.

Reduce

The reduce category was most common in the present review and was closely associated with biological pathways. A total of 17 studies were included in this group. The dominant theme related to stress reduction, or said another way, improved regulation of sympathetic nervous system arousal. This was evidenced by significant reductions in cortisol. These findings link to a recent review of research studying sympathetic nervous system activity and the hypothalamic-pituitary adrenal (HPA) axis, showing that these two systems work in concert (Jones et al., 2020). Therefore, changes to sympathetic nervous system activity driven by psychological interventions can impact the output of the HPA axis which is responsible for cortisol release.

Interventions within the reduce category were mixed. Broadly, they had components that centred on participants' emotional states. Behavioural activation therapy, gratitude interventions and MBSR are all examples. Mindfulness-based approaches may be most promising demonstrated by their strong association with cortisol reduction. A recent review of a broad range of psychological interventions found that mindfulness-based psychological interventions showed comparatively high efficacy both in clinical and non-clinical populations (van Agteren et al., 2021). A separate review identifies changes to cognitive and emotional reactivity as being a key mechanism underlying mindfulness-based approaches (Gu et al., 2015), which ties in with the emotional component of this category.

These changes then link back to biological correlates, since cognitive framing of experiences has been shown to impact cortisol output (Daubenmier et al., 2014) and emotional reactivity directly impacts sympathetic nervous system arousal (Beri & Reddy, 2019). Excess cortisol is associated with a wide range of detrimental PH outcomes such as insulin resistance and cardiovascular diseases (McEwen & Seeman, 2003), cancer development (Larsson et al., 2021), sleeping difficulties (Buckley & Schatzberg, 2005), and Alzheimer's disease (Ouanes & Popp, 2019). Therefore, interventions that combated elevated cortisol are important.

Produce

Studies that fell into the produce categorisation were second most common, numbering 13. They are defined by generating a favourable output such as increased positive affect that links to beneficial behavioural and biological pathways. For example, positive affect elucidated by PPIs may broadened the thoughts and actions that patients pursue to improve their physical wellbeing (Hausmann et al., 2017); positive affect may improve physical activity adherence by acting as a reward that reinforces health behaviours (Duque et al., 2019), and; positive affect could trigger the release of endogenous opioids related to pain processing and hedonic regulation impacting biological correlates (Garland et al., 2019).

The review noted a relative lack of what could be considered "positive health markers". This is a perhaps a simplistic phrasing, but a useful way of framing an argument that measures of things that induce positive phenomena in our bodies should be used, as well as reduced negative markers. For example, heart rate variability (HRV) only made up five out of the 139 outcomes measured. This may go some way to explaining why more significant outcomes were not observed. The premise of this review was to measure how increasing PW impacts PH. Many of the interventions included aim to increase certain beneficial physiological phenomena, rather than reduce negative ones, but still measured reductions of negative markers in the body. For instance, opioid release, specifically endorphins, have been linked to a range of psychological disorders that impact PH (Naber & Piekar, 1983). In another study, (Kasala et al., 2014) linked meditation practice with neurophysiological changes beneficial for PH, such as increased 5-HT, a neurotransmitter important for regulating mood, sleep and appetite.

The lack of positive health markers may be due to various reasons. One could be the higher cost of measuring markers like endorphins (Tamvakopoulos, 2007) and HRV, where specialist laboratory techniques or measurement devices are required. Additionally, there may not be enough interdisciplinary research, where sharing of expertise on different aspects of studied phenomena, biology, positive psychology, and health psychology would be beneficial. Increased use of positive markers where possible may be an important development for future studies.

Conceptually the produce category aligns most closely to seminal concepts in first wave positive psychology, focused on increasing positive emotions and behaviours (Lomas et al., 2021). In particular the benefits of increased positive affect link to Fredrickson's (1998) broaden-and-build theory showing how conceptualisations can relate to actualised PH. This would support the notion that hedonic forms of wellbeing have a role to play in PH. Indeed, optimism and hedonic wellbeing have been found to be more closely related to improved cardiovascular disease outcomes than eudaimonic wellbeing (Boehm & Kubzansky, 2012). In contrast, other studies have found that eudaimonia was correlated with lower stress markers, cardiovascular disease risk and longer duration of REM sleep (Ryff et al., 2004). This highlights that distinct kinds of PW are important as they may impact different aspects of PH.

Despite this, studies in the present review rarely discussed the area of PW they targeted and the implications of this. It could be argued that PW is generally narrowly and inconsistently defined across the literature. For instance, the PANAS (Watson et al., 1988) was used by many studies in this review and has been criticised for representing a limited definition of positive and negative emotions based on high arousal states (Diener et al., 2009). Further to this point, many of the studies in the present review focused solely on affective and evaluative wellbeing derived from a range of measures. This is one of the reasons that a meta-analysis was not carried out. Moreover, PPIs showed mixed results, which may reflect the variability in which aspects of PW each intervention targets. It is therefore important to carefully consider definitions as well as what is being measured when studying PW and at present this is not commonly recognised in the literature.

Limitations

The findings of this review have several limitations that should be acknowledged. At a study level, the RoB2 (Sterne et al., 2019) and ROBINS-I (Sterne et al., 2016) risk of bias tools can be used to guide limitation exploration. Randomisation process was missing from 10 studies. Where randomisation was present typically it is not possible to blind study participants to the psychological intervention that they are receiving (Juul et al., 2021), meaning there could be effect of assignment to the intervention. Missing outcome data may have impacted some studies where there was attrition of participants. Confounding could also have impacted effects. For example, the association between PW and health can be mediated by physical activity (Koopmans et al., 2010; Wiest et al., 2011). Other factors that may have impacted the outcomes include some small sample sizes. These could have created false positives as well as type II errors where changes did take place but went undetected.

Additionally, limited follow-up length may mask effects, as significant health differences could unfold over years, not months (Kushlev et al., 2020). In particular, the effect of PPIs might accumulate and build positive feedback loops over the course of a lifespan (Fredrickson & Losada, 2005). This limitation could compound with usage of self-report measures since some have been found to have poor alignment with objective equivalents (Gorber & Tremblay, 2016). Moreover, those partaking in gratitude interventions can bias more favourable outcomes in subjective assessments (Karanicolas et al., 2010). In selection of reported results, published articles could further bias towards positive findings, but this limitation is hard to account for. It is also worth noting that

most of the included articles were efficacy studies and not effectiveness trials, linking to calls from scholars for more reporting of effectiveness within PPI research (Hone et al., 2015).

There were also limitations at the level of the present review. The time frame for the search strategy of this review was a pragmatic one, stemming from the academic background of the authors whilst also accepting the limitations of resources with non-funded research. The authors contest that it could be argued that more focused intention was placed toward positive interventions after the inauguration of positive psychology, therefore this offered a natural time period to focus on in this review. However, it should be noted that a broader inclusion criterion could offer further insight from earlier work. Regardless, the authors are confident that this review will nevertheless offer original insights into the work conducted during this time period.

Furthermore, the initial database searches missed 21 articles that were later found in references searches, and a further 17 studies were found in a relevant review paper. This could highlight challenges in database indexing for systematic reviews. Further, only studies written in English were included, which may exclude important pieces of research written in other languages. On the other hand, a broad approach was taken to study inclusion across methodology, population and psychological intervention used. This meant that the heterogeneity of studies included was large, precluding the ability to conduct a meta-analysis and to provide detailed findings. Therefore, themes are based on frequency rather than effect sizes, which risks over emphasis of some areas and underrepresentation of others.

However, since this is the first review of its kind, a broad approach enables an overview of an area of investigation that has received little attention to date. It also highlighted that studies measure varying aspects of PW and PH. This creates challenges for comparison. It also creates opportunities, as there are many potential mechanisms that are only beginning to be explored.

Future Research

The link between PW and PH is ripe for further research. Detailed investigation into potential pathways should account for potential confounding factors and use objective health measures where possible to allow for more confident statements about causal mechanisms. The role of social support is also understudied and warrants further research. Whilst the broad approach of the present review provides a useful overview, other studies could benefit from focusing on specific psychological interventions with enough similarity to quantify generalisable effects through meta-analysis. This review highlighted cognitive behavioural, PPIs and mindfulness-based interventions as showing the most promise. The authors recommend that future research examines the nuance in how different areas of PW may impact discrete areas of PH, enabling the development of protocols most fitting a particular purpose. This should inform the area of PW that interventions target, and the measures of PH used. Studies may benefit by addressing the relative lack of measurement of positive health markers, such as endorphins and HRV. The authors advocate increased interdisciplinary research to aid such endeavours. The PRP framework could provide structure to inform these investigations.

Conclusion

This systematic review supports the notion that psychological interventions benefit PH and corroborates pathways by which this relationship exists. Significant effects were observed in 43% of outcomes and most often linked to reduction in cortisol levels and inflammation markers, and improvements in self-report pain, self-report physical wellbeing and self-report sleep. An association between mindfulness and cortisol reduction was particularly evident. Pathways were behavioural, biological, or social support related. Determination of which psychological interventions were most effective was not possible. However, a framework by which psychological interventions my act upon PH is suggested. The review found that there needs to be much more investigation into which elements of PW related to different markers of PH so that the right areas can be focused on with the correct measures.

The novel approach of the present review and its resulting framework highlights the potential of psychological interventions as a complementary route to improve PH in both clinical and non-clinical populations. This is a unique perspective, since the body has largely been overlooked in positive psychology research to date (Hefferon, 2015). There is fertile ground for future research. Cognitive behavioural, PPI and mindfulness-based approaches show substantial potential. Important will be isolating causal mechanisms with closely controlled studies that measure

objective outcomes. Particularly, wider inclusion of positive health markers such as endorphins and HRV could be an area for development, aided by interdisciplinary approaches. The role of a social support is also a gap in the literature. Additionally, nuance in how different aspects of PW impact distinct areas of PH warrants further study, and the PRP framework could offer a structure for this investigation.

