



What works to improve life satisfaction in intervention and observational research: a technical report of two systematic rapid reviews

Commissioned by the What Works Centre for Wellbeing

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Executive Summary

This technical report, conducted by Kohlrabi and commissioned by the What Works Centre for Wellbeing, presents findings from two distinct yet complementary rapid reviews. The first rapid review focuses on interventions aimed at improving life satisfaction, while the second review examines observational evidence regarding the long-term determinants of life satisfaction. This report supports policymakers and commissioners by enhancing their understanding of the determinants of life satisfaction and identifying additional studies with effect sizes that can be translated for use in policy. The two rapid reviews were conducted in parallel, with complementary inclusion/exclusion criteria, search strategies, extraction and synthesis, and critical appraisal. Where possible, best practices for conducting systematic reviews from the Cochrane Collaboration were followed.

Inclusion Criteria

Review 1: Intervention aimed at improving life satisfaction in the general population; must include control group comparator; intervention delivered in high-income OECD country; study design includes randomised control trials or quasi-experimental studies; published between Jan 2011 and Oct 2023; English language; measures life satisfaction with a validated outcome measure.

Review 2: Observational cohort study examining longitudinal associations between factor of interest and life satisfaction; study based in the United Kingdom; non-modifiable factors such as age, sex, personality were not eligible; published between Jan 2011 and Oct 2023; English language; measures life satisfaction with a validated outcome measure.

Key Findings

In the intervention review, a total of 189 studies with 234 intervention arms delivered in high-income OECD countries met criteria for inclusion. In the observational review, a total of 49 studies using data from 1 or more of eight UK-based longitudinal cohort studies were included. In each review, six main themes were identified, most of which had several subthemes.

Intervention review

- The six themes (18 subthemes total) identified were: Emotion-based activities (intrapersonal and interpersonal, n=154); Didactic emotional development (n=30); Health promotion (n=31); Social media (n=4); Music (n=3); and Multi-component interventions (n=12).
- Meta-analyses were possible in six themes and examined overall standardised mean differences (SMD), indicating the difference in change in life satisfaction from pre to post intervention between the intervention group and control group.
- In the intrapersonal (e.g. related to self) emotion-based activities theme:

- Meta-analyses revealed **small significant** effects of **mindfulness** (SMD: 0.28 (95% Confidence Interval: 0.13, 0.42), **gratitude** (0.19 (0.11, 0.27) and **therapy** (0.33 (0.12, 0.53) interventions on life satisfaction and a non-significant effect of **meditation** interventions on life satisfaction (SMD: 0.33 (-0.10, 0.76)).
- Narrative synthesis found no evidence that **visualisation** or **reflection**-based exercise improved life satisfaction.
- Narrative synthesis indicated there was mixed evidence on the effectiveness of **positivity**-based interventions and the remaining interventions classified as **'other'** (i.e., some interventions were effective and others were not) and no summary conclusions could be drawn.
- In the interpersonal (e.g. relating to others) emotion-based activities theme, there was mixed evidence on the effectiveness of **prosocial** interventions, with no evidence that **social** interventions improved life satisfaction.
- In the didactic emotional development theme:
 - Meta-analyses revealed a **moderate effect** of **emotional skills development** training on life satisfaction (SMD 0.50 (0.12, 0.88)).
 - There was mixed evidence on the effectiveness of **emotional regulation** and **resilience**-based interventions.
- In the health promotion subtheme, there was **a small to moderate** effect of **exercise** (SMD: 0.33 (0.04, 0.62)) on life satisfaction and mixed evidence of the effectiveness of **health promotion education** interventions.
- There was insufficient evidence across both the **social media** and **music** themes (each contained ≤4 interventions).
- There was mixed evidence on the effectiveness of **multicomponent interventions**.

Observational review

- The six themes (10 subthemes) identified were: Economic and financial situations (n=12); Education and employment (n=14); Social capital (n=13); Health and wellness (n=11); Environment (n=5); and Arts and culture (n=5). Note some studies included factors that appear across multiple themes.
- Among economic and financial factors, **income changes** were found to be the most positive determinant of higher life satisfaction, although the strength of this association was moderated by age, education, and gender.
- Among employment factors, **unemployment** was found to have consistent and long-lasting negative associations with low life satisfaction.
- Among education factors, it was found that obtaining **educational qualifications** had a strong positive effect on life satisfaction, although the strength of this association was moderated and varied by generation, gender, and age.
- **Participation** in neighbourhood communities and in political and non-political associations showed weak evidence of longitudinal association with life satisfaction.

- All social support factors related to **close relationships and support networks**, including cohabitation, marriage, childbirth, informal caregiving, and network formation, were positively associated with life satisfaction.
- Among health factors, **declining physical health and disability acquisition** were identified as strong determinants of low life satisfaction.
- A strong positive association was found **between engagement and participation in arts and culture activities** (e.g., music, arts, and culture classes; visiting galleries and museums) and life satisfaction.
- The evidence regarding **environmental factors** was mixed due to an insufficient number of studies exploring each factor.

Discussion and Implications

The two rapid reviews offer complementary and comprehensive insight into factors associated with life satisfaction. The intervention review primarily identified intrapersonal emotional activities, which were generally associated with improvements in life satisfaction although effect sizes were small. The observational review identified broader determinants of life satisfaction including socioeconomic circumstances, social capital and health factors. Together, the reviews identify key targets for improving life satisfaction as well as areas for further research. Addressing overall socioeconomic and health factors at a population-level could complement individual-centric interventions aimed specifically at improving life satisfaction.

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1. Introduction

Life satisfaction, a fundamental component of subjective wellbeing, is increasingly recognised as a crucial indicator of overall quality of life and societal welfare (OECD, 2019). Defined as “a person’s cognitive and affective evaluations of his or her life” (Diener et al., 2002), life satisfaction encompasses a holistic view that reflects one’s perceptions, opinions, and evaluations of their circumstances. Within the United Kingdom, life satisfaction has garnered particular attention, with the Office for National Statistics (ONS) incorporating it into the Measuring National Well-being Programme, reflecting a broader societal shift towards prioritising holistic measures of wellbeing beyond traditional economic or health indicators (Tinkler & Hicks, 2011).

The existing literature on life satisfaction primarily revolves around understanding the drivers of life satisfaction, developing valid and comprehensive measures of life satisfaction, investigating how one’s life satisfaction shapes their future outcomes, and exploring interventions to improve life satisfaction. Yet, despite its significance, gaps persist in understanding both the effectiveness of existing interventions and policies which may have positive influences on life satisfaction or the wider determinants. To address these gaps, this technical report presents findings from two distinct but complementary systematic rapid reviews: one focusing on interventions aimed at improving life satisfaction across the life course, and the other examining observational evidence regarding the long-term determinants of life satisfaction.

In the first review, the effectiveness of interventions in improving life satisfaction is assessed. Through a systematic search of available evidence in high-income OECD countries, this review seeks to identify what works to improve life satisfaction at the individual-level. Consequently, it identifies promising individual-level approaches that can improve life satisfaction and, importantly, highlights key gaps in current understanding.

The second review explores the observational evidence, utilising large UK-based cohort study data to examine associations between diverse factors of interest and subsequent life

satisfaction. Here, the review aims to identify individual, societal and structural determinants that policymakers can leverage to enhance the overall wellbeing and life satisfaction of the general UK population.

Together, these reviews offer a comprehensive understanding of the current landscape of life satisfaction research, highlighting areas of strength, gaps in knowledge, and avenues for future exploration. By synthesising existing literature, these reviews aim to provide valuable insights for policymakers, researchers, and practitioners alike. Specifically, the review questions are:

- I. What is the effectiveness of interventions aimed at improving life satisfaction across the life-course?
- II. What are the long-term determinants of life satisfaction?

2. Methods

2.1 Overview

The reviews presented in this report were conducted separately; tailored to their respective research question and study designs, each review had different search strategies, eligibility criteria, data extraction templates, and approaches to synthesis. Despite these differences, efforts were made to maintain consistent methodologies, definitions, and contexts where possible. Therefore, the overall methodology of both reviews is described below, with differences between reviews highlighted where appropriate. Conversely, the results sections will focus on review 1 (section 3) and review 2 (section 4) sequentially, due to different review questions and resulting evidence.

Both reviews adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009); see Appendix A for PRISMA checklists. Study protocols were registered with PROSPERO (Review 1: CRD42023475384; Review 2: CRD42023475394). This registration ensures clarity and accountability in the review process, aligning, where possible, with best practices in conduct of systematic reviews. Below, the methodology of both review processes are described; this includes defining a

rapid review (2.2), eligibility criteria (2.3), search strategy (2.4), study selection (2.5), data extraction and critical appraisal (2.6), and synthesis (2.7).

2.2 Rapid reviews

In evidence-based practice, systematic reviews are placed at the peak of the hierarchy of evidence pyramid, providing the most rigorous evidence due to the strength and precision of findings (Hoffman et al., 2013). However, systematic reviews require substantial resources – time, cost, and capacity – which has led to increasing use of rapid review methodology as an alternative approach (Garritty et al., 2021). Rapid reviews are defined as “literature reviews that use methods to accelerate or streamline traditional systematic review processes to meet the needs and timelines of the end-users (e.g. government policymakers, health care institutions, health professionals, and patient associations)”. There are a wide range of systematic processes and methodologies to publish rapid reviews, with no single gold standard guidelines (Hartling et al., 2017; Gannann et al., 2010; Tricco et al., 2015). The sections below outline the systematic processes conducted in these two rapid reviews, which are more consistent with approaches utilised in a rigorous systematic review than other rapid reviews (as compared by Khangura et al., 2012). These rigorous processes include a priori registration of protocols, comprehensive terminology for search strategies, use of five academic databases, grey literature search, critical appraisal of all included articles using established QA tools, and use of meta-analyses. Any modifications to the systematic review process for these rapid reviews are described in each section below.

2.3 Eligibility criteria

Studies from peer-reviewed journals and grey literature sources were eligible for inclusion if they met the PICO (Population, Intervention, Control, and Outcome) criteria described below in Table 1. Both reviews shared several common eligibility criteria including: population (i.e. general population, no age restrictions, no clinical groups (e.g. excluding study samples selected on the basis of clinical diagnoses such as asthma, bipolar disorder, etc.)), outcome (i.e. measurement of life satisfaction using a standardised or validated

scale), language (English only), and publication date (between January 1st, 2011 and date of search: October 2023). Differences were related to study design, intervention/exposure, and geographical scope. The intervention review was restricted to randomised controlled trials and quasi-experimental studies, which necessitated the inclusion of interventions that aimed to improve life satisfaction (e.g. defined as a stated primary aim of intervention or one of three or fewer secondary aims; Blodgett et al. [*under review*]), measurement of life satisfaction pre and post intervention, and a control group. The observational review was restricted to observational study designs where the life satisfaction outcome was measured at a subsequent temporal point to the baseline modifiable exposure of interest. To manage scope of both reviews and ensure findings were applicable to policy priorities within the UK, the intervention review was restricted to countries from high-income OECD countries only, whereas the observational review was restricted to UK-based samples only. Across both reviews, interventions or factors specifically related to Covid-19 contexts (e.g. interventions during lockdowns, factors not applicable to non-Covid-19 contexts) were excluded; a list of these records is available on the What Works Centre for Wellbeing website.

Table 1. Inclusion criteria for the intervention and observational reviews, outlining key similarities and differences

Criteria	Intervention review	Observational review
Population	<i>General population (no age restrictions)</i>	
Intervention /exposure	Intervention aimed to improve life satisfaction	Modifiable factor
Control/ comparator	Must include a control group (i.e., ‘no intervention’) and a historical time-based comparator (pre-post assessment of life satisfaction)	Not applicable
Outcome	<i>Life satisfaction measured with a valid quantitative measure (e.g. Satisfaction with Life Scale, ONS wellbeing scale, other single-item question)</i>	
Study Design	Randomised controlled trials or quasi-experimental studies	Observational studies
Language	<i>English</i>	
Timeframe	<i>January 1st, 2011 to present</i>	
Geographical Scope	High-income OECD countries	United Kingdom
Other Criteria	<i>Must provide sufficient detail to appraise the quality of the included study (e.g. conference abstracts and presentation slides were excluded)</i>	

2.4 Search strategy

In October 2023, eligible studies for both reviews were identified by searching five academic databases and seven grey literature searches (restricted to 2011 to present). Academic databases included: OVID MEDLINE, OVID PsycINFO, Web of Science (Social Sciences Citation Index collection), Social Policy & Practice, and British Education Index. Grey literature sources included: Google Scholar, Google Advanced Search, Social Science Research Network, King's Fund Library, the Health Foundation, Mental Health Foundation and Gov.uk.

Separate search terms were used for each review, although both utilised key words as well as MeSH terms/mapped subject headings and had two distinct arms combined with the Boolean operator 'AND'; the first arm covered "life satisfaction" and the second arm covered study type. For both reviews, 'life adj2 satisfaction' was the sole term used for the first arm, while the second component consisted of study-specific terms combined with the Boolean operator 'OR'. In review 1, terms related to the study design included evaluation, intervention program and randomised control trial. In review 2, terms related to study design were identified (Li et al., 2019) and included epidemiology, cohort, follow-up, longitudinal, prospective and panel study. Slight modifications were made by database to make use of subject or mapped terms (e.g., MeSH; Medical Subject Headings in Medline). Box 1 provides an example of each search strategy within a single database.

Box 1. Examples of search strategies conducted for Review 1 in Ovid PsychINFO and Review 2 in Ovid Medline

Review 1

1. life adj2 satisfaction
2. evaluation*
3. intervention*
4. “randomi\$ed control”*
5. Evaluation Study as Topic
6. Randomized Controlled Trials as Topic
7. 2 OR 3 OR 4 OR 5 OR 6
8. 1 AND 7
9. limit 8 to yr=“2011-Current”

Review 2

1. life adj2 satisfaction
2. Epidemiologic Studies/ [MeSH term] OR
3. exp Cohort Studies/ [MeSH term] OR
4. epidemiologic adj (study or studies) OR
5. cohort adj (study or studies) OR
6. cohort analy\$ OR
7. follow up adj (study or studies) OR
8. longitudinal OR
9. prospective\$ OR
10. observ\$ adj3 (study or studies) OR
11. panel adj3 (study or studies)
12. 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11
13. 1 AND 12

Key:

*adj: adjacent to adj2 = <2 words between them
(e.g. life satisfaction, satisfaction with life)*
** truncation: replaces 1+ letters, always placed at end
(e.g. observe, observation, observational, etc.)*
*\$ wildcard: replaces 1 letter
(e.g., randomized, randomised)*

2.5 Study selection

Screening for eligible studies followed parallel processes for each review. First, results from the five academic databases were combined, deduplicated, and managed using Endnote v20, a reference software, and Rayyan, a web-based systematic review tool (Ouzzani et al., 2016). Next, the review team piloted the title-abstract screening phase by independently reviewing 50 title-abstracts against the inclusion and exclusion criteria and discussing any differences in decisions made. Subsequently, two reviewers independently (i.e., blinded to the other’s decision) screened 20% of all title-abstracts of records; any conflicts were resolved through discussion with a third reviewer to reach a final consensus decision. Following this, a single member of the review team screened the remaining 80% of records (i.e. non-independent).

The same approach was employed for the second stage of screening, which involved assessing the full text of studies that had passed the title-abstract stage; the full review team

piloted 15 full-text records, two reviewers independently screened 20% of the full-text articles and all conflicts were resolved through discussion with a third reviewer. Although a single reviewer then screened the remaining 80% of full-text articles, an additional step involved a second reviewer confirming all full text decisions to ensure that no evidence was missed or inadvertently included. During full-text screening, exclusion decisions were recorded following a hierarchical list of reasons.

For the intervention review, exclusion reasons were recorded hierarchically as follows:

- i. Non-English language;
- ii. Inappropriate record type (e.g. conference article, media article) or wrong study design;
- iii. Did not measure life satisfaction with a validated or standardised measure;
- iv. No control group;
- v. Life satisfaction not measured pre- and post-intervention;
- vi. Intervention delivered in a non-high-income OECD country;
- vii. Clinical sample;
- viii. Covid-19-related (e.g. intervention only relevant to Covid-19 context such as lockdown);
- ix. Intervention did not directly aim to improve life satisfaction.

For the observational review, exclusion reasons were recorded hierarchically as follows:

- i. Non-English language;
- ii. Inappropriate record type (e.g. conference article, media article) or wrong study design;
- iii. Did not measure life satisfaction with a validated or standardised measure;
- iv. No longitudinal study design;
- v. Not conducted in a high-income OECD country;
- vi. Clinical sample;
- vii. Life satisfaction not assessed as an outcome;
- viii. Covid-19-related;
- ix. Not conducted in the United Kingdom;
- x. Non-modifiable factor. (e.g., sex, age, personality, views of the world)

The above steps for title-abstract and full-text stages were repeated for the grey literature search.

2.6 Data extraction and critical appraisal

For both reviews, a single reviewer independently extracted data from all included studies, while a second reviewer conducted a quality assurance check by confirming the extracted data against the original record for a minimum of 20% of included studies. Any discrepancies were resolved by a third reviewer. The following data were extracted for the intervention review:

- publication year;
- evidence type (e.g. academic paper, report, etc.);
- characteristics of study sample (description including specific sex, ethnicity or health characteristics, age mean \pm standard deviation (SD), and range, country where intervention was delivered);
- study design (randomisation, method of allocation);
- intervention details (description including frequency, length and context of intervention and duration of follow-up, preliminary mapping of intervention theme);
- life satisfaction data (scale used, and the sample size, mean \pm SD pre- and post-intervention for intervention and control groups);
- details on whether economic evaluation or subgroup analyses were conducted (both outside of scope of this review);
- critical appraisal checklist.

The following data were extracted for review 2 on observational studies:

- publication year;
- evidence type (e.g. academic paper, report, etc.);
- characteristics of study sample (description, age mean \pm SD and range, country and, if applicable, the name of panel or cohort study);
- details on factor of interest (level of determinant [macro, meso, micro], description of ascertainment, preliminary mapping of factor theme);
- life satisfaction data (scale used, mean \pm SD at final follow-up, summary of core findings);
- details on whether subgroup analyses were conducted;
- critical appraisal checklist.

Three different critical appraisal checklists, each developed by the Joanna Briggs Institute (JBI) were utilised across the two reviews. In review 1 (intervention review), the JBI Randomised Control Trial (RCT) Critical Appraisal Checklist (Varker et al., 2023) and or the

JBI Quasi-experimental Critical Appraisal Checklist (Joanna Briggs Institute, 2020) were used depending on the study design. The RCT checklist assesses thirteen elements across five themes:

1. selection (whether true randomisation was used, allocation to treatment groups was blind, and treatment groups were similar at baseline);
2. administration (whether participants were blind to treatment assignment, those delivering the intervention were blind to treatment assignment, and groups received similar treatment other than the intervention);
3. assessment (whether outcome assessors were blind to treatment assignment, outcome measures were similar between treatment groups, and reliable outcome measures were used);
4. retention (whether follow-up was complete);
5. statistics (whether participants were analysed in the groups they were assigned, appropriate statistical analysis was used, and the trial design was appropriate).

The Quasi-experimental checklist assesses nine elements:

1. whether there was clear cause and effect;
2. similar participants between treatment groups;
3. similar treatment between groups other than the intervention;
4. a control group;
5. pre and post intervention measures;
6. complete follow-up or attrition adequately described;
7. similar outcome measures between treatment groups;
8. reliable outcome measures;
9. appropriate statistical analysis.

In review 2, the JBI Checklist for Cohort Studies was utilised to assess the quality of included studies (Joanna Briggs Institute, 2017). This checklist evaluates 11 specific dimensions of study quality including:

1. Similar populations
2. Similar measurement of exposure
3. Exposure measured in valid and robust way;
4. Identification of confounding factors;
5. Strategies applied to deal with confounding factors;
6. Participants 'free' of outcome at baseline;
7. Outcome measured in valid and robust way;
8. Sufficient follow-up time;

9. Complete follow-up;
10. Incomplete follow-up addressed;
11. Appropriate statistical analyses.

Checklist scores for each element are binary; 1 indicates 'yes' (i.e. meeting the criteria) and 0 constitutes 'no' or 'not applicable', such that scores could range from 0-13, 0-9, or 0-11, respectively. Any conflicts were resolved by a third reviewer.

2.7 Synthesis

Initial narrative synthesis of all included studies was used to describe key characteristics of the included evidence (e.g. age range, country, scale used, etc.). Across each review, inductive coding was used to identify key themes and subthemes that were used to organize results synthesis. Both reviews conducted synthesis examined each individual theme or subtheme. Rather than at study level, synthesis was conducted at the intervention or factor unit level, as multiple intervention arms or factors were sometimes explored in a single study. Synthesis approaches differed substantially between the two reviews and are therefore described independently below.

2.7.1 Intervention review synthesis

The most commonly reported data were pre- and post-intervention life satisfaction scores of both those receiving the intervention and a control/comparison group. Therefore, we conducted random-effects meta-analyses using Hedge's g (Higgins et al., 2019), which provides the standardised mean differences (SMD) of pre-post changes between the intervention and control groups. This is also referred to as the 'difference in differences' approach. Use of SMDs allows data to be included regardless of the type of life satisfaction scale used. Hedge's g is similar to Cohen's d , additionally including an adjustment factor to account for small sample sizes; 0.20, 0.50 and 0.80 correspond to small, medium, and large effect sizes, respectively (Brydges, 2019). A 95% Confidence Interval (CI) is calculated alongside each SMD; if a 95% confidence contains 0, this signifies a non-significant result. Analyses were conducted using the *meta* and *metaphor* Packages in R (Balduzzi et al., 2019; Viechtbauer, 2010). Where data was unavailable, we utilised the Cochrane Collaboration

recommended approach for dealing with missing data in meta-analyses (e.g., SD imputation, medians, ranges, interquartile ranges, etc.) (Higgins et al., 2019; Weir et al., 2018). Some studies measured life satisfaction at multiple time-points post intervention; to maximise comparability and manage review scope, the first available measure (nearly entirely immediately post-intervention) was extracted for synthesis.