Compliance with Ethical Standards

Ethical Standards

Ethical approval was not required for this study, as the research did not involve the collection of data from human participants.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Author Contributions

Lawrence Paddon was the primary researcher for this study, leading literature search, analysis and writing the initial manuscript. Dr Hanna Kampman oversaw the study, contributing to the design, key decisions, analysis as well as discussion of the findings. Both authors contributed to the final version of the manuscript and approved the submitted version.

Acknowledgements

The authors would like to express their gratitude to all the researchers that contributed to the papers included within this systematic review.

Received: March 12, 2023
Accepted: June 1, 2023
Published Online: July 4, 2023

References

Adam, E. K., Quinn, M. E., Tavernier, R., McQuillan, M. T., Dahlke, K. A., & Gilbert, K. E. (2017). Diurnal cortisol slopes and mental and physical health outcomes: A systematic review and meta-analysis. *Psychoneuroendocrinology*, *83*, 25–41.

Antoni, M. H., Carver, C. S., & Lechner, S. C. (2009). *Enhancing positive adaptation: Example intervention during treatment for breast cancer.*

Arslan, G. (2017). Psychological maltreatment, coping strategies, and mental health problems: A brief and effective measure of psychological maltreatment in adolescents. *Child Abuse & Neglect, 68*, 96-106. https://doi.org/10.1016/j.chiabu.2017.03.023

Aspinwall, L. G., & Brunhart, S. M. (1996). Distinguishing optimism from denial: Optimistic beliefs predict attention to health threats. *Personality and Social Psychology Bulletin*, *22*(10), 993–1003.

Aspinwall, L. G., & MacNamara, A. (2005). Taking positive changes seriously: Toward a positive psychology of cancer survivorship and resilience. *Cancer: Interdisciplinary International Journal of the American Cancer Society*, *104*(S11), 2549–2556.

Aspinwall, L. G., & Tedeschi, R. G. (2010). The Value of Positive Psychology for Health Psychology: Progress and Pitfalls in Examining the Relation of Positive Phenomena to Health. *Annals of Behavioral Medicine*, *39*(1), 4–15. https://doi.org/10.1007/s12160-009-9153-0

Avvenuti, G., Baiardini, I., & Giardini, A. (2016). Optimism's explicative role for chronic diseases. *Frontiers in Psychology*, *7*, 295.

Bai, C.-F., Cui, N.-X., Xu, X., Mi, G., Sun, J.-W., Shao, D., Li, J., Jiang, Y.-Z., Yang, Q.-Q., Zhang, X., & Cao, F.-L. (2019). Effectiveness of two guided self-administered interventions for psychological distress among women with infertility: A three-armed, randomized controlled trial. *Human Reproduction*, *34*(7), 1235–1248. https://doi.org/10.1093/humrep/dez066

Bartlett, M. Y., & Arpin, S. N. (2019). Gratitude and loneliness: Enhancing health and well-being in older adults. *Research on Aging*, *41*(8), 772–793.

Beck, A. T. (1970). Cognitive therapy: Nature and relation to behavior therapy. *Behavior Therapy*, *1*(2), 184–200.

Beri, D., & Reddy, J. (2019). Physiological Correlates of Arousal: A Metaanalytic Review. *Journal of Neurology and Neuroscience*, *10*(4), 0–0.

Berk, L., van Boxtel, M., Köhler, S., & van Os, J. (2017). Positive affect and cognitive decline: A 12-year follow-up of the Maastricht Aging Study. *International Journal of Geriatric Psychiatry*, *32*(12), 1305–1311.

Berscheid, E. (2003). The human's greatest strength: Other humans. In *A psychology of human strengths: Fundamental questions and future directions for a positive psychology* (pp. 37–47). American Psychological Association. https://doi.org/10.1037/10566-003

Black, S. V., Cooper, R., Martin, K. R., Brage, S., Kuh, D., & Stafford, M. (2015). Physical activity and mental well-being in a cohort aged 60–64 years. *American Journal of Preventive Medicine*, *49*(2), 172–180.

Blanchflower, D. G., Oswald, A. J., & Stewart-Brown, S. (2013). Is psychological well-being linked to the consumption of fruit and vegetables? *Social Indicators Research*, *114*(3), 785–801.

Boehm, J. K., & Kubzansky, L. D. (2012). The heart's content: The association between positive psychological well-being and cardiovascular health. *Psychological Bulletin*, *138*(4), 655–691. https://doi.org/10.1037/a0027448

Boehm, J. K., Peterson, C., Kivimaki, M., & Kubzansky, L. (2011). A prospective study of positive psychological well-being and coronary heart disease. *Health Psychology*, *30*(3), 259.

Boehm, J. K., Soo, J., Zevon, E. S., Chen, Y., Kim, E. S., & Kubzansky, L. D. (2018). Longitudinal associations between psychological well-being and the consumption of fruits and vegetables. *Health Psychology*, *37*(10), 959.

Boggiss, A. L., Consedine, N. S., Brenton-Peters, J. M., Hofman, P. L., & Serlachius, A. S. (2020). A systematic review of gratitude interventions: Effects on physical health and health behaviors. *Journal of Psychosomatic Research*, *135*, 110165. https://doi.org/10.1016/j.jpsychores.2020.110165

Bolier, L., Haverman, M., Westerhof, G. J., Riper, H., Smit, F., & Bohlmeijer, E. (2013). Positive psychology interventions: A meta-analysis of randomized controlled studies. *BMC Public Health*, *13*(1), 119. https://doi.org/10.1186/1471-2458-13-119

Borowsky, I. W., Ireland, M., & Resnick, M. D. (2009). Health status and behavioral outcomes for youth who anticipate a high likelihood of early death. *Pediatrics*, *124*(1), e81–e88.

Boutin-Foster, C., Offidani, E., Kanna, B., Ogedegbe, G., Ravenell, J., Scott, E., Rodriguez, A., Ramos, R., Michelen, W., Gerber, L., & et al. (2016). Results from the Trial Using Motivational Interviewing, Positive Affect, and Self-Affirmation in African Americans with Hypertension (TRIUMPH). *Ethnicity & Disease*, *26*(1), 51-60. https://doi.org/10.18865/ed.26.1.51

Boyle, P. A., Buchman, A. S., Barnes, L. L., & Bennett, D. A. (2010). Effect of a purpose in life on risk of incident Alzheimer disease and mild cognitive impairment in community-dwelling older persons. *Archives of General Psychiatry*, *67*(3), 304–310.

Brissette, I., Scheier, M. F., & Carver, C. S. (2002). The role of optimism in social network development, coping, and psychological adjustment during a life transition. *Journal of Personality and Social Psychology*, *82*(1), 102.

Broadbent, E. (2010). Illness perceptions and health: Innovations and clinical applications. *Social and Personality Psychology Compass*, *4*(4), 256–266.

Buckley, T. M., & Schatzberg, A. F. (2005). On the interactions of the hypothalamic-pituitary-adrenal (HPA) axis and sleep: Normal HPA axis activity and circadian rhythm, exemplary sleep disorders. *The Journal of Clinical Endocrinology & Metabolism*, *90*(5), 3106–3114.

Buman, M. P., Hekler, E. B., Haskell, W. L., Pruitt, L., Conway, T. L., Cain, K. L., Sallis, J. F., Saelens, B. E., Frank, L. D., & King, A. C. (2010). Objective light-intensity physical activity associations with rated health in older adults. *American Journal of Epidemiology*, *172*(10), 1155–1165.

Butler, A. C., Chapman, J. E., Forman, E. M., & Beck, A. T. (2006). The empirical status of cognitive-behavioral therapy: A review of meta-analyses. *Clinical Psychology Review*, *26*(1), 17–31.

Carlson, L. E., Beattie, T. L., Giese-Davis, J., Faris, P., Tamagawa, R., Fick, L. J., Degelman, E. S., & Speca, M. (2015). Mindfulness-based cancer recovery and supportive-expressive therapy maintain telomere length relative to controls in distressed breast cancer survivors. *Cancer*, *121*(3), 476–484.

Carlson, L. E., Speca, M., Patel, K. D., & Goodey, E. (2004). Mindfulness-based stress reduction in relation to quality of life, mood, symptoms of stress and levels of cortisol, dehydroepiandrosterone sulfate (DHEAS) and melatonin in breast and prostate cancer outpatients. *Psychoneuroendocrinology*, *29*(4), 448–474. https://doi.org/10.1016/S0306-4530(03)00054-4

Carrico, A., Neilands, T., Dilworth, S., Evans, J., Gomicronmez, W., Jain, J., Gandhi, M., Shoptaw, S., Horvath, K., Coffin, L., & et al. (2019). Randomized controlled trial of a positive affect intervention to reduce HIV viral load among sexual minority men who use methamphetamine. *Journal of the International AIDS Society*, *22*(12). https://doi.org/10.1002/jia2.25436

Celano, C., Freedman, M., Harnedy, L., Park, E., Januzzi, J., Healy, B., & Huffman, J. (2020). Feasibility and preliminary efficacy of a positive psychology-based intervention to promote health behaviors in heart failure: The REACH for Health study. *Journal of Psychosomatic Research*, *139*, 110285. https://doi.org/10.1016/j.jpsychores.2020.110285

Celano, C. M., Albanese, A. M., Millstein, R. A., Mastromauro, C. A., Chung, W.-J., Campbell, K. A., Legler, S. R., Park, E. R., Healy, B. C., & Collins, L. M. (2018). Optimizing a positive psychology intervention to promote health behaviors following an acute coronary syndrome: The Positive Emotions after Acute Coronary Events-III (PEACE-III) randomized factorial trial. *Psychosomatic Medicine*, *80*(6), 526.

Chandler J, Cumpston M, Thomas J, Higgins JPT, Deeks JJ, Clarke MJ. (2022). Chapter I: Introduction. In *Cochrane Handbook for Systematic Reviews of Interventions* (version 6.3). www.training.cochrane.org/handbook

Cheon, B. K., Melani, I., & Hong, Y. (2020). How USA-Centric Is Psychology? An Archival Study of Implicit Assumptions of Generalizability of Findings to Human Nature Based on Origins of Study Samples. *Social Psychological and Personality Science*, *11*(7), 928–937. https://doi.org/10.1177/1948550620927269

Chiavarino, C., Cavallero, E., Rabellino, D., Palumbo, L., Bianchino, C., Gaita, F., Bergerone, S., & Bara, B. G. (2016). Mental Fitness for patients with acute coronary syndrome: A randomized clinical trial. *British Journal of Health Psychology*, *21*(3), 584–599.

Chida, Y., & Steptoe, A. (2008). Positive Psychological Well-Being and Mortality: A Quantitative Review of Prospective Observational Studies. *Psychosomatic Medicine*, *70*(7), 741–756. https://doi.org/10.1097/PSY.0b013e31818105ba

Claesson, M., Birgander, L., Jansson, J., Lindahl, B., Burell, G., Asplund, K., & Mattsson, C. (2006). Cognitive-behavioural stress management does not improve biological cardiovascular risk indicators in women with ischaemic heart disease: A randomized-controlled trial. *Journal of Internal Medicine*, *260*(4), 320-331. https://doi.org/10.1111/j.1365-2796.2006.01691.x

Cohen, S., Alper, C. M., Doyle, W. J., Treanor, J. J., & Turner, R. B. (2006). Positive emotional style predicts resistance to illness after experimental exposure to rhinovirus or influenza A virus. *Psychosomatic Medicine*, *68*(6), 809–815.

Cohen, S., & Janicki-Deverts, D. (2009). Can We Improve Our Physical Health by Altering Our Social Networks? *Perspectives on Psychological Science*, *4*(4), 375–378. https://doi.org/10.1111/j.1745-6924.2009.01141.x

Cohen, S., & Rodriguez, M. S. (1995). Pathways linking affective disturbances and physical disorders. *Health Psychology*, *14*(5), 374.

Conner, T. S., Brookie, K. L., Carr, A. C., Mainvil, L. A., & Vissers, M. C. (2017). Let them eat fruit! The effect of fruit and vegetable consumption on psychological well-being in young adults: A randomized controlled trial. *PloS One*, *12*(2), e0171206.

Cook, K. A., Woessner, K. M., & White, A. A. (2018). Happy asthma: Improved asthma control with a gratitude journal. *The Journal of Allergy and Clinical Immunology: In Practice*, *6*(6), 2154–2156.

Cooper, A., Lloyd, G., Weinman, J., & Jackson, G. (1999). Why patients do not attend cardiac rehabilitation: Role of intentions and illness beliefs. *Heart*, *82*(2), 234–236.

Craig, H., Freak-Poli, R., Phyo, A. Z. Z., Ryan, J., & Gasevic, D. (2021). The association of optimism and pessimism and all-cause mortality: A systematic review. *Personality and Individual Differences*, *177*, 110788.

Daubenmier, J., Hayden, D., Chang, V., & Epel, E. (2014). It's not what you think, it's how you relate to it: Dispositional mindfulness moderates the relationship between psychological distress and the cortisol awakening response. *Psychoneuroendocrinology*, *48*, 11–18.

Davidson, K. W., Mostofsky, E., & Whang, W. (2010). Don't worry, be happy: Positive affect and reduced 10-year incident coronary heart disease: the Canadian Nova Scotia Health Survey. *European Heart Journal*, *31*(9), 1065–1070.

Davis, M. C., & Zautra, A. J. (2013). An online mindfulness intervention targeting socioemotional regulation in fibromyalgia: Results of a randomized controlled trial. *Annals of Behavioral Medicine*, *46*(3), 273–284.

Department of Health (2019). (n.d.). *Physical activity guidelines*. GOV.UK. Retrieved 27 April 2022, from https://www.gov.uk/government/collections/physical-activity-guidelines

Diener, E. (1984). Subjective well-being. *Psychological Bulletin*, *95*(3), 542–575. https://doi.org/10.1037/0033-2909.95.3.542

Diener, E., & Chan, M. Y. (2011). Happy people live longer: Subjective well-being contributes to health and longevity. *Applied Psychology: Health and Well-Being*, *3*(1), 1–43.

Diener, E., & Tay, L. (2017). A scientific review of the remarkable benefits of happiness for successful and healthy living. *Happiness: Transforming the Development Landscape*, 90–117.

Diener, E., Wirtz, D., Biswas-Diener, R., Tov, W., Kim-Prieto, C., Choi, D., & Oishi, S. (2009). New measures of well-being. In *Assessing well-being* (pp. 247–266). Springer.

Digdon, N., & Koble, A. (2011). Effects of constructive worry, imagery distraction, and gratitude interventions on sleep quality: A pilot trial. *Applied Psychology: Health and Well-Being*, *3*(2), 193–206.

Dingle, G. A., Stark, C., Cruwys, T., & Best, D. (2015). Breaking good: Breaking ties with social groups may be good for recovery from substance misuse. *British Journal of Social Psychology*, *54*(2), 236–254.

Dodge, R., & Daly, A. (2012). P. HUYTON. SANDERS, LD The challenge of defining wellbeing. *International Journal of Wellbeing*, *2*(3), 222–235.

Dodge, R., Daly, A. P., Huyton, J., & Sanders, L. D. (2012). *The challenge of defining wellbeing, 2, 222–235*.

Dulloo, A. G., Miles-Chan, J. L., & Montani, J.-P. (2017). Nutrition, movement and sleep behaviours: Their interactions in pathways to obesity and cardiometabolic diseases. *Obesity Reviews*, *18*(S1), 3–6. https://doi.org/10.1111/obr.12513

Duque, L., Brown, L., Celano, C. M., Healy, B., & Huffman, J. C. (2019). Is it better to cultivate positive affect or optimism? Predicting improvements in medical adherence following a positive psychology intervention in patients with acute coronary syndrome. *General Hospital Psychiatry*, *61*, 125–129. https://doi.org/10.1016/j.genhosppsych.2019.06.001

Elias, B. L., Polancich, S., Jones, C., & Colvin, S. (2015). Evolving the PICOT method for the digital age: The PICOT-D. *Journal of Nursing Education*, *54*(10), 594–599.

Ellis A. (1962). *Reason and emotion in psychotherapy*. Lyle Stuart.

El-Mokadem, J. F. K., DiMarco, K., Kelley, T. M., & Duffield, L. (2020). Three principles/innate health: The efficacy of psycho-spiritual mental health education for people with chronic fatigue syndrome. *Spirituality in Clinical Practice*. https://doi.org/10.1037/scp0000232

Emmons, R. A., & McCullough, M. E. (2003). Counting blessings versus burdens: An experimental investigation of gratitude and subjective well-being in daily life. *Journal of Personality and Social Psychology*, *84*(2), 377.

Errazuriz, A., Schmidt, K., Undurraga, E. A., Medeiros, S., Baudrand, R., Cussen, D., Henriquez, M., Celhay, P., & Figueroa, R. A. (2022). Effects of mindfulness-based stress reduction on psychological distress in health workers: A three-arm parallel randomized controlled trial. *Journal of Psychiatric Research*, *145*, 284–293. https://doi.org/10.1016/j.jpsychires.2020.11.011

Ferwerda, M., van Beugen, S., van Middendorp, H., Spillekom-van Koulil, S., Donders, A. R. T., Visser, H., Taal, E., Creemers, M. C., van Riel, P. C., & Evers, A. W. (2017). A tailored-guided internet-based cognitive-behavioral intervention for patients with rheumatoid arthritis as an adjunct to standard rheumatological care: Results of a randomized controlled trial. *Pain*, *158*(5), 868–878.

Freak-Poli, R., Mirza, S. S., Franco, O. H., Ikram, M. A., Hofman, A., & Tiemeier, H. (2015). Positive affect is not associated with incidence of cardiovascular disease: A population-based study of older persons. *Preventive Medicine*, *74*, 14–20.

Fredrickson, B. L. (1998). What Good Are Positive Emotions? *Review of General Psychology*, *2*(3), 300–319. https://doi.org/10.1037/1089-2680.2.3.300

Fredrickson, B. L. (2016). Love: Positivity resonance as a fresh, evidence-based perspective on an age-old topic. *Handbook of Emotions*, *4*, 847–858.

Fredrickson, B. L., & Losada, M. F. (2005). Positive Affect and the Complex Dynamics of Human Flourishing. *American Psychologist*, *60*(7), 678–686. https://doi.org/10.1037/0003-066X.60.7.678

Friedman, E. M., Hayney, M., Love, G. D., Singer, B. H., & Ryff, C. D. (2007). Plasma interleukin-6 and soluble IL-6 receptors are associated with psychological well-being in aging women. *Health Psychology*, *26*(3), 305.