Heterogeneity refers to any kind of diversity or variability between the studies included in the review. Differences in study sample (e.g. age, recruitment), intervention (e.g. type, duration, setting) or outcome (i.e. scale used) are examples of clinical heterogeneity; in such a broad review, heterogeneity between interventions is expected. Conversely, differences in study design (i.e. RCT or quasi-experimental) or various sources of bias are known as methodological heterogeneity. Finally, statistical heterogeneity refers to differences in effect sizes (e.g. SMD, 95% CI) that are greater than one would expect due to random chance alone. Statistical heterogeneity is nearly entirely explained by clinical or methodological heterogeneity; one intervention may work better due to the target sample, specific intervention components or unintended bias. Where meta-analyses are conducted, statistical heterogeneity can be measured with the I^2 statistic. Thresholds for the I^2 statistics can be arbitrary, although I^2 above 75% is generally indicative of considerable heterogeneity (Higgins et al., 2019).

Based on intervention description and content, preliminary coding of each intervention by theme and sub-theme was conducted by three members of the review team. Here, interventions were themed according to the primary component of the intervention. Where there were multiple components to an intervention, interventions were themed under multi-component interventions. Subthemes and themes were then modified and restructured based on expert input. Specifically, this consisted of a workshop with three members of the Kohlrabi review team and five members of What Works Centre for Wellbeing, with varying expertise in wellbeing policy, research and practice. Themes and subthemes were then presented for input at an expert advisory group meeting, with iterative modifications to themes made throughout the process.

Frequently, two intervention arms were presented against a single control group. Here, standard Cochrane Collaboration guidance was also followed to avoid any errors due to unaddressed correlation between interventions from multiple comparisons (e.g. avoiding double counting control groups) (Higgins et al., 2019). First, where intervention arms were similar and fell under a single theme, intervention arm estimates were combined to create a single effect size (e.g. the same intervention performed at different frequencies each week). Where intervention arms differed substantially across subtheme, the ‘shared’ control group was split into two equal groups with means and SDs remaining the same (e.g. control group of 80 becomes two control groups of 40); this approach partially overcomes issues with double counting.

Due to substantial within-theme heterogeneity, meta-analyses were only conducted for themes which had comparability in intervention descriptions between studies and a sufficient number of studies (minimum 4; Brydges, 2019). Decisions on comparability were made through discussion with experts, per mapping decisions above. Where meta-analyses were not conducted for a given subtheme, individual SMD scores were calculated for each intervention which presented pre- and post-intervention scores for both intervention and control groups, enabling consistency in quantitative synthesis. Finally, description of primary findings (favouring intervention, favouring control, or null) were provided for studies which did not provide sufficient data to derive SMDs.

2.7.2 Observational review synthesis

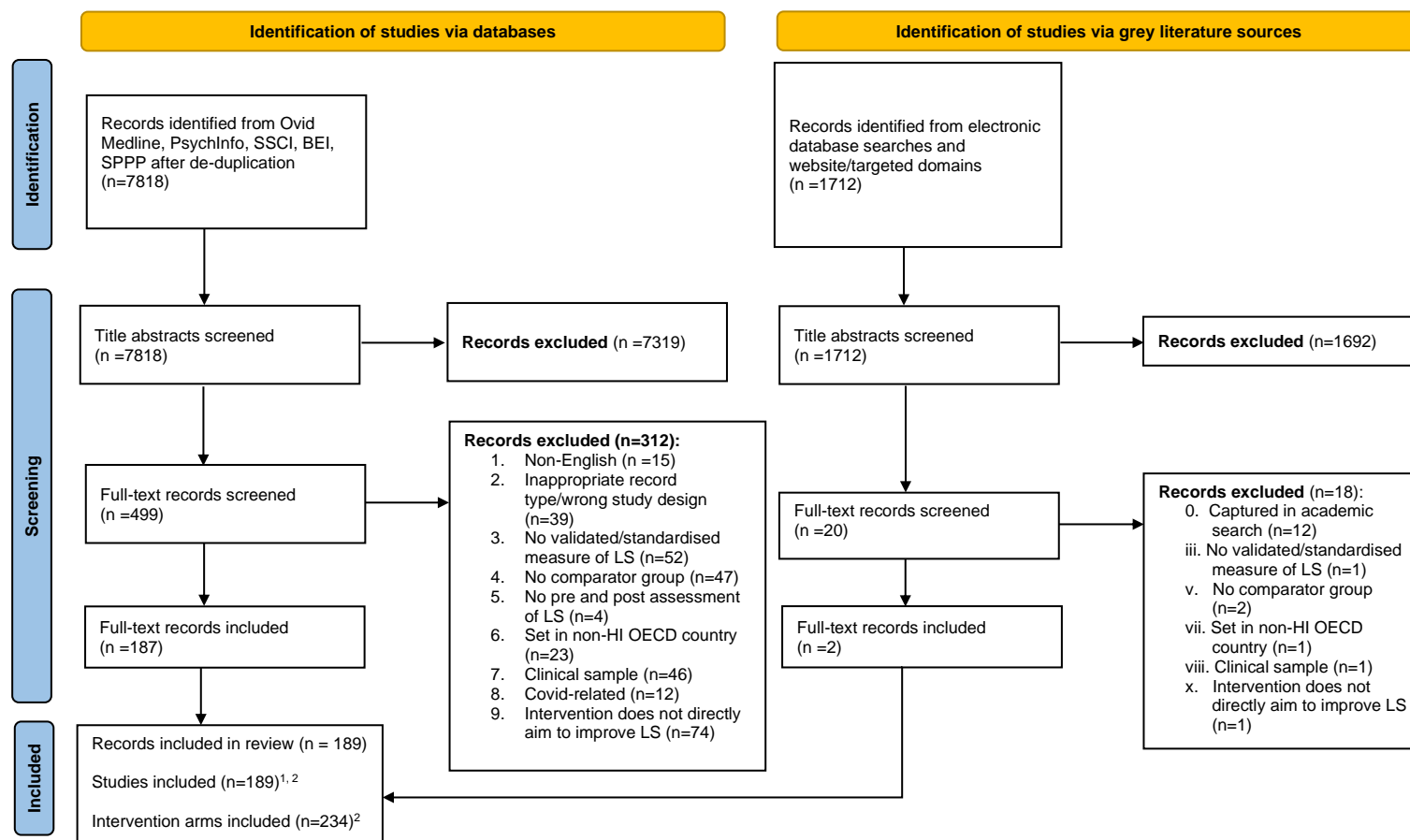
Due to the substantial heterogeneity in the design, reporting, and statistical approaches of studies included in the observational review, no meta-analysis was possible. The primary baseline factor(s) of interest associated with life satisfaction were coded by two members of the review team. Subthemes and themes were then modified and restructured based on an expert panel discussion. Here, a narrative synthesis was used to describe ascertainment of baseline factors (‘exposures’), study samples, mean life satisfaction scores at outcome, and key relationships between baseline factor and life satisfaction. Investigation of moderating or mediating pathways of association were considered out of scope of this

review, although many studies presented complex findings embedding consideration of such factors in primary analysis. Where interpretable, example effect sizes are provided within each theme.

3. Results: Intervention review

3.1 Search results

After deduplication of records found in the databases search, 7818 records underwent initial title-abstract screening, with 499 moving forward to full-text screening and 187 meeting the inclusion criteria. In the grey literature search, 1712 records were identified, with 20 moving forward to full-text screening and 2 additional studies meeting inclusion criteria. Therefore, a total of 189 records were included in the intervention review; two records included two separate studies with the aim of conducting secondary comparative analysis, thus we were able to extract the comparator studies separately (Carrillo et al., 2021; Sanders et al., 2019), whilst two pairs of records described data from the same intervention, i.e., contained duplicate samples (O'Connell et al., 2017; O'Connell et al., 2018; Armenta et al., 2017; Armenta et al., 2022). Hierarchical exclusion reasons for all records that underwent full-text screening in the database or grey literature search are provided in Figure 1. A list of included studies is included in Appendix B.



¹Two records contained two studies (Carillo et al., 2021; Sanders et al., 2019) and two pairs of records described data from the same intervention (i.e., used a duplicate sample; O'Connell et al., 2017; O'Connell et al., 2018)

²Thirty-three records had multiple intervention arms, giving a total of 234 arms included in synthesis.

Figure 1. PRISMA diagram outlining records identified in search, screened, and included in final review

3.2 Overview of included records

3.2.1 Characteristics of included studies

Table 2 provides a summary of the characteristics of all studies included in the intervention review. The majority of the 189 included records were peer-reviewed publications (n=162; 85.7%), although postgraduate theses were also common (n= 25; 13.2%). Interventions were delivered across 6 continents and 27 countries, with most studies coming from Europe (n=87; 46%) or North America (n=73; 38.6%). In order of prevalence, countries included: USA, Spain, UK, Australia, Germany, Portugal, Israel, Netherlands, Norway, Sweden, South Korea, France, Finland, Italy, Canada, Greece, Chile, Poland, Ireland, Austria, Hungary, Japan, Denmark, Czech Republic, Belgium, and Switzerland. Of note, there were 15 studies from the United Kingdom. A total of 47 studies did not report the age range of their sample; of those which did, the majority encompassed the full adult lifespan (n=74; 52.1%), while one fifth of the studies focused on children under 18 (n=30; 21.1%), and another fifth targeted individuals aged 50+ (n=29; 20.4%). A total of 31 of studies did not report mean age of their sample; of those which did, the average mean age of all included participants in the review was 36.3 (SD: 20.4).

Despite all studies containing a control group, less than two thirds used randomisation to assign participants to the intervention or control condition (52.4% individual, 11.6% cluster randomisation). The remaining studies utilised a wait-list control group (n=44, 23.3%) or conducted no randomisation, consistent with the inclusion criteria allowing both RCTs and quasi-experimental studies. The most common scale used was the Satisfaction With Life Scale (SWLS) – a five-item scale designed to measure global cognitive judgments of one’s life satisfaction – (Diener et al., 1985), which was used by 60% (n=113) of included studies. The Student’s Life Satisfaction Scale (SLSS) and its extension the Multidimensional Student’s Life Satisfaction Scale (MSLSS) were commonly used in children and secondary school-aged students (n=19, 10.1%; and n=3, 1.6%; respectively). Modified and validated measures of life satisfaction (n=40, 21.2%) included validated language translations of standard scales (e.g., from English into French, Spanish, Portuguese, German, Italian, Polish, and Hebrew), adapted versions of standard scales (e.g., the Brief Multidimensional

Students' Life Satisfaction Scale, a shortened adaptation of the MSLSS), as well as specialised scales. Examples of the latter include the Temporal Life Satisfaction Scale which assesses life satisfaction in past, present, and future, and measures designed for older people including the Life Satisfaction Index A and the Life Satisfaction Index for the Third Age – Short Form which have dimensions around zest for life, fortitude, and congruence between desired and achieved goals.