Garland, E. L., Hanley, A. W., Riquino, M. R., Reese, S. E., Baker, A. K., Salas, K., Yack, B. P., Bedford, C. E., Bryan, M. A., Atchley, R., Nakamura, Y., Froeliger, B., & Howard, M. O. (2019). Mindfulness-oriented recovery enhancement reduces opioid misuse risk via analgesic and positive psychological mechanisms: A randomized controlled trial. *Journal of Consulting and Clinical Psychology*, *87*(10), 927–940. https://doi.org/10.1037/ccp0000390

Gorber, S. C., & Tremblay, M. S. (2016). Self-Report and Direct Measures of Health: Bias and Implications. In R. J. Shephard & C. Tudor-Locke (Eds.), *The Objective Monitoring of Physical Activity: Contributions of Accelerometry to Epidemiology, Exercise Science and Rehabilitation* (pp. 369–376). Springer International Publishing. https://doi.org/10.1007/978-3-319-29577-0_14

Grant, N., Wardle, J., & Steptoe, A. (2009). The relationship between life satisfaction and health behavior: A cross-cultural analysis of young adults. *International Journal of Behavioral Medicine*, *16*(3), 259–268.

Gregg, J. A., Callaghan, G. M., Hayes, S. C., & Glenn-Lawson, J. L. (2007). Improving diabetes self-management through acceptance, mindfulness, and values: A randomized controlled trial. *Journal of Consulting and Clinical Psychology*, *75*(2), 336.

Gu, J., Strauss, C., Bond, R., & Cavanagh, K. (2015). How do mindfulness-based cognitive therapy and mindfulness-based stress reduction improve mental health and wellbeing? A systematic review and meta-analysis of mediation studies. *Clinical Psychology Review*, *37*, 1–12.

Hafez, D., Heisler, M., Choi, H., Ankuda, C. K., Winkelman, T., & Kullgren, J. T. (2018). Association between purpose in life and glucose control among older adults. *Annals of Behavioral Medicine*, *52*(4), 309–318.

Hausmann, L. R. M., Youk, A., Kwoh, C. K., Ibrahim, S. A., Hannon, M. J., Weiner, D. K., Gallagher, R. M., & Parks, A. (2017). Testing a positive psychological intervention for osteoarthritis. *Pain Medicine*, *18*(10), 1908–1920. https://doi.org/10.1093/pm/pnx141

Hausmann, L. R., Parks, A., Youk, A. O., & Kwoh, C. K. (2014). Reduction of bodily pain in response to an online positive activities intervention. *The Journal of Pain*, *15*(5), 560–567.

Hazlett, L. I., Moieni, M., Irwin, M. R., Haltom, K. E. B., Jevtic, I., Meyer, M. L., Breen, E. C., Cole, S. W., & Eisenberger, N. I. (2021). Exploring neural mechanisms of the health benefits of gratitude in women: A randomized controlled trial. *Brain, Behavior, and Immunity*, *95*, 444–453. https://doi.org/10.1016/j.bbi.2021.04.019

Heckendorf, H., Lehr, D., Ebert, D. D., & Freund, H. (2019). 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. *Behaviour Research and Therapy*, *119*, 103415.

Hefferon, K. (2013). *EBOOK: Positive Psychology and the Body: The somatopsychic side to flourishing*. McGraw-Hill Education (UK).

Hefferon, K. (2015). The role of embodiment in optimal functioning. *Positive Psychology in Practice: Promoting Human Flourishing in Work, Health, Education, and Everyday Life. New Jersey: John Wiley & Sons Inc*, 791–805.

Hendriks, T., Schotanus-Dijkstra, M., Hassankhan, A., de Jong, J., & Bohlmeijer, E. (2020). The Efficacy of Multi-component Positive Psychology Interventions: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Journal of Happiness Studies*, *21*(1), 357–390. https://doi.org/10.1007/s10902-019-00082-1

Hendriks, T., Schotanus-Dijkstra, M., Hassankhan, A., Graafsma, T. G. T., Bohlmeijer, E., & de Jong, J. (2018). The efficacy of positive psychological interventions from non-western countries: A systematic review and meta-analysis. *International Journal of Wellbeing*, *8*(1).

Hodges, L. J., Walker, J., Kleiboer, A. M., Ramirez, A. J., Richardson, A., Velikova, G., & Sharpe, M. (2011). What is a psychological intervention? A metareview and practical proposal. *Psycho-Oncology*, *20*(5), 470–478.

Holt-Lunstad, J., Smith, T. B., & Layton, J. B. (2010). Social relationships and mortality risk: A meta-analytic review. *PLoS Medicine*, *7*(7), e1000316.

Hone, L. C., Jarden, A., & Schofield, G. M. (2015). An evaluation of positive psychology intervention effectiveness trials using the re-aim framework: A practice-friendly review. *The Journal of Positive Psychology*, *10*(4), 303–322.

Howell, R. T., Kern, M. L., & Lyubomirsky, S. (2007). Health benefits: Meta-analytically determining the impact of well-being on objective health outcomes. *Health Psychology Review*, *1*(1), 83–136.

Huffman, J. C., Feig, E. H., Millstein, R. A., Freedman, M., Healy, B. C., Chung, W.-J., Amonoo, H. L., Malloy, L., Slawsby, E., & Januzzi, J. L. (2019). Usefulness of a positive psychology-motivational interviewing intervention to promote positive affect and physical activity after an acute coronary syndrome. *The American Journal of Cardiology*, *123*(12), 1906–1914.

Huffman, J. C., Golden, J., Massey, C. N., Feig, E. H., Chung, W.-J., Millstein, R. A., Brown, L., Gianangelo, T., Healy, B. C., & Wexler, D. J. (2020). A positive psychology–motivational interviewing intervention to promote positive affect and physical activity in type 2 diabetes: The BEHOLD-8 controlled clinical trial. *Psychosomatic Medicine*, *82*(7), 641.

Huppert, F. A. (2017). Challenges in defining and measuring well-being and their implications for policy. *Future Directions in Well-Being: Education, Organizations and Policy*, 163–167.

Jackowska, M., Brown, J., Ronaldson, A., & Steptoe, A. (2016). The impact of a brief gratitude intervention on subjective well-being, biology and sleep. *Journal of Health Psychology*, *21*(10), 2207–2217.

Jiang, M., Yin, Z., Li, S., Chen, X., & Gu, J. (2018). Effect of positive psychological intervention on well-being, 2-week illness prevalence, and salivary immunoglobulin A. *Western Journal of Nursing Research*, *40*(6), 889–906. https://doi.org/10.1177/0193945917690733

Johnson, T., & Fendrich, M. (2005). Modeling sources of self-report bias in a survey of drug use epidemiology. *Annals of Epidemiology*, *15*(5), 381–389.

Jones, E. J., Rohleder, N., & Schreier, H. M. C. (2020). Neuroendocrine coordination and youth behavior problems: A review of studies assessing sympathetic nervous system and hypothalamic-pituitary adrenal axis activity using salivary alpha amylase and salivary cortisol. *Hormones and Behavior*, *122*, 104750. https://doi.org/10.1016/j.yhbeh.2020.104750

Joshanloo, M. (2016). Revisiting the empirical distinction between hedonic and eudaimonic aspects of well-being using exploratory structural equation modeling. *Journal of Happiness Studies*, *17*(5), 2023–2036.

Juul, S., Gluud, C., Simonsen, S., Frandsen, F. W., Kirsch, I., & Jakobsen, J. C. (2021). Blinding in randomised clinical trials of psychological interventions: A retrospective study of published trial reports. *BMJ Evidence-Based Medicine*, *26*(3), 109–109.

Kabat-Zinn, J., Wheeler, E., Light, T., Skillings, A., Scharf, M. J., Cropley, T. G., Hosmer, D., & Bernhard, J. D. (1998). Influence of a Mindfulness Meditation-Based Stress Reduction Intervention on Rates of Skin Clearing in Patients With Moderate to Severe Psoriasis Undergoing Photo Therapy (UVB) and Photochemotherapy (PUVA): *Psychosomatic Medicine*, *60*(5), 625–632. https://doi.org/10.1097/00006842-199809000-00020

Kalisch, L., Boniwell, I., Osin, E., & Baeza-Velasco, C. (2022). Feeling Good Despite EDS: The Effects of a 5-Week Online Positive Psychology Programme for Ehlers–Danlos-Syndromes Patients. *Journal of Contemporary Psychotherapy*, *52*(1), 79–87. Scopus. https://doi.org/10.1007/s10879-021-09521-8

Kaplan, S., Bradley-Geist, J. C., Ahmad, A., Anderson, A., Hargrove, A. K., & Lindsey, A. (2014). A test of two positive psychology interventions to increase employee well-being. *Journal of Business and Psychology*, *29*(3), 367–380.

Karanicolas, P. J., Farrokhyar, F., & Bhandari, M. (2010). Blinding: Who, what, when, why, how? *Canadian Journal of Surgery*, *53*(5), 345–348.

Kasala, E. R., Bodduluru, L. N., Maneti, Y., & Thipparaboina, R. (2014). Effect of meditation on neurophysiological changes in stress mediated depression. *Complementary Therapies in Clinical Practice*, *20*(1), 74–80.

Kashdan, T. B., Biswas-Diener, R., & King, L. A. (2008). Reconsidering happiness: The costs of distinguishing between hedonics and eudaimonia. *The Journal of Positive Psychology*, *3*(4), 219–233.

Keng, S.-L., Looi, P. S., Tan, E. L. Y., Yim, O.-S., Lai, P. S., Chew, S. H., & Ebstein, R. P. (2020). Effects of Mindfulness-Based Stress Reduction on Psychological Symptoms and Telomere Length: A Randomized Active-Controlled Trial. *Behavior Therapy*, *51*(6), 984–996. https://doi.org/10.1016/j.beth.2020.01.005

Keyes, C. L. (2003). *Complete mental health: An agenda for the 21st century.*

Kim, E. S., Strecher, V. J., & Ryff, C. D. (2014). Purpose in life and use of preventive health care services. *Proceedings of the National Academy of Sciences*, *111*(46), 16331–16336.

Kim, E. S., Sun, J. K., Park, N., & Peterson, C. (2013). Purpose in life and reduced incidence of stroke in older adults:'The Health and Retirement Study'. *Journal of Psychosomatic Research*, *74*(5), 427–432.

Kok, B. E., Coffey, K. A., Cohn, M. A., Catalino, L. I., Vacharkulksemsuk, T., Algoe, S. B., Brantley, M., & Fredrickson, B. L. (2013). How Positive Emotions Build Physical Health: Perceived Positive Social Connections Account for the Upward Spiral Between Positive Emotions and Vagal Tone. *Psychological Science*, *24*(7), 1123–1132. https://doi.org/10.1177/0956797612470827

Koopmans, T., Geleijnse, J., Zitman, F., & Giltay, E. (2010). Effects of Happiness on All-Cause Mortality During 15 Years of Follow-Up: The Arnhem Elderly Study. *Journal of Happiness Studies*, *11*(1), 113–124. https://doi.org/10.1007/s10902-008-9127-0

Koschwanez, H., Robinson, H., Beban, G., MacCormick, A., Hill, A., Windsor, J., Booth, R., Jüllig, M., & Broadbent, E. (2017). Randomized clinical trial of expressive writing on wound healing following bariatric surgery. *Health Psychology*, *36*(7), 630.

Kotaro Imamura, Yuki Sekiya, Yumi Asai, Maki Umeda, Naoko Horikoshi, Seiji Yasumura, Hirooki Yabe, Tsuyoshi Akiyama, & Norito Kawakami. (2016). The effect of a behavioral activation program on improving mental and physical health complaints associated with radiation stress among mothers in Fukushima: A randomized controlled trial. *BMC Public Health*, *16*(1), 1–9. https://doi.org/10.1186/s12889-016-3819-x

Kubzansky, L. D., Boehm, J. K., & Segerstrom, S. C. (2015). Positive Psychological Functioning and the Biology of Health. *Social & Personality Psychology Compass*, *9*(12), 645–660. https://doi.org/10.1111/spc3.12224

Kushlev, K., Heintzelman, S. J., Lutes, L. D., Wirtz, D., Kanippayoor, J. M., Leitner, D., & Diener, E. (2020). Does Happiness Improve Health? Evidence From a Randomized Controlled Trial. *Psychological Science*, *31*(7), 807–821. https://doi.org/10.1177/0956797620919673

Lai, S. T., & O'Carroll, R. E. (2017). 'The Three Good Things'–The effects of gratitude practice on wellbeing: A randomised controlled trial. *Health Psychology Update*, *26*(1), 10–18.

Lambert D'raven, L. T., Moliver, N., & Thompson, D. (2015). Happiness intervention decreases pain and depression, boosts happiness among primary care patients. *Primary Health Care Research and Development*, *16*(2), 114–126. https://doi.org/10.1017/S146342361300056X

Lambiase, M. J., Kubzansky, L. D., & Thurston, R. C. (2015). Positive psychological health and stroke risk: The benefits of emotional vitality. *Health Psychology*, *34*(10), 1043.

Lamers, S. M. A., Bolier, L., Westerhof, G. J., Smit, F., & Bohlmeijer, E. T. (2012). The impact of emotional well-being on long-term recovery and survival in physical illness: A meta-analysis. *Journal of Behavioral Medicine*, *35*(5), 538–547. https://doi.org/10.1007/s10865-011-9379-8

Larsson, S. C., Lee, W.-H., Kar, S., Burgess, S., & Allara, E. (2021). Assessing the role of cortisol in cancer: A wide-ranged Mendelian randomisation study. *British Journal of Cancer*, *125*(7), 1025–1029.

Lim, K. K., Matchar, D. B., Tan, C. S., Yeo, W., Østbye, T., Howe, T. S., & Koh, J. S. (2020). The association between psychological resilience and physical function among older adults with hip fracture surgery. *Journal of the American Medical Directors Association*, *21*(2), 260–266.

Lindfors, P., & Lundberg, U. (2002). Is low cortisol release an indicator of positive health? *Stress and Health: Journal of the International Society for the Investigation of Stress*, *18*(4), 153–160.

Liu, B., Floud, S., Pirie, K., Green, J., Peto, R., & Beral, V. (2016). Does happiness itself directly affect mortality? The prospective UK Million Women Study. *The Lancet*, *387*(10021), 874–881. https://doi.org/10.1016/S0140-6736(15)01087-9

Lomas, T., Waters, L., Williams, P., Oades, L. G., & Kern, M. L. (2021). Third wave positive psychology: Broadening towards complexity. *The Journal of Positive Psychology*, *16*(5), 660–674.

Lu, Q., Zheng, D., Young, L., Kagawa-Singer, M., & Loh, A. (2012). A pilot study of expressive writing intervention among Chinese-speaking breast cancer survivors. *Health Psychology*, *31*(5), 548–551. https://doi.org/10.1037/a0026834

Luciano, J. V., Guallar, J. A., Aguado, J., López-del-Hoyo, Y., Olivan, B., Magallón, R., Alda, M., Serrano-Blanco, A., Gili, M., & Garcia-Campayo, J. (2014). Effectiveness of group acceptance and commitment therapy for fibromyalgia: A 6-month randomized controlled trial (EFFIGACT study). *PAIN®*, *155*(4), 693–702.

Luppino, F. S., de Wit, L. M., Bouvy, P. F., Stijnen, T., Cuijpers, P., Penninx, B. W., & Zitman, F. G. (2010). Overweight, obesity, and depression: A systematic review and meta-analysis of longitudinal studies. *Archives of General Psychiatry*, *67*(3), 220–229.

Lyubomirsky, S., King, L., & Diener, E. (2005). The benefits of frequent positive affect: Does happiness lead to success? *Psychological Bulletin*, *131*(6), 803.

Lyubomirsky, S., Sheldon, K. M., & Schkade, D. (2005). Pursuing happiness: The architecture of sustainable change. *Review of General Psychology*, *9*(2), 111–131.

Mahoney, A., Li, I., Grierson, A., Millard, M., Haskelberg, H., & Mason, E. (2022). Internet-based cognitive behaviour therapy for insomnia before and during the COVID-19 pandemic. *Australian Psychologist*, *57*(1), 65–76. https://doi.org/10.1080/00050067.2021.1979884

Majumdar, S., & Morris, R. (2019). Brief group-based acceptance and commitment therapy for stroke survivors. *The British Journal of Clinical Psychology*, *58*(1), 70–90. https://doi.org/10.1111/bjc.12198

Mammen, G., & Faulkner, G. (2013). Physical activity and the prevention of depression: A systematic review of prospective studies. *American Journal of Preventive Medicine*, *45*(5), 649–657.

Marciniak, R., Šumec, R., Vyhnálek, M., Bendíčková, K., Lázničková, P., Forte, G., Jeleník, A., Římalová, V., Frič, J., Hort, J., & Sheardová, K. (2020). The effect of mindfulness-based stress reduction (Mbsr) on depression, cognition, and immunity in mild cognitive impairment: A pilot feasibility study. *Clinical Interventions in Aging*, *15*, 1365–1381. Scopus. https://doi.org/10.2147/CIA.S249196

Martínez-Martí, M. L., Avia, M. D., & Hernández-Lloreda, M. J. (2010). The effects of counting blessings on subjective well-being: A gratitude intervention in a Spanish sample. *The Spanish Journal of Psychology*, *13*(2), 886–896.

Martín-María, N., Miret, M., Caballero, F. F., Rico-Uribe, L. A., Steptoe, A., Chatterji, S., & Ayuso-Mateos, J. L. (2017). The Impact of Subjective Well-being on Mortality: A Meta-Analysis of Longitudinal Studies in the General Population. *Psychosomatic Medicine*, *79*(5), 565–575. https://doi.org/10.1097/PSY.0000000000000444

Matos, M., Duarte, C., Duarte, J., Pinto-Gouveia, J., Petrocchi, N., & Gilbert, P. (2022). Cultivating the compassionate self: An exploration of the mechanisms of change in compassionate mind training. *Mindfulness*, *13*(1), 66–79. https://doi.org/10.1007/s12671-021-01717-2

Matvienko-Sikar, K., & Dockray, S. (2017). Effects of a novel positive psychological intervention on prenatal stress and well-being: A pilot randomised controlled trial. *Women and Birth: Journal of the Australian College of Midwives*, *30*(2), e111–e118. https://doi.org/10.1016/j.wombi.2016.10.003

McEwen, B. S., & Seeman, T. (2003). *Stress and affect: Applicability of the concepts of allostasis and allostatic load.*

McGue, M., Osler, M., & Christensen, K. (2010). Causal inference and observational research: The utility of twins. *Perspectives on Psychological Science*, *5*(5), 546–556.

Miller, A. H., & Raison, C. L. (2016). The role of inflammation in depression: From evolutionary imperative to modern treatment target. *Nature Reviews Immunology*, *16*(1), 22–34.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Group*, P. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine*, *151*(4), 264–269.

Moieni, M., Irwin, M. R., Haltom, K. E. B., Jevtic, I., Meyer, M. L., Breen, E. C., Cole, S. W., & Eisenberger, N. I. (2019). Exploring the role of gratitude and support-giving on inflammatory outcomes. *Emotion*, *19*(6), 939.