Table 2. Characteristics of studies included in the intervention review (n=189)

CHARACTERISTIC	N (%)
Evidence type	
Peer-reviewed publication	162 (85.7)
Thesis	25 (13.2)
Evaluation report	2 (1.1)
Country	
Europe	87 (46.0)
North America	73 (38.6)
Australia & New Zealand	12 (6.3)
Africa	9 (4.8)
Asia	4 (2.1)
South America	2 (1.1)
Cross-continental ^a	2 (1.1)
Age group (n=142 studies; 47 did not report age range)	
Under 18yo	30 (21.1)
19 – 49yo	9 (6.3)
Over 50yo	29 (20.4)
Life span ^b	74 (52.1)
Randomisation	
Individual randomisation	99 (52.4)
Wait-list control group	44 (23.3)
No randomisation	24 (12.7)
Cluster randomisation	22 (11.6)
Life Satisfaction measure (n=189 studies)	
Satisfaction With Life Scale (SWLS)	113 (59.8)
Modified and validated measure	40 (21.2)
Student's Life Satisfaction Scale	19 (10.1)
Other	6 (3.2)
ONS single-item measure	4 (2.1)
Ad-hoc single-item measure	4 (2.1)
Multidimensional Student's Life Satisfaction Scale	3 (1.6)

^a The sample of two records includes participants from different continents: UK and USA (Champion et al., 2018), and USA and South Korea (Shin et al., 2020).

^b Age ranges which do not fit the other categories, ranging across the life span between 17-90 years old.

Single-item measures were used infrequently, with just four studies using the ONS single-item measure and four using a bespoke single-item measure. Finally, six life satisfaction scales within the ‘Other’ category were used in a single study each. These included: Wood’s Life Satisfaction Index (a 13-item scale developed specially for older people; Wood et al., 1969), Cantril’s Ladder of Life Satisfaction (Cantril, 1965), Life Satisfaction Assessment LiSat-11 (Fugl-Meter, 2002), Fragebogen zur Lebenszufriedenheit or “Life Satisfaction Questionnaire” (a German life satisfaction measure with ten sub-scales; Fahrenberg et al., 2000), Bowling’s Life Satisfaction Index for older adults (Bowling, 2005; Neugarten, 1961), and an unnamed 4-item scale combining aspects of happiness, interest in life, feelings of loneliness and ease of living (Koivumaa-Honkanen et al., 2000; Kovumaa-Honkaenen et al., 2008). Of note, only a single record included an economic evaluation (Whooten et al., 2018).

3.2.2 Mapping and overview of intervention themes

Synthesis was primarily conducted at the intervention level, with 33 studies providing data on multiple intervention arms; here, 23 studies included two intervention arms, 8 studies included three arms and 2 studies included four arms. Therefore, the total number of intervention arms included across 189 studies was 234. Brief descriptions of intervention delivery are described in Table 3. Half of the interventions were delivered solely in individual formats (n=121; 51.7%), a third in group (n=86; 36.8%) and the remainder involved aspects of both individual and group activities. There was a broad range of delivery locations, although home (n=42; 18.4%, i.e., completed in the participants own time, most likely at home), online (n=40; 17.5%), and school (n=39; 17.1%) were the most common. The baseline sample sizes for the intervention arms ranged from 3 to 1813 participants, with a sample size between 21 and 50 most common (n=95; 44.4%); sample sizes are visualised in Figure 2.

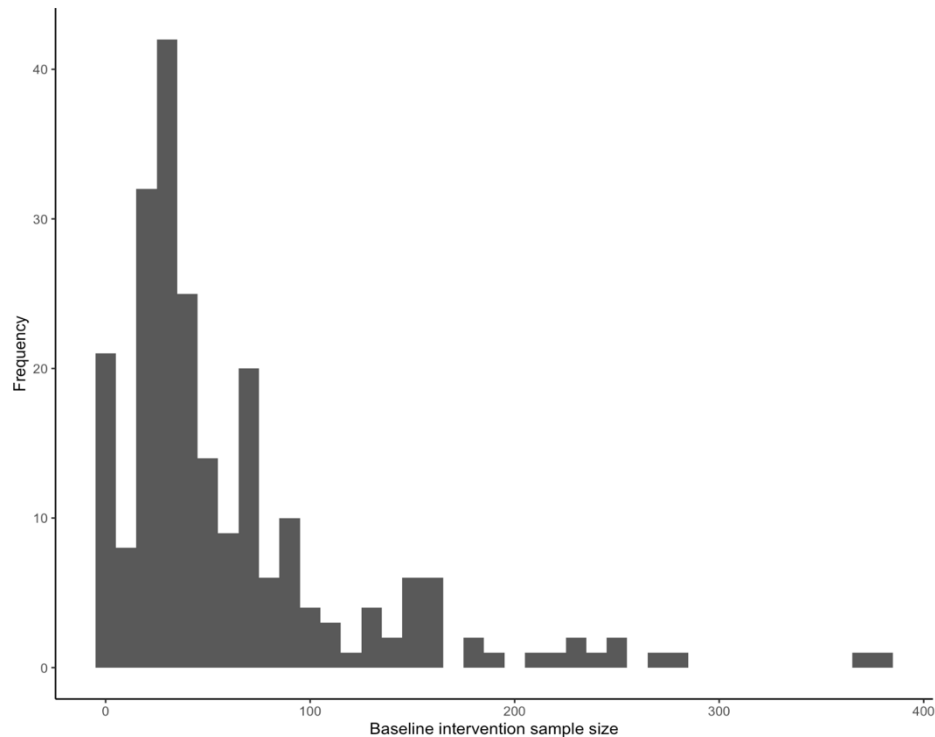
Table 3. Summary characteristics of intervention delivery format, location, and sample size (n=234)

CHARACTERISTIC	N (%)
Intervention delivery format	
Individual	122 (52.1)
Group	85 (36.3)
Individual and group	27 (11.5)
Intervention delivery location^a	
Home	42 (18.4)
Online	40 (17.5)
School	39 (17.1)
University	27 (11.8)
Other ^b	25 (11)
Health centre	19 (8.3)
Community centre	15 (6.6)
Nursing home	10 (4.4)
Multiple locations	7 (3.1)
Outdoors	4 (1.8)
Number of participants in intervention arm at baseline^c	
1-20	21 (9.8)
21-50	95 (44.4)
51-100	55 (25.7)
101-200	25 (11.7)
201-500	11 (5.1)
501-1000	4 (1.9)
1000+	3 (1.4)

^a Six interventions did not report delivery location

^b 'Other' delivery locations include intervention-specific spaces such as meditation retreat, workplace, ski centre, local yoga studio and local theatre

^c Twenty interventions did not report number of participants at baseline



^a Due to a heavy left skew, seven studies are not included in the plot (n=537, 579, 634, 678, 1539, 1812, 1813)

Figure 2. Frequency of intervention group baseline sample sizes.

Thematic mapping of the 234 interventions identified six primary themes:

- I. Emotion-based activities (n=154; 65.8%);
- II. Didactic emotional development (n=30; 12.8%);
- III. Health promotion (n=31; 13.1%);
- IV. Social media (n=4);
- V. Music (n=3);
- VI. Multi-component interventions (n=12; 5.1%).

The largest theme was Emotion-based activities which contained eight subthemes related to intrapersonal aspects and two subthemes related to interpersonal aspects. Figure 3 provides an overview of all 18 subthemes contained within each of the six primary themes, with definitions provided in Table 4. Complete details on each study and intervention are available in the ***study look-up table in Appendix C***. Study quality (assessed via JBI checklists) are explored further in section 3.9. However, study quality was broadly very high, and unless otherwise stated in the theme-by-theme synthesis below, studies can be assumed to be of high quality (e.g. scored $\geq 10/13$ on RCT checklist or $\geq 8/9$ on quasi-experimental checklist).

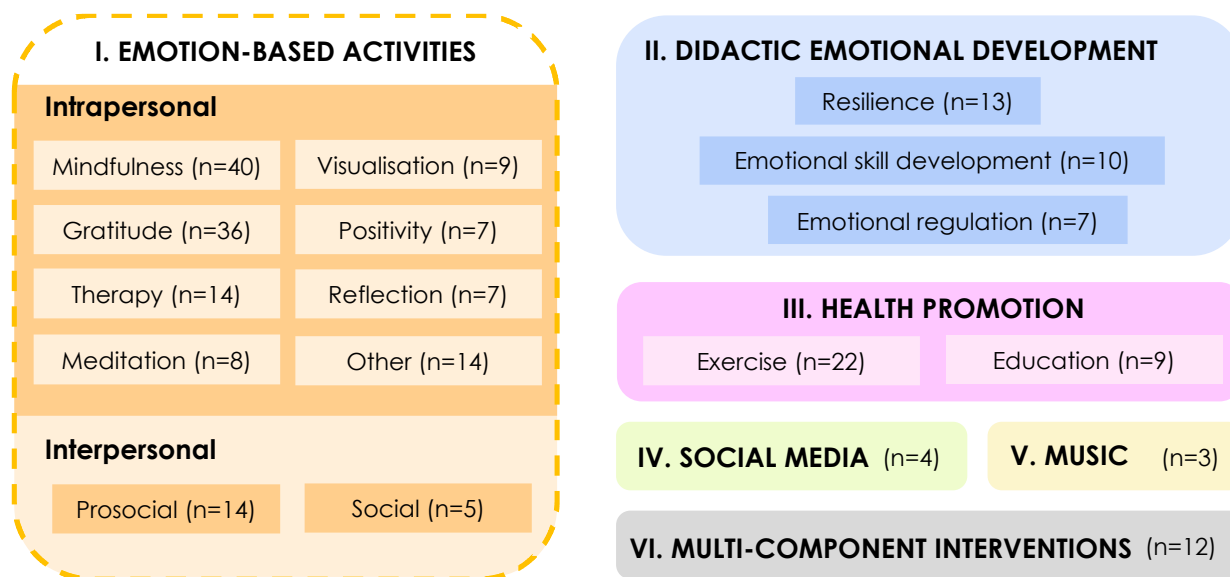


Figure 3. Mapping overview of key themes and subthemes included in the intervention review

Table 4. Summary characteristics of (sub)theme and theme descriptions.