Monferrer, M., Ricarte, J. J., Montes, M. J., Fernández-Caballero, A., & Fernandez-Sotos, P. (2021). Psychosocial remediation in depressive disorders: A systematic review. *Journal of Affective Disorders*, *290*, 40–51.

Moore, R. C., Chattillion, E. A., Ceglowski, J., Ho, J., von Känel, R., Mills, P. J., Ziegler, M. G., Patterson, T. L., Grant, I., & Mausbach, B. T. (2013). A randomized clinical trial of Behavioral Activation (BA) therapy for improving psychological and physical health in dementia caregivers: Results of the Pleasant Events Program (PEP). *Behaviour Research and Therapy*, *51*(10), 623–632. https://doi.org/10.1016/j.brat.2013.07.005

Mujcic, R., & J. Oswald, A. (2016). Evolution of well-being and happiness after increases in consumption of fruit and vegetables. *American Journal of Public Health*, *106*(8), 1504–1510.

Müller, R., Gertz, K. J., Molton, I. R., Terrill, A. L., Bombardier, C. H., Ehde, D. M., & Jensen, M. P. (2016). Effects of a Tailored Positive Psychology Intervention on Well-Being and Pain in Individuals with Chronic Pain and a Physical Disability. *Clinical Journal of Pain*, *32*(1), 32–44. Scopus. https://doi.org/10.1097/AJP.0000000000000225

Naber, D., & Piekar, D. (1983). The measurement of endorphins in body fluids. *Psychiatric Clinics of North America*, *6*(3), 443–456.

Nabi, H., Kivimaki, M., De Vogli, R., Marmot, M. G., & Singh-Manoux, A. (2008). Positive and negative affect and risk of coronary heart disease: Whitehall II prospective cohort study. *Bmj*, *337*.

Nath, P., & Pradhan, R. K. (2012). Influence of positive affect on physical health and psychological well-being: Examining the mediating role of psychological resilience. *Journal of Health Management*, *14*(2), 161–174.

Nelson-Coffey, S. K., Fritz, M. M., Lyubomirsky, S., & Cole, S. W. (2017). Kindness in the blood: A randomized controlled trial of the gene regulatory impact of prosocial behavior. *Psychoneuroendocrinology*, *81*, 8–13. https://doi.org/10.1016/j.psyneuen.2017.03.025

Nikrahan, G. R., Suarez, L., Asgari, K., Beach, S. R., Celano, C. M., Kalantari, M., Abedi, M. R., Etesampour, A., Abbas, R., & Huffman, J. C. (2016). Positive psychology interventions for patients with heart disease: A preliminary randomized trial. *Psychosomatics: Journal of Consultation and Liaison Psychiatry*, *57*(4), 348–358. https://doi.org/10.1016/j.psym.2016.03.003

Ogedegbe, G. O., Boutin-Foster, C., Wells, M. T., Allegrante, J. P., Isen, A. M., Jobe, J. B., & Charlson, M. E. (2012). A randomized controlled trial of positive-affect intervention and medication adherence in hypertensive African Americans. *Archives of Internal Medicine*, *172*(4), 322–326.

O'Leary, K., O'Neill, S., & Dockray, S. (2016). A systematic review of the effects of mindfulness interventions on cortisol. *Journal of Health Psychology*, *21*(9), 2108–2121. https://doi.org/10.1177/1359105315569095

Olivera-Figueroa, L. A., Juster, R.-P., Morin-Major, J. K., Marin, M.-F., & Lupien, S. J. (2015). A time to be stressed? Time perspectives and cortisol dynamics among healthy adults. *Biological Psychology*, *111*, 90–99.

Ortega, F. B., Lee, D., Sui, X., Kubzansky, L. D., Ruiz, J. R., Baruth, M., Castillo, M. J., & Blair, S. N. (2010). Psychological well-being, cardiorespiratory fitness, and long-term survival. *American Journal of Preventive Medicine*, *39*(5), 440–448.

Ostir, G. V., Markides, K. S., Peek, M. K., & Goodwin, J. S. (2001). The association between emotional well-being and the incidence of stroke in older adults. *Psychosomatic Medicine*, *63*(2), 210–215.

Ouanes, S., & Popp, J. (2019). High cortisol and the risk of dementia and Alzheimer's disease: A review of the literature. *Frontiers in Aging Neuroscience*, *11*, 43.

Pahwa, R., Goyal, A., Bansal, P., & Jialal, I. (2018). *Chronic inflammation*.

Pai, A. L., & McGrady, M. (2014). Systematic review and meta-analysis of psychological interventions to promote treatment adherence in children, adolescents, and young adults with chronic illness. *Journal of Pediatric Psychology*, *39*(8), 918–931.

Papousek, I., & Schulter, G. (2008). Effects of a mood-enhancing intervention on subjective well-being and cardiovascular parameters. *International Journal of Behavioral Medicine*, *15*(4), 293-302. https://doi.org/10.1080/10705500802365508

Parks, A. C., & Boucher, E. M. (2020). Positive Psychological Interventions (PPIs) in the age of COVID-19: On the potential impact of digital PPIs on loneliness. *The Journal of Positive Psychology*, *15*(5), 569–571.

Pedersen, B. K., & Saltin, B. (2015). Exercise as medicine–evidence for prescribing exercise as therapy in 26 different chronic diseases. *Scandinavian Journal of Medicine & Science in Sports*, *25*, 1–72.

Peters, M. L., Smeets, E., Feijge, M., Van Breukelen, G., Andersson, G., Buhrman, M., & Linton, S. J. (2017). Happy Despite Pain: A Randomized Controlled Trial of an 8-Week Internet-delivered Positive Psychology

Intervention for Enhancing Well-being in Patients with Chronic Pain. *Clinical Journal of Pain*, *33*(11), 962–975. Scopus. https://doi.org/10.1097/AJP.0000000000000494

Peterson, J. C., Charlson, M. E., Hoffman, Z., Wells, M. T., Wong, S.-C., Hollenberg, J. P., Jobe, J. B., Boschert, K. A., Isen, A. M., & Allegrante, J. P. (2012). A randomized controlled trial of positive-affect induction to promote physical activity after percutaneous coronary intervention. *Archives of Internal Medicine*, *172*(4), 329–336.

Pressman, S. D., & Cohen, S. (2005). Does positive affect influence health? *Psychological Bulletin*, *131*(6), 925–971. https://doi.org/10.1037/0033-2909.131.6.925

Prinzing, M. M., Zhou, J., West, T. N., Le Nguyen, K. D., Wells, J. L., & Fredrickson, B. L. (2020). Staying 'in sync' with others during COVID-19: Perceived positivity resonance mediates cross-sectional and longitudinal links between trait resilience and mental health. *The Journal of Positive Psychology*, *0*(0), 1–16. https://doi.org/10.1080/17439760.2020.1858336

Public Health England, 2016. (n.d.). *The Eatwell Guide*. GOV.UK. Retrieved 27 April 2022, from https://www.gov.uk/government/publications/the-eatwell-guide

Rasmussen, H. N., Scheier, M. F., & Greenhouse, J. B. (2009). Optimism and physical health: A meta-analytic review. *Annals of Behavioral Medicine*, *37*(3), 239–256.

Rawtaer, I., Gao, Q., Nyunt, M. S. Z., Feng, L., Chong, M. S., Lim, W. S., Lee, T.-S., Yap, P., Yap, K. B., & Ng, T. P. (2017). Psychosocial risk and protective factors and incident mild cognitive impairment and dementia in community dwelling elderly: Findings from the Singapore Longitudinal Ageing Study. *Journal of Alzheimer's Disease*, *57*(2), 603–611.

Redwine, L. S., Henry, B. L., Pung, M. A., Wilson, K., Chinh, K., Knight, B., Jain, S., Rutledge, T., Greenberg, B., & Maisel, A. (2016). Pilot randomized study of a gratitude journaling intervention on heart rate variability and inflammatory biomarkers in patients with stage B heart failure. *Psychosomatic Medicine*, *78*(6), 667–676.

Richman, L. S., Kubzansky, L., Maselko, J., Kawachi, I., Choo, P., & Bauer, M. (2005). Positive Emotion and Health: Going Beyond the Negative. *Health Psychology*, *24*(4), 422–429. https://doi.org/10.1037/0278-6133.24.4.422

Robinson, H., Jarrett, P., Vedhara, K., & Broadbent, E. (2017). The effects of expressive writing before or after punch biopsy on wound healing. *Brain, Behavior, and Immunity*, *61*, 217–227.

Rosenkranz, M., Davidson, R., Maccoon, D., Sheridan, J., Kalin, N., & Lutz, A. (2013). A comparison of mindfulness-based stress reduction and an active control in modulation of neurogenic inflammation. *Brain, Behavior, and Immunity*, *27*(1), 174-184. https://doi.org/10.1016/j.bbi.2012.10.013

Roy, B., Diez-Roux, A. V., Seeman, T., Ranjit, N., Shea, S., & Cushman, M. (2010). The association of optimism and pessimism with inflammation and hemostasis in the Multi-Ethnic Study of Atherosclerosis (MESA). *Psychosomatic Medicine*, *72*(2), 134.

Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology*, *57*(6), 1069–1081. https://doi.org/10.1037/0022-3514.57.6.1069

Ryff, C. D., Dienberg Love, G., Urry, H. L., Muller, D., Rosenkranz, M. A., Friedman, E. M., Davidson, R. J., & Singer, B. (2006). Psychological Well-Being and Ill-Being: Do They Have Distinct or Mirrored Biological Correlates? *Psychotherapy and Psychosomatics*, *75*(2), 85–95. https://doi.org/10.1159/000090892

Ryff, C. D., Singer, B. H., & Dienberg Love, G. (2004). Positive health: Connecting well–being with biology. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, *359*(1449), 1383–1394.