Theme	Theme description
1. Emotion-based activities	Involve interventions focused on delivering activities that engage participants in emotional development. ¹
<i>Intrapersonal</i>	<i>Involve topics that take place within or primarily concern participants' own mind and the self.</i>
Mindfulness	Mindfulness is a cognitive skill which broadly involves sustaining attention on the conscious self and the present moment . Interventions in this subtheme focus on learning and practicing mindfulness activities.
Gratitude	Involves showing appreciation and thankfulness ; these interventions primarily involve gratitude-focused activities, such as reflection, writing, and expressing gratitude to others.
Therapy	Comprise programmes or educational material that follow recognised psychological therapeutic practices , e.g., Cognitive Behavioural Therapy.
Visualisation	Characterised by making a strong mental image of things or events; interventions in this subtheme include visualisations of the self in the past, present, and future.
Meditation	Meditation involves the practice of focusing the mind on a particular object, thought, or activity. While meditation is a core element to mindfulness training, interventions in this subtheme <u>only</u> focus on the practice of meditation (rather than combining or prioritising other mindfulness activities).
Positivity	Comprise activities that foster a more positive or optimistic outlook on events and personal relationships.

Reflection	Involves the process of serious thought or consideration , and interventions in this subtheme consistently directed participants to reflect upon their own life experiences.
Other	Includes interventions categorised as intrapersonal emotion-based activities (i.e., focus on the mind and the self) but that do not fit into the other subthemes.
<i>Interpersonal</i>	<i>Interventions that relate to relationships and communication between people.</i>
Prosocial	Prosocial relates to voluntary behaviour intended to benefit others ; interventions in this subtheme include topics like kindness, volunteering, and forgiveness.
Social	Interventions in this subtheme have the primary focus on promoting the benefits of social interactions .
2. Didactic emotional development	Didactic emotional development involves instructional interventions on the nature of emotions, how and why they occur , and developing ways to effectively manage feelings .*
Resilience	Interventions that teach participants the ability to withstand or quickly recover from difficulties , e.g., by using personal strengths.
Emotional skill development	Interventions that teach participants the ability to maintain or improve emotional wellbeing and emotional intelligence .
Emotional regulation	Interventions that teach participants how to effectively manage feelings .
3. Health promotion	Interventions that promote a healthy lifestyle , including exercise, diet, sleep, etc.
Exercise	Includes physical activity that improves health and fitness, such as yoga, walking, dance, skiing, and strength training.
Education	Educational programmes focused on maintaining or improving health – primarily physical health.
4. Social media	Involve changes to social media use, typically reduction or abstinence .
5. Music	Involve participants engaging with some form of music, such as singing or playing instruments .
6. Multi-component interventions	Involve multi-faceted wellbeing programmes . Interventions in this theme have no primary component, i.e., several components are equally represented, therefore, these interventions cannot be sorted into a single theme.

¹ The distinction between themes 1 (emotion-based activities) and 2 (didactic emotional development) is that 1 primarily involves activities and 2 primarily involves instructional teaching.

3.3 Theme 1 Emotional activities

3.3.1. Intrapersonal emotional activities

Eight subthemes were included under the intra-personal emotional activities theme. Meta-analyses were possible for four of these themes: mindfulness, gratitude, therapy, and meditation. The remaining four subthemes were: visualisation, positivity, reflection, and

‘other’ (activities that did not fit under any of the seven core subthemes). All eight subthemes are described in turn below.

3.3.1.1 Mindfulness (n=40)

The most common intervention type was mindfulness (n=40). Interventions in this subtheme ranged from 1-to-12-weeks in duration and many contained a learning element related to mindfulness activities (e.g., 2.5hr classroom sessions or educational reading material) combined with time to practice mindfulness exercises in the sessions or individually at home (ranging from 5- to 60-mins/day). Two-thirds of these mindfulness interventions involved some group component and the majority of studies were delivered across the life span, with six interventions delivered specifically to young people and only two specifically to older adults. Of the 40 interventions, 37 were eligible for inclusion in the meta-analysis because they reported pre- and post-intervention life satisfaction scores for both the intervention and control groups (total n=3184). Four studies had two intervention arms against a single control group, and therefore were combined in meta-analyses; each of these involved modifications to the intervention delivery including online or in-person (Chiodelli, 2022), additional video conferences (Ahmad et al., 2020), formality of mindfulness practice (Hindman, 2014) or length of intervention (2 days vs 6 weeks; Jones & Drummond, 2022). There was a ***small positive effect of mindfulness interventions on life satisfaction (SMD: 0.28 (0.13, 0.42);*** see Figure 4).

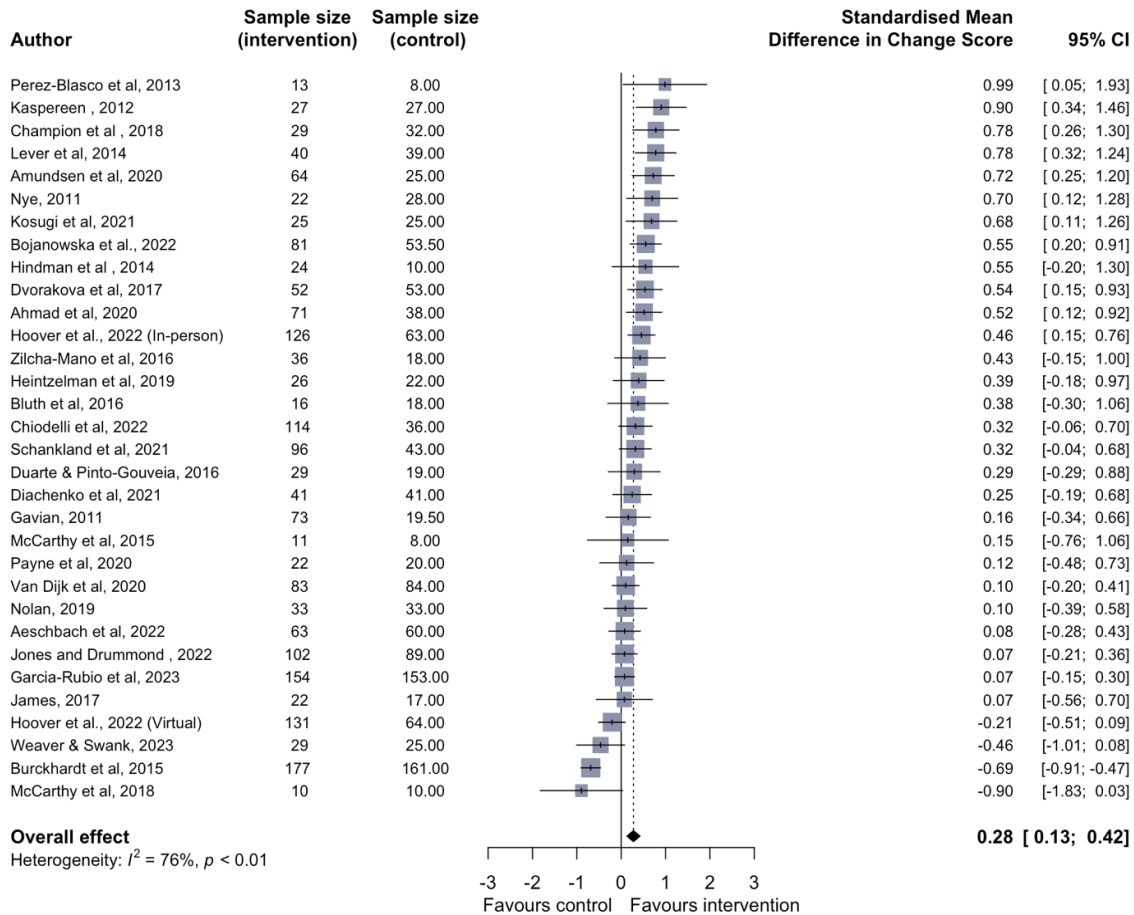


Figure 4. Forest plot demonstrating standardised mean difference in pre-post intervention life satisfaction scores between control and intervention arms for *mindfulness* interventions (total n=3184)

Statistical heterogeneity was moderately high (I^2 : 76%). Of the interventions with moderate to large effect sizes (e.g., SMD: 0.5-0.8), all had small sample sizes ($n < 75$) with wide confidence intervals. Generally, the mindfulness interventions with the largest effect sizes were recurrent (e.g. 6+ weeks), structured sessions that included group-workshops or individual didactic programmes followed by individual at-home practice. The three studies not included in the meta-analysis all reported null results (see Table 5). However, it was notable that two of these contained large sample sizes (both > 3500); these were both based in Germany and comprised eight mindfulness modules on topics such as acceptance, compassion, and communication (Lyssenko et al., 2015; 2019).

Table 5. Summary of findings from studies not included in mindfulness meta-analysis (n=3)

Study	Findings	Sample size (intervention)	Sample size (control)
Charest 2015	No change	115	113
Lyssenko et al 2015	No change	1813	2519
Lyssenko et al 2019	No change	1812	1812

Hoover et al. (2022) delivered an identical series of five interactive lectures and meditation exercises for physician assistant students via virtual and in-person delivery. With separate control groups for each arm, delivery mode could be directly compared; there was a moderate effect of in-person delivery (SMD: 0.46 (95%CI: 0.15, 0.76)) on life satisfaction, whilst the virtual delivery intervention had no effect (SMD: -0.21 (-0.51, 0.09)). As noted in the methods section, if a 95% CI contains 0, this signifies that the difference between groups is not significant. Similar findings were observed in a study by Chiodelli et al. (2022), who compared 8-week interventions of either six 2hr sessions delivered in-person (moderate effect size in additional split analysis, where the control group was split between intervention arms) and four 2hr sessions delivered online (null effect in additional split analysis).

Several results also significantly favoured the control arm, indicating participants in the control group demonstrated greater improvements in life satisfaction than those in the intended intervention group (Burckhardt et al., 2015; McCarthy et al., 2018). Authors hypothesised these unexpected differences could be due to 1) existing conflict in the intervention group - based at a senior's centre - and a more cohesive control group (McCarthy et al., 2018); and 2) resentment from students of having to follow the school-delivered program multiple times per week (Burckhardt et al., 2015). Finally, three studies were of low quality (JBI RCT score ≤ 9), typically because they failed to meet the criteria around blinding and adequately reporting follow-up, with one study achieving a score of 9 (Jones and Drummond, 2022) and two only achieving a score 8 (Hindman et al., 2014; Dvorakova et al., 2017).

3.3.1.2 Gratitude (n=36)

The second largest subtheme was gratitude-based interventions. These interventions were typically short 5- to 10-minute reflection or more commonly writing activities, repeated multiple times a week over a 1-to-12-week period; a third (n=12) were delivered to participants of ages across the lifespan. While these interventions are primarily individual-based, Antoine et al. (2020) describe an intervention in which couples' express reciprocal gratitude about their shared life and one another. Of the 36 interventions, 24 were eligible for inclusion in the meta-analysis (total n=2307). There was a **small positive effect of gratitude interventions on life satisfaction (SMD: 0.19 (0.11, 0.27))**; see Figure 5). Several studies had multiple intervention arms against a single control group and therefore were combined in the synthesis; this included differences in frequency (daily vs weekly; Ahmed, 2016), ways of practicing gratitude (app, journal, 'hand-over-heart'; Tolcher et al., 2022) and gratitude topics (any vs external interactions; O'Connell et al., 2017). Statistical heterogeneity was very low (I^2 : 4%), reflecting similar effect sizes and confidence intervals between studies.

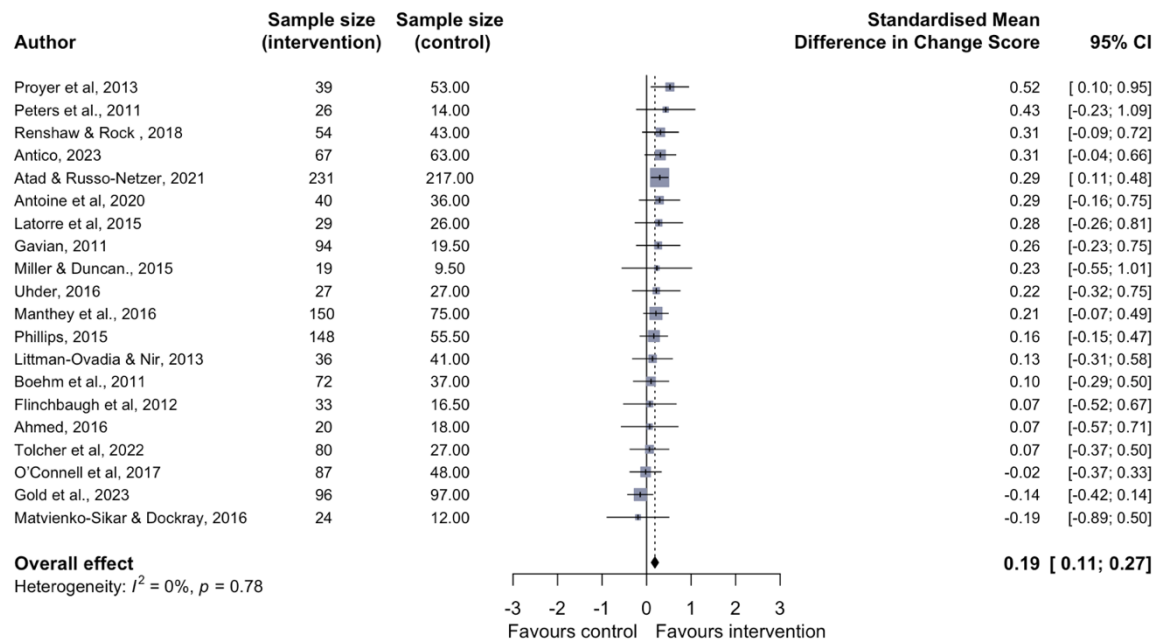


Figure 5. Forest plot demonstrating standardised mean difference in pre-post intervention life satisfaction scores between control and intervention arms for **gratitude** interventions (total n=2307)

The largest effect size in the gratitude theme – the ‘Zurich Strengths Program’ - had a moderate effect size (SMD: 0.52 (0.10, 0.95)) and consisted of five sessions of gratitude-related writing and other activities linked to curiosity, humour, and hope in adults (Proyer et al., 2013). Although Atad & Russo-Netzer (2021) had the largest sample size of interventions included in the meta-analysis and had a significant effect size, study quality was low (JBI RCT score of 9/13) as they failed to meet the criteria around blinding and selection (i.e., intervention and control groups being sufficiently similar at baseline).

When individual intervention arms were compared within a single study, there were no differences in effect estimates for gratitude topics (O’Connell et al., 2017) or ways of practice (Tolcher et al., 2022). However, participants in the intervention arm that practiced gratitude daily for 1-month appeared to have greater improvements in life satisfaction (SMD: 0.70 (95%CI: -0.08,1.48)) relative to the control group compared to those who practiced gratitude weekly over a 1-month period (-0.01 (-0.79, 0.78); Ahmed, 2016); sample sizes were small (n=20 in daily, n=25 in weekly intervention arm, n=18 in control group). A summary of findings of the 11 interventions not included in the meta-analysis is provided in Table 6.

Table 6. Summary of findings from studies not included in gratitude meta-analysis (n=11)

Study	Findings	Sample size (intervention)	Sample size (control)
Ragan 2012	No change	251	Not reported
Tricaró 2012	No change	59	73
Booker 2015	No change	Not reported	Not reported
Harlan 2016	Favours intervention	68	67
Renshaw et al 2017	No change	Not reported	Not reported
Smith & Bryant 2018	Favours intervention	95	79
Berger 2019	No change	28	30
Sanders et al 2019 (study 1)	Favours intervention	276	Not reported
Sanders et al 2019 (study 2)	Favours intervention	579	Not reported
Armenta et al 2022	No change	Not reported	Not reported
Benjamin & Holliman 2022	No change	3	2
Smoktunowicz 2023	No change	162	121

3.3.1.3 Therapy (n=14)

The interventions included in the therapy subtheme (n=14) consisted of diverse interventions delivered at the individual (n=6) or group (n=5) level, with several involving both individual and group components (n=3). These interventions comprise: Acceptance and Commitment Therapy (ACT; n=5), Cognitive Behavioural Therapy (CBT; n=4), Existential Behavioural Therapy (EBT; n=3), counselling (n=1), and Family Group Conferences (n=1) which involves an extended family network coming together with a trained facilitator to discuss concerns for an at-risk young person. Of the 14 interventions in this theme, 8 interventions were included in the meta-analysis (total n=1361). Overall, there was a **small to moderate positive effect of therapy interventions on life satisfaction (SMD: 0.33 (0.12, 0.53))**. Statistical heterogeneity was low ($I^2=46%$). The largest effect size was observed in secondary school students engaging in an intensive 4-week program (3 x 60min/week) of group-based ACT (Macias et al., 2022). One study in this subtheme was low quality (Kogler, 2015), only achieving a JBI RCT score of 8, and did not report sufficient data to be included in meta-analysis and did not report any change in life satisfaction between intervention and control groups. A summary of findings of the six interventions not included in the meta-analysis is provided in Table 7.

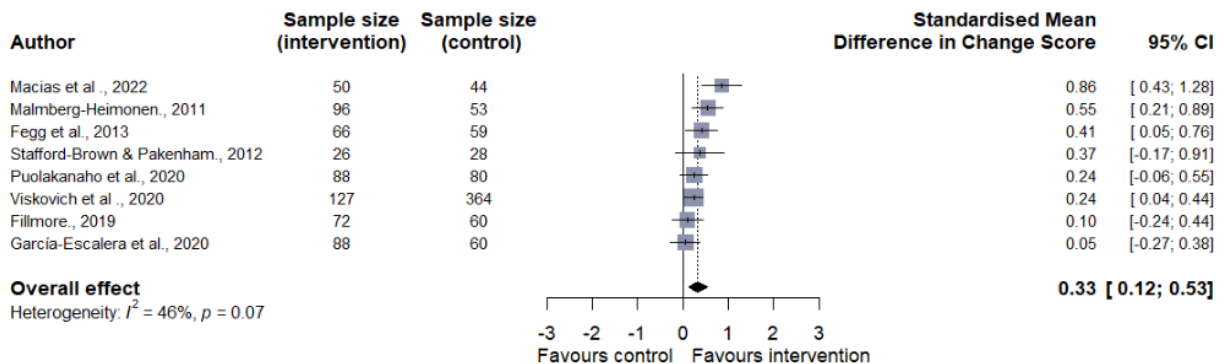


Figure 6. Forest plot demonstrating standardised mean difference in pre-post intervention life satisfaction scores between control and intervention arms for **therapy** interventions (total n=1361)

Table 7. Summary of findings from studies not included in therapy meta-analysis (n=6)

Study	Findings	Sample size (intervention)	Sample size (control)
Parks & Szano 2013	No change	20	9 ¹
Kogler 2015	No change	Not reported	Not reported
Milot 2019	Favours intervention	152	152
Taussig et al 2019	No change	233	192
Kühnel et al 2020	No change	75	82
Hämäläinen et al	No change	161	82

² Control group split across sub-themes (original n=18)

3.3.1.4 Meditation (n=8)

While meditation is often regarded as a mindfulness practice, the meditation subtheme (n=8) makes the distinction between general mindfulness activities and these interventions which only involve meditation or focus on specific types of meditation practice. For example, Kaplan et al. (2022) investigated 8 weeks of guided weekly meditation sessions with two marginally different intervention arms: meditation focused on training compassion and meditation focused on training attention. Interventions were delivered to diverse target samples including high school and university students, healthy adults, and military recruits.

Six interventions consisted of weekly sessions held over an 8-to-10-week period, with one intervention delivered over a three-week period and one consisting of a four-week Vipassana meditation retreat (8-9 hours of meditation per day). The shorter three-week intervention demonstrated the largest effect size (SMD: 1.05 (0.60, 1.49)); it included 10-min meditation sessions after a university class once a week and daily at-home practices (Shinde et al., 2021). Seven interventions (one study had two arms combined) provided sufficient data for inclusion in meta-analysis (total n=473) with a **null overall effect on life satisfaction (SMD: 0.33 (-0.10, 0.76))**; see Figure 7). The study not included in meta-analysis reported null findings (Rothchild et al., 2017). Statistical heterogeneity was moderate to high (I²: 63%).

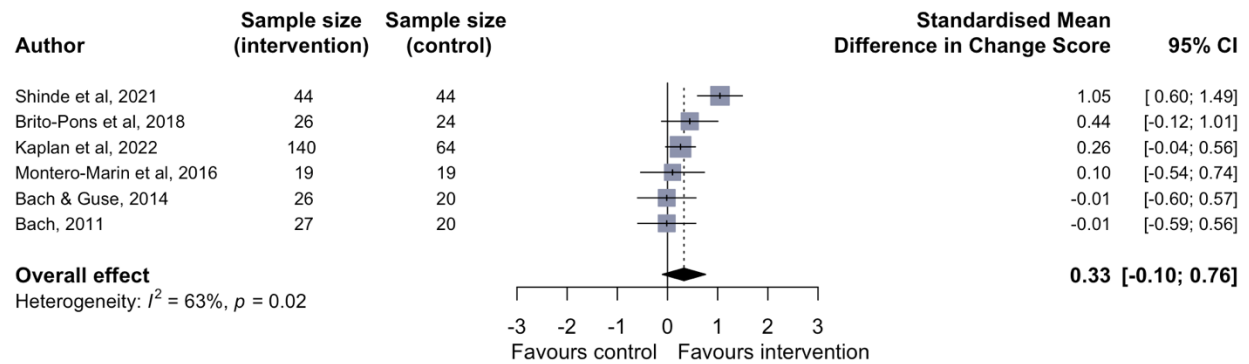


Figure 7. Forest plot demonstrating standardised mean difference in pre-post intervention life satisfaction scores between control and intervention arms for *meditation* interventions (total n=473)

3.3.1.5 Visualisation (n=9)

Interventions within the ‘Visualisation’ subtheme (n=9) used either written or imagined visualisation of participant’s best self. These interventions were short and grounded in consistency, typically lasting under 20 minutes, and performed daily (Boehm et al., 2011; Manthey et al., 2016; Carrillo et al., 2021) or, in one case, a 10-minute writing task weekly for six weeks (Peters et al., 2013). Most of the evidence comes from two studies in university students and adults which used identical three-arm interventions asking individuals to follow a writing prompt and then visualise the best version of themselves in past, present, and future scenarios (Carrillo et al., 2021). All nine *visualisation interventions had no impact on life satisfaction* (see Table 8).