Sadler, M. E., Miller, C. J., Christensen, K., & McGue, M. (2011). Subjective wellbeing and longevity: A co-twin control study. *Twin Research and Human Genetics*, *14*(3), 249–256.

Sadlonova, M., Kermani, M., Huffman, J., Nikrahan, G., Sadeghi, M., & Celano, C. (2022). Feasibility, Acceptability, and Preliminary Efficacy of a Positive Psychology Intervention in Patients with Coronary Heart Disease: A Randomized Controlled Trial. *Journal of the Academy of Consultation-Liaison Psychiatry*. https://doi.org/10.1016/j.jaclp.2022.03.004

Sanada, K., Montero-Marin, J., Alda Diez, M., Salas-Valero, M., Pérez-Yus, M. C., Morillo, H., Demarzo, M. M., Garcia-Toro, M., & Garcia-Campayo, J. (2016). Effects of mindfulness-based interventions on salivary cortisol in healthy adults: A meta-analytical review. *Frontiers in Physiology*, *7*, 471.

Sanders, C., Burke, J., & Muzyk, A. (2022). Contributing to a healthier world: Exploring the impact of wellbeing on nursing burnout. *Journal of Happiness and Health, 2*(2), 70–86. https://doi.org/10.47602/johah.v2i2.14

Sato, D., Yoshinaga, N., Nagai, E., Nagai, K., & Shimizu, E. (2019). Effectiveness of internet-delivered computerized cognitive behavioral therapy for patients with insomnia who remain symptomatic following pharmacotherapy: Randomized controlled exploratory trial. *Journal of Medical Internet Research*, *21*(4), e12686.

Schakel, L., Veldhuijzen, D. S., van Middendorp, H., Prins, C., Drittij, A. M. H. F., Vrieling, F., Visser, L. G., Ottenhoff, T. H. M., Joosten, S. A., & Evers, A. W. M. (2020). An Internet-Based Psychological Intervention with a Serious Game to Improve Vitality, Psychological and Physical Condition, and Immune Function in Healthy Male Adults: Randomized Controlled Trial. *Journal of Medical Internet Research*, *22*(7), e14861. https://doi.org/10.2196/14861

Scheier, M. F., & Carver, C. S. (1985). Optimism, coping, and health: Assessment and implications of generalized outcome expectancies. *Health Psychology*, *4*(3), 219.

Schenk, H. M., Jeronimus, B. F., van der Krieke, L., Bos, E. H., de Jonge, P., & Rosmalen, J. G. (2018). Associations of positive affect and negative affect with allostatic load: A lifelines cohort study. *Psychosomatic Medicine*, *80*(2), 160–166.

Schnitker, S. A., & Richardson, K. L. (2019). Framing gratitude journaling as prayer amplifies its hedonic and eudaimonic well-being, but not health, benefits. *The Journal of Positive Psychology*, *14*(4), 427–439.

Schuch, F. B., Vancampfort, D., Firth, J., Rosenbaum, S., Ward, P. B., Silva, E. S., Hallgren, M., Ponce De Leon, A., Dunn, A. L., & Deslandes, A. C. (2018). Physical activity and incident depression: A meta-analysis of prospective cohort studies. *American Journal of Psychiatry*, *175*(7), 631–648.

Seligman, M. E. (2002). Positive psychology, positive prevention, and positive therapy. *Handbook of Positive Psychology*, *2*(2002), 3–12.

Seligman, M. E. P. (2008). Positive health. *Applied Psychology: An International Review*, *57*(Suppl 1), 3–18. https://doi.org/10.1111/j.1464-0597.2008.00351.x

Shaw, B. R., Hawkins, R., McTavish, F., Pingree, S., & Gustafson, D. H. (2006). Effects of Insightful Disclosure Within Computer Mediated Support Groups on Women With Breast Cancer. *Health Communication*, *19*(2), 133–142. https://doi.org/10.1207/s15327027hc1902_5

Sin, N. L., Graham-Engeland, J. E., & Almeida, D. M. (2015). Daily positive events and inflammation: Findings from the National Study of Daily Experiences. *Brain, Behavior, and Immunity*, *43*, 130–138.

Sin, N. L., & Lyubomirsky, S. (2009). Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: A practice-friendly meta-analysis. *Journal of Clinical Psychology*, *65*(5), 467–487. https://doi.org/10.1002/jclp.20593

Slatcher, R. B., & Selcuk, E. (2017). A social psychological perspective on the links between close relationships and health. *Current Directions in Psychological Science*, *26*(1), 16–21.

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339.

Southwell, S., & Gould, E. (2017). A randomised wait list-controlled pre–post–follow-up trial of a gratitude diary with a distressed sample. *The Journal of Positive Psychology*, *12*(6), 579–593.

Srivastava, S., McGonigal, K. M., Richards, J. M., Butler, E. A., & Gross, J. J. (2006). Optimism in close relationships: How seeing things in a positive light makes them so. *Journal of Personality and Social Psychology*, *91*(1), 143.

Stadler, G., Snyder, K. A., Horn, A. B., Shrout, P. E., & Bolger, N. P. (2012). Close relationships and health in daily life: A review and empirical data on intimacy and somatic symptoms. *Psychosomatic Medicine*, *74*(4), 398–409.

Steffen, P. R., Foxx, J., Cattani, K., Alldredge, C., Austin, T., & Burlingame, G. M. (2021). Impact of a 12-week group-based compassion focused therapy intervention on heart rate variability. *Applied Psychophysiology and Biofeedback*, *46*(1), 61–68.

Steptoe, A. (2019a). Happiness and Health. *Annual Review of Public Health*, *40*, 339–359.

Steptoe, A. (2019b). Investing in happiness: The gerontological perspective. *Gerontology*, *65*(6), 634–639.

Steptoe, A., Deaton, A., & Stone, A. A. (2015). Subjective wellbeing, health, and ageing. *The Lancet*, *385*(9968), 640–648.

Steptoe, A., Demakakos, P., de Oliveira, C., & Wardle, J. (2012). Distinctive biological correlates of positive psychological well-being in older men and women. *Psychosomatic Medicine*, *74*(5), 501–508.

Steptoe, A., & Fancourt, D. (2019). Leading a meaningful life at older ages and its relationship with social engagement, prosperity, health, biology, and time use. *Proceedings of the National Academy of Sciences of the United States of America*, *116*(4), 1207–1212. https://doi.org/10.1073/pnas.1814723116

Steptoe, A., O'Donnell, K., Badrick, E., Kumari, M., & Marmot, M. (2008). Neuroendocrine and inflammatory factors associated with positive affect in healthy men and women: The Whitehall II study. *American Journal of Epidemiology*, *167*(1), 96–102.

Steptoe, A., Wardle, J., & Marmot, M. (2005). Positive affect and health-related neuroendocrine, cardiovascular, and inflammatory processes. *Proceedings of the National Academy of Sciences*, *102*(18), 6508–6512.

Sterne, J. A. C., Savović, J., Page, M. J., Elbers, R. G., Blencowe, N. S., Boutron, I., Cates, C. J., Cheng, H.-Y., Corbett, M. S., Eldridge, S. M., Emberson, J. R., Hernán, M. A., Hopewell, S., Hróbjartsson, A., Junqueira, D. R., Jüni, P., Kirkham, J. J., Lasserson, T., Li, T., … Higgins, J. P. T. (2019). RoB 2: A revised tool for assessing risk of bias in randomised trials. *BMJ*, *366*, l4898. https://doi.org/10.1136/bmj.l4898

Sterne, J. A., Hernán, M. A., Reeves, B. C., Savović, J., Berkman, N. D., Viswanathan, M., Henry, D., Altman, D. G., Ansari, M. T., Boutron, I., Carpenter, J. R., Chan, A.-W., Churchill, R., Deeks, J. J., Hróbjartsson, A., Kirkham, J., Jüni, P., Loke, Y. K., Pigott, T. D., … Higgins, J. P. (2016). ROBINS-I: A tool for assessing risk of bias in non-randomised studies of interventions. *BMJ*, *355*, i4919. https://doi.org/10.1136/bmj.i4919

Suh, S., Cho, N., Jeoung, S., & An, H. (2021). Developing a Psychological Intervention for Decreasing Bedtime Procrastination: The BED-PRO Study. *Behavioral Sleep Medicine*, 1–15.

Surtees, P. G., Wainwright, N. W., Luben, R., Wareham, N. J., Bingham, S. A., & Khaw, K.-T. (2010). Mastery is associated with cardiovascular disease mortality in men and women at apparently low risk. *Health Psychology*, *29*(4), 412.

Tamvakopoulos, C. (2007). Mass spectrometry for the quantification of bioactive peptides in biological fluids. *Mass Spectrometry Reviews*, *26*(3), 389–402.

Taylor, S. E., & Sherman, D. K. (2004). Positive psychology and health psychology: A fruitful liaison. *Positive Psychology in Practice*, 305–319.

van Agteren, J., Iasiello, M., Lo, L., Bartholomaeus, J., Kopsaftis, Z., Carey, M., & Kyrios, M. (2021). A systematic review and meta-analysis of psychological interventions to improve mental wellbeing. *Nature Human Behaviour*, *5*(5), 631–652.

van Beugen, S., Ferwerda, M., Spillekom-van Koulil, S., Smit, J. V., Zeeuwen-Franssen, M. E., Kroft, E. B., de Jong, E. M., Otero, M. E., Donders, A. R. T., & van de Kerkhof, P. C. (2016). Tailored therapist-guided internet-based cognitive behavioral treatment for psoriasis: A randomized controlled trial. *Psychotherapy and Psychosomatics*, *85*(5), 297–307.

Van Der Ven, N. C. W., Hogenelst, M. H. E., Tromp-Wever, A. M. E., Twisk, J. W. R., Van Der Ploeg, H. M., Heine, R. J., & Snoek, F. J. (2005). Short-term effects of cognitive behavioural group training (CBGT) in adult Type 1 diabetes patients in prolonged poor glycaemic control. A randomized controlled trial. *Diabetic Medicine*, *22*(11), 1619–1623. Scopus. https://doi.org/10.1111/j.1464-5491.2005.01691.x

Veenhoven, R. (2008). Healthy happiness: Effects of happiness on physical health and the consequences for preventive health care. *Journal of Happiness Studies*, *9*(3), 449–469. https://doi.org/10.1007/s10902-006-9042-1

Veenhoven, R. (2021). Will Healthy Eating Make You Happier? A Research Synthesis Using an Online Findings Archive. *Applied Research in Quality of Life*, *16*(1), 221–240. https://doi.org/10.1007/s11482-019-09748-7

von Känel, R., Mills, P. J., Dimsdale, J. E., Ziegler, M. G., Allison, M. A., Patterson, T. L., Ancoli-Israel, S., Pruitt, C., Grant, I., & Mausbach, B. T. (2020). Effects of psychosocial interventions and caregiving stress on cardiovascular biomarkers in family dementia caregivers: The UCSD Pleasant Events Program (PEP)

randomized controlled trial. *The Journals of Gerontology: Series A: Biological Sciences and Medical Sciences*, *75*(11), 2215–2223. https://doi.org/10.1093/gerona/glaa079

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063.

Wells, J. L., Haase, C. M., Rothwell, E. S., Naugle, K. G., Otero, M. C., Brown, C. L., Lai, J., Chen, K.-H., Connelly, D. E., & Grimm, K. J. (2022). Positivity resonance in long-term married couples: Multimodal characteristics and consequences for health and longevity. *Journal of Personality and Social Psychology*.

West, T. N., Le Nguyen, K., Zhou, J., Prinzing, M. M., Wells, J. L., & Fredrickson, B. L. (2021). How the Affective Quality of Social Connections May Contribute to Public Health: Prosocial Tendencies Account for the Links Between Positivity Resonance and Behaviors that Reduce the Spread of COVID-19. *Affective Science*, *2*(3), 241–261. https://doi.org/10.1007/s42761-021-00035-z

White, C. A., Uttl, B., & Holder, M. D. (2019). Meta-analyses of positive psychology interventions: The effects are much smaller than previously reported. *PloS One*, *14*(5), e0216588.

White, R. L., Babic, M. J., Parker, P. D., Lubans, D. R., Astell-Burt, T., & Lonsdale, C. (2017). Domain-specific physical activity and mental health: A meta-analysis. *American Journal of Preventive Medicine*, *52*(5), 653–666.

Wicksell, R. K., Kemani, M., Jensen, K., Kosek, E., Kadetoff, D., Sorjonen, K., Ingvar, M., & Olsson, G. L. (2013). Acceptance and commitment therapy for fibromyalgia: A randomized controlled trial. *European Journal of Pain*, *17*(4), 599–611.

Wiest, M., Schüz, B., Webster, N., & Wurm, S. (2011). Subjective well-being and mortality revisited: Differential effects of cognitive and emotional facets of well-being on mortality. *Health Psychology*, *30*(6), 728.

Wilson, R. S., Boyle, P. A., Segawa, E., Yu, L., Begeny, C. T., Anagnos, S. E., & Bennett, D. A. (2013). The influence of cognitive decline on well-being in old age. *Psychology and Aging*, *28*(2), 304.

Wiltink, J., Dippel, A., Szczepanski, M., Thiede, R., Alt, C., & Beutel, M. E. (2007). Long-term weight loss maintenance after inpatient psychotherapy of severely obese patients based on a randomized study: Predictors and maintaining factors of health behavior. *Journal of Psychosomatic Research*, *62*(6), 691–698. https://doi.org/10.1016/j.jpsychores.2006.12.014

Wolfe, W. L., & Patterson, K. (2017). Comparison of a gratitude-based and cognitive restructuring intervention for body dissatisfaction and dysfunctional eating behavior in college women. *Eating Disorders*, *25*(4), 330–344.

World Health Organization. (2009). *Constitution of the World Health Organization.* Geneva: World Health Organization.

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica*, *67*(6), 361–370.

Zilioli, S., Slatcher, R. B., Ong, A. D., & Gruenewald, T. L. (2015). Purpose in life predicts allostatic load ten years later. *Journal of Psychosomatic Research*, *79*(5), 451–457.

Zyl, L. E. van, Schotanus-Dijkstra, M., Llorens, S., Klibert, J., Heuvel, M. van den, & Mayer, C.-H. (2021). Positive Psychological Interventions beyond WEIRD contexts: How, when, and why they work. *Frontiers in Psychology*. https://research.utwente.nl/en/publications/positive-psychological-interventions-beyond-weird-contexts-how-wh

Appendix A: Search strategy across databases

Database	Keyword combinations	Search notes
EBSCO	(DE "Happiness") OR (DE "Well Being" OR DE "Subjective Well Being") Psych* health OR "Psychological well*being" OR "Life satisfaction" OR Flourishing OR "Positive affect") AND (Health OR "phy* health" OR "phy* fitness" OR Longevity OR "Phys* function*" OR "Biological health" OR Mortality OR Morbidity OR Disease OR "Disease risk" OR "Health status" OR "Self*report health") AND ("Positive psych* intervention*" OR PPI* OR "Psych* intervention*" OR "Behaviour* intervention*" OR "Cognitive activit*" OR "Positive psych* activit*" OR "Psych* activit*" OR "Cognitive tool*")	Limited to Jan 1998 to June 2022, peer reviewed publications and terms within abstract. Also filtered by Methodology: treatment outcome; followup study; longitudinal study; clinical trial; quantitative study; empirical study
SCOPUS	(Happiness OR Well*being OR "Psych* health" OR "Psychological well*being" OR "Subjective well*being" OR "Life satisfaction" OR Flourishing OR "Positive affect") AND (Health OR "phy* health" OR "phy* fitness" OR Longevity OR "Phys* function*" OR "Biological health" OR Mortality OR Morbidity OR Disease OR "Disease risk" OR "Health status" OR "Self*report health") AND ("Positive psych* intervention*" OR PPI* OR "Psych* intervention*" OR "Behaviour* intervention*" OR "Cognitive activit*" OR "Positive psych* activit*" OR "Psych* activit*" OR "Cognitive tool*")	Limited to Jan 1998 to June 2022, research articles and terms within keywords
ScienceDirect	(Happiness OR psychology OR "Psychological wellbeing" OR "Subjective wellbeing" OR "Positive affect") AND ("Physical Health" OR Longevity)	Limited to Jan 1998 to June 2022, research articles and terms within keywords, title and abstract
The Cochrane Library	(Happiness OR Well*being OR "Psych* health" OR "Psychological well*being" OR "Subjective well*being" OR "Life satisfaction" OR Flourishing OR "Positive affect") AND (Health OR "phy* health" OR "phy* fitness" OR Longevity OR "Phys* function*" OR "Biological health" OR Mortality OR Morbidity OR Disease OR "Disease risk" OR "Health status" OR "Self*report health") AND ("Positive psych* intervention*" OR PPI* OR "Psych* intervention*" OR "Behaviour* intervention*" OR "Cognitive activit*" OR "Positive psych* activit*" OR "Psych* activit*" OR "Cognitive tool*")	Limited to Jan 1998 to June 2022, research articles and terms within keywords, title and abstract
PubMed	(Happiness OR Wellbeing OR "Psychological health" OR "Psychological wellbeing" OR "Subjective wellbeing" OR "Life satisfaction" OR Flourishing OR "Positive affect") AND ("physical health" OR Longevity OR "Biological health" OR Mortality OR Morbidity OR "Health status" OR "Self-report health") AND ("Positive psychology intervention" OR PPI OR "Psychological intervention" OR "Cognitive tool")	Limited to Jan 1998 to June 2022, clinical or controlled trials, MeSH Major Topic
JSTOR	(Happiness OR Well*being OR "Psych* health" OR "Psychological well*being" OR "Subjective well*being" OR "Positive affect") AND (Health OR "phy* health" OR Longevity OR Mortality OR Morbidity OR "Self*report health")	Limited to Jan 1998 to June 2022, terms within abstract, health sciences or psychology journals

Appendix B: Completed PRISMA checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	p. 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	p. 1-2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	p. 4-14
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	p. 15
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	p. 17-19
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	p. 16-18
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Appendix A
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	p. 17-19
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	p. 17-19
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	p. 17-19
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	p. 17-19
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	p. 19
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	p. 19-54
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	p. 18
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	p. 18-19
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	p. 18-19
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	N/A
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	p. 19
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Figure 1

Section and Topic	Item #	Checklist item	Location where item is reported
Study characteristics	17	Cite each included study and present its characteristics.	p. 20-54
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	p. 43
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	p. 19-54
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	p. 43
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	p. 55-62
	23b	Discuss any limitations of the evidence included in the review.	p. 62-63
	23c	Discuss any limitations of the review processes used.	p. 63
	23d	Discuss implications of the results for practice, policy, and future research.	p. 63-64
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Supporting documents to submission
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Protocol not submitted
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Supporting documents to submission
Competing interests	26	Declare any competing interests of review authors.	Not yet completed
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	N/A