Table 8. Summary of findings from visualisation sub-theme (n=9)

Study	Findings ¹	Sample size (intervention)	Sample size (control)
Peters et al 2013	0.48 (-0.17, 1.13)	28	28
Carrillo et al 2021 (3 arms) ²	0.30 (-0.13, 0.73)	84	28
Manthey et al 2016	0.24 (-0.05, 0.52)	135	149
Boehm et al 2011	0.08 (-0.31, 0.48)	74	74
Carrillo et al 2021 (3 arms) ²	-0.38 (-0.83, 0.07)	82	25

¹ SMD provided where sufficient data are reported by study. If not, brief description of direction of statistically significant associations are provided

² Two studies were included within the same paper; one in university students and one in adults

3.3.1.6 Positivity (n=7)

The ‘positivity’ subtheme (n=7) contains interventions which focus on fostering positivity and an optimistic outlook towards life events and personal relationships. Intervention modes were diverse, and mainly consisted of individual activities such as daily photo diaries

(McKee et al., 2020), watching video “pep” talks (Brindal et al., 2023), listing daily things which bring happiness (Miller & Duncan, 2015), writing exercises around reframing stressors positively (Hyun 2023), or happiness-themed book study sessions (Parks & Szano, 2013). Two interventions consisted of older adults engaging in weekly group-based sessions such as a happiness-themed book study club (Greenawalt, 2018) and rewriting a fairy tale narrative (Cesetti et al., 2017). **Evidence was mixed**; three of seven studies reported greater improvement in life satisfaction in the intervention group, three found non-significant differences and one favoured the control group (see Table 9). In an intervention using a positive psychology-based self-help book, the control group demonstrated initial improvements post-intervention, although after six months, there was a clear positive effect on the intervention group (Parks & Szano, 2013).

The largest effect size was observed in the intervention in which a group of older adults communally engaged in rewriting a fairy tale so that the narrative focuses on overcoming fearful situations (Cesetti, 2017). There were also moderate positive effects of individual writing exercises around reframing stressors through the lens of positivity for military academy cadets (Hyun 2023). Finally, McKee (2020) reported intervention group participants had significantly higher life satisfaction at the end of the intervention (pre and post scores not reported), however, this study was low quality achieving a JBI RCT score of 9 due to lack of blinding and meeting the selection criteria.

Table 9. Summary of findings from positivity sub-theme (n=7)

Study	Findings¹	Sample size (intervention)	Sample size (control)
Cesetti et al 2017	0.91 (0.11, 1.70)*	20	10
Hyun et al 2023	0.43 (0.04, 0.82)*	51	52
Brindal et al 2023	0.31 (-0.05, 0.66)	81	85
Greenawalt 2018	0.12 (-0.45, 0.70)	34	18
Miller & Duncan 2015	0.00 (-0.79, 0.80)	17	19
Parks & Szano 2013	-0.83 (-1.65, -0.01)	20	9 ²
McKee et al 2020	Favours intervention	Not reported	Not reported

* intervention group demonstrated significantly larger improvement in life satisfaction compared to control

¹ SMD provided where sufficient data are reported by study. If not, brief description of direction of statistically significant associations are provided.

² Control group split across sub-themes (original n=18)

3.3.1.7 Reflection (n=7)

The ‘reflection’ subtheme (n=7) had substantial heterogeneity between interventions, however, each consistently directed participants to reflect upon their own life experiences. Interventions included individual interviews with older people about their life stories (Ligon et al., 2012), weekly group sessions learning about creative writing techniques and sharing written life stories (Chippendale, 2011), and “Life Playback Theatre” which focused on groups sharing and communally re-enacting participants life stories (Keisari et al., 2022). There was **no evidence that reflection-based interventions improved life satisfaction** (see Table 10).

Table 10. Summary of findings from reflection sub-theme (n=7)

Study	Findings ¹	Sample size (intervention)	Sample size (control)
Layous et al 2022	0.48 (-0.17, 1.13)	80	80
Nichols et al 2022 ²	0.30 (-0.13, 0.73)	44	23
Keisari et al 2022	0.24 (-0.05, 0.52)	40	38
Chippendale, 2011	0.08 (-0.31, 0.48)	23	22
Ligon et al 2012	-0.38 (-0.83, 0.07)	30	30
Booker 2015	No change	Not reported	Not reported

*intervention group demonstrated significantly larger improvement in life satisfaction compared to control

¹ SMD provided where sufficient data are reported by study. If not, brief description of direction of statistically significant associations are provided.

²Two arms combined (Reflection alone, Reflection + Intentional change to increase meaningfulness in life)

3.3.1.8 Other (n=14)

The ‘Other’ subgroup (n=14) included heterogeneous interventions that could not be categorised under any of the subthemes yet are still considered to be intrapersonal emotion-based activities. For example, several interventions focused on finding or exemplifying personal values (van Agteren et al., 2021; Oliver & MacLeod, 2018; Bojanowska et al., 2022) and building self-compassion (Anderson et al., 2020; Smeets et al., 2014). Others included a goal setting careers intervention for adolescents in foster care (Silva et al., 2017), Christian groups focusing on humility (Cuthbert et al., 2018), and an intervention which prompts participants to do something outside of their comfort zone (Russo-Netzer & Cohen 2022). Most results trended towards the intervention group improving life satisfaction compared to control, with two interventions showing statistically significant

improvements (Table 11). A 5-week school-based intervention programme focused on hope-based goal setting (Marques, 2011) reported a large improvement in life satisfaction from baseline to post-intervention measures compared to the control group. Additionally, a continuous 7-day intervention involved 15-minute daily activities focused on identifying personal values (van Agteren, 2021) reported a moderate improvement in life satisfaction from baseline to post-intervention measures compared to the control group. Due to the lack of clear intervention type in the ‘other’ intrapersonal emotional activities subtheme, **no summary conclusions can be made.**

Table 11. Summary of findings from ‘other’ intrapersonal emotional activities sub-theme (n=14)

Study	Type	Findings ¹	Sample size (intervention)	Sample size (control)
Marques et al 2011	Hope-based goal setting	0.74 (0.22, 1.25)*	31	31
van Agteren et al 2021	Personal values	0.51 (0.15, 0.87)*	47	86
Bojanowska et al 2022	Personal values	0.31 (-0.04, 0.65)	80	107
Anderson 2020 (2 arms)	Self-compassion	0.28 (-0.21, 0.77)	51	24
Smeets et al 2014	Self-compassion	0.23 (-0.31, 0.78)	27	25
Cuthbert et al 2018	Humility	0.18 (-0.29, 0.65)	41	30
Prestin 2012 (3 arms)	Inspiring media	0.16 (-0.17, 0.49)	188	60
Phillips 2015	Personal integrity	0.12 (-0.19, 0.42)	161	55 ²
Silva et al 2017	Personal values and goal setting	-0.17 (-1.11, 0.77)	16	6
Russo-Netzer & Cohen 2022	Try something out of comfort zone	No change ³	73	71
Oliver & MacLeod 2018	Personal values	No change	90	73

* intervention group demonstrated significantly larger improvement in life satisfaction compared to control

¹ SMD provided where sufficient data are reported by study. If not, brief description of direction of statistically significant associations are provided.

² Control group split across sub-themes (original n=111)

³ No overall change; however, those with low baseline satisfaction in the intervention group significantly improved life satisfaction over two weeks compared to the control group, however, this was not seen in participants with high baseline life satisfaction scores.

3.3.2 Interpersonal emotional activities

In contrast to above, interpersonal emotional activities refer to activities involving actions towards others rather than working on the self. Below, prosocial-based interventions (n=14) and social-based interventions (n=5) are described.

3.3.2.1 Prosocial (n=14)

Interventions within the prosocial subtheme (n=14) typically involve practicing acts of kindness or generosity towards others and engaging in prosocial behaviour (i.e., social behaviour with the intent to benefit others). These interventions are typically short, for example, performing unlimited amounts of acts of kindness over the course of three days (Ko et al., 2021) or in some cases once weekly for a month (Fritz et al., 2021; Fritz et al., 2023); the longest intervention duration involved performing two generous acts weekly for five weeks (Wang et al., 2014). One study included intervention arms involving performing kind acts to oneself or performing kind acts to others and reading associated material about the benefits of performing these acts (Shin et al., 2019). Most studies had multiple intervention arms, which generally included slight modifications to the intervention delivery mode rather than distinct intervention designs; after combining arms, eight primary interventions were explored. There was ***mixed evidence across the prosocial subtheme***, with three studies demonstrating greater improvements in baseline to post-intervention life satisfaction compared to the control group, four reporting no difference, and one reporting a reduction in life satisfaction for the intervention group from baseline to post-intervention measures compared to the control group (see Table 12).

Table 12. Summary of findings from prosocial sub-theme (n=14)

Study	Findings ¹	Sample size (intervention)	Sample size (control)
Vassilopoulos et al 2018	0.86 (0.23, 1.50)*	21	21
Jongenelis et al 2022	0.39 (0.10, 0.69)*	73	112
Shin et al 2019 (US; 2 arms)	0.29 (0.03, 0.55)*	199	81
Shin et al 2019 (S. Korea; 2 arms)	-0.26 (-0.01,-0.51)*	179	94
Ko et al 2021 (3 arms)	Favours intervention	Not reported	Not reported
Fritz et al 2021 (2 arms)	No change	Not reported	Not reported
Fritz et al 2023 (2 arms) ²	No change	Not reported	Not reported
Wang et al 2014	No change	Not reported	Not reported

* intervention group demonstrated significantly larger improvement in life satisfaction compared to control

¹ SMD provided where sufficient data are reported by study. If not, brief description of direction of association is provided.

² Four arms in total; 2 in social subtheme

The intervention with the largest effect size was a primary school-based intervention, in which children engaged in six 2-hour group sessions learning about and practicing

forgiveness (Vassilopoulos 2018). A six-month formal volunteering programme where individuals could choose any type of activity involving a 1-hour minimum weekly commitment also demonstrated larger improvements in life satisfaction in the intervention group (Jongenelis et al., 2022).

Two identical interventions delivered across two countries found that performing acts of kindness significantly improved life satisfaction for university students in the USA while the same intervention significantly reduced life satisfaction for students in South Korea; the authors discuss differences in cultural values as a potential driver for these findings (Shin et al., 2019). Finally, a three-day intervention among undergraduate students observed that all intervention arms (perform acts of kindness, recall acts of kindness, or a combination of both) improved life satisfaction compared to the control group, however, associations were strongest for the combined groups (Ko et al., 2021). All four of the effective interventions were delivered to children or university students, whereas studies which reported null effect of the intervention were primarily in adults (Fritz et al., 2021, Fritz et al., 2023).

3.3.2.2 Social (n=5)

Only five interventions, across four studies, examined social activities, with high heterogeneity between interventions (see Table 13). No intervention reported an improvement in life satisfaction from baseline to post-intervention measures compared to the control group. Two interventions were delivered to university students, including pet therapy (Binfet & Passmore, 2016) and a group-based intervention ('Groups4Health') examining the importance of social groups for health (Haslam et al 2016). The 'Groups-4-Retirement' intervention involved a single self-directed online session which emphasised the benefits of social groups for individuals transitioning into retirement (La Rue et al., 2023). The final two interventions came from the same study and explored brief social acts towards others designed to promote social acceptance (Fritz et al., 2023). There was **no evidence** to suggest an effect of social-based interventions on life satisfaction.

Table 13. Summary of findings from social sub-theme (n=5)

Study	Findings ¹	Sample size (intervention)	Sample size (control)
La Rue et al 2023	0.24 (-0.16, 0.64)	49	49
Binfet & Passmore 2016	0.33 (-0.27, 0.92)	22	22
Haslam et al 2016	No change	26	25
Fritz et al 2023 (2 arms) ²	No change	Not reported	Not reported

* intervention group demonstrated significantly larger improvement in life satisfaction compared to control

¹ SMD provided where sufficient data are reported by study. If not, brief description of direction is provided.

² Four arms in total; 2 in prosocial subtheme

3.4 Theme 2 Didactic emotional development

Didactic emotional development interventions involve structured learning and education, typically led by a teacher but in some cases self-guided, around three core subthemes: resilience (n=13), emotional skill development (n=10; meta-analysis possible) and emotional regulation (n=7).

3.4.1 Resilience (n=13)

The interventions focused on building resilience (n=13) were overwhelmingly aimed at secondary school-aged adolescents and typically longer programmes (intervention length ranged from 1 week to 9 months). However, a few studies differed, for example, one intervention involved cultivating personal strengths and sharing them with a significant other (MacDougall 2017) and another involved a full-day ‘post-traumatic growth’ workshop focused on helping bereaved adults move through the process of grief (Roepke et al 2018). Overall, there was **mixed evidence** for resilience interventions, with four of the thirteen interventions observing a significant improvement in life satisfaction in the intervention groups compared to the control group (see Table 14). Some of the largest effect sizes were reported from three secondary school programmes focused on life skills (Gomes & Marques, 2023), positive personal development (Freire et al., 2018), and character building (Proctor et al., 2011). Furthermore, two school-based interventions had particularly large samples sizes (Challen et al., 2011; Tak et al., 2014; n=2993 and 1341, respectively) but reported no change in life satisfaction between intervention and control groups. Finally, distribution of educational material in hotel employees designed to build resilience by

improving intrinsic motivation resulted in significant improvements in life satisfaction compared to those that did not receive it (Morgan, 2016).

Table 14. Summary of findings from the resilience sub-theme (n=13)

Study	Findings ¹	Sample size (intervention)	Sample size (control)
Freire et al 2018	0.58 (0.12, 1.04)*	74	25
Gomes & Marques 2023	0.53 (0.10, 0.97)*	41	43
Proctor et al 2011	0.24 (0.00, 0.47)*	218	101
Cuomo 2020	0.12 (-0.24, 0.48)	68	51
Meyers & van Woerkom 2017	0.03 (-0.31, 0.38)	67	63
MacDougall 2017 (2 arms)	-0.01 (-0.43, 0.45)	61	29
Quinlan et al 2014	-0.11 (-0.42, 0.20)	136	56
Morgan 2016	Favours intervention	26	26
Tak et al 2014	No change	634	707
Richards et al 2016	No change	52	30
Roepke et al 2018	No change	56	56
Challen et al 2011	No change	1539	1454

*intervention group demonstrated significantly larger improvement in life satisfaction compared to control

¹ SMD provided where sufficient data are reported by study. If not, brief description of direction of association is provided.

3.4.2 Emotional skill development (n=10)

A total of ten interventions were included in this subtheme, most of which involved school-based programmes focused on emotional development, intelligence, and wellbeing (Schoeps et al 2018, Suldo et al 2013, Shoshani & Steinmetz, 2013, Boniwell et al., 2016, Rickard et al 2023, Roth et al., 2017, Shoshani & Slone, 2017), however, similar programmes were studied in university students (Shoeps et al 2019), hospital employees (Veloso-Besio et al 2015) and older adults (Delhom et al 2020). All ten interventions provided sufficient data for inclusion in meta-analysis, with a **moderate positive effect on life satisfaction (SMD 0.50 (0.12, 0.88);** see Figure 8).

The largest effect size was observed for a series of 12 two-hour emotional development workshops for hospital employees which covered topics such as leadership, personal strengths, positive social skills, and optimism (Veloso-Besio et al., 2015). A moderate effect size was observed in a 10-week group-based programme where older adults aimed to improve their emotional intelligence (Delhom et al., 2020). Shoshani and Steinmetz (2013) reported a small to moderate effect size for a 30-week intervention in primary-school aged

children and had a large sample size (n=1038). All five interventions with significant effect sizes were delivered in a group setting, although school-based interventions demonstrated mixed results. Statistical heterogeneity was high ($I^2 = 86\%$), as evidenced by varying effect sizes.

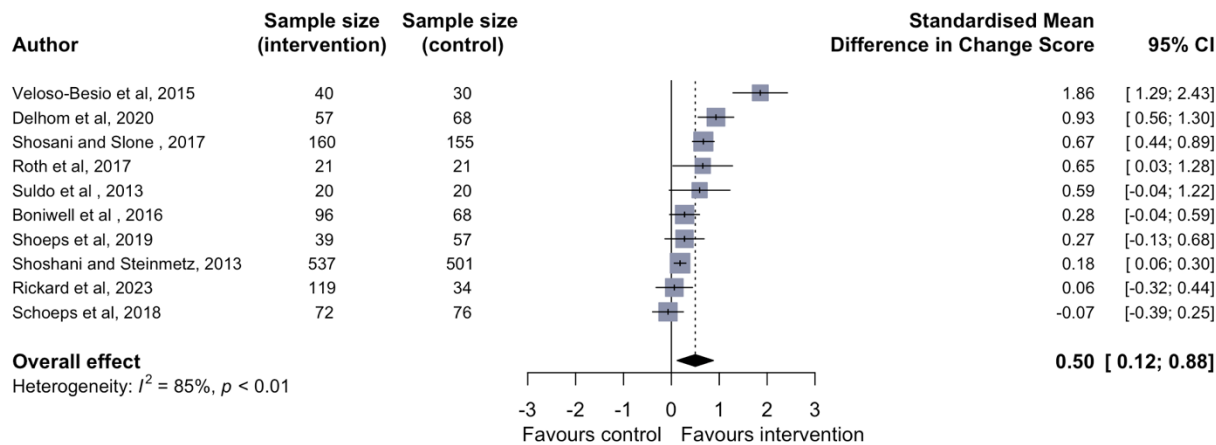


Figure 8. Forest plot demonstrating standardised mean difference in pre-post intervention life satisfaction scores between control and intervention arms for **emotional skill development** interventions (total n=2191)

3.4.3 Emotional regulation (n=7)

Seven interventions were included in the emotional regulation subtheme. As with emotional skill development, most interventions were longer programmes (4-to-16-weeks) delivered through workshops which sustain group interactions (Caballero-Garcia & Ruiz, 2021, Leblanc et al., 2017; Leblanc et al., 2020., Meyer DeMott et al., 2017; Weytens et al., 2014). There was **mixed evidence** on the benefits of such interventions, with two of seven interventions reporting the intervention improved life satisfaction compared to the control group (see Table 15). The largest effect size in this subtheme and across the entire intervention review was reported for a 6-week ‘intensive training programme’ for 21 university students which involved 5.5hrs of lectures, group discussions, and activities each weekday accompanied by a nightly journal entry (Mrazek et al., 2021). Topics which were grounded in the self-regulation literature included growth mindsets, motivation, attention control, and primarily emotional regulation. The other intervention with a significant effect size involved four weekly 2hr semi-structured workshops on developing emotional

regulation skills in adults (Leblanc et al., 2020). Interventions which demonstrated null effects were more likely to be delivered at a lower intensity, such as shorter duration, frequency, and involving less group work.

Table 15. Summary of findings from emotional regulation sub-theme (n=7)

Study	Findings ¹	Sample size (intervention)	Sample size (control)
Mrazek et al 2021	1.45 (0.75, 2.14)*	21	20
Leblanc et al 2020	0.82 (0.42, 1.22)*	51	53
Weytens et al 2014	0.41 (-0.09, 0.91)	28	35
Leblanc et al 2017	0.12 (-0.33, 0.58)	38	37
Meyer DeMott et al 2017	0.06 (-0.29, 0.41)	70	73
Caballero-Garcia & Ruiz 2021	-0.14 (-0.36, 0.09)	162	138
Seppälä et al 2020	No change	21	15 ²

*intervention group demonstrated significantly larger improvement in life satisfaction compared to control

¹ SMD provided where sufficient data are reported by study. If not, brief description of direction of statistically significant associations are provided.

² Control group split across three sub-themes (original n=47)

3.5 Theme 3 Health promotion

Health-based interventions were clustered under two subthemes: exercise (n= 22; meta-analysis possible) and health promotion education (n=9).

3.5.1 Exercise (n=22)

The majority of interventions in the exercise subtheme were structured exercise-based programmes taking place over a longer period of time (most commonly 6+ weeks) with multiple sessions per week. Intervention frequency and duration ranged from 15-to-90-min sessions, 1-7x/week, and up to 6-months in total duration. Half of these interventions were group-based, with activities ranging from 15-min walks and gentle Hatha yoga to creative dancing and Nordic skiing. In this subtheme, 16 of 22 interventions were included in the meta-analysis, of which three were modifications of the same intervention (i.e. strength, functional or endurance training) and thus combined for synthesis. Overall, there was a **small to moderate positive effect of exercise interventions on life satisfaction (SMD: 0.33 (0.04, 0.62);** see Figure 9). Although statistical heterogeneity was high ($I^2=74%$) and interventions differed by exercise type, there was sufficient homogeneity in the aim and delivery components of these interventions. There was a general trend where group-based

exercise interventions appeared to have larger effect sizes than interventions delivered at the individual level.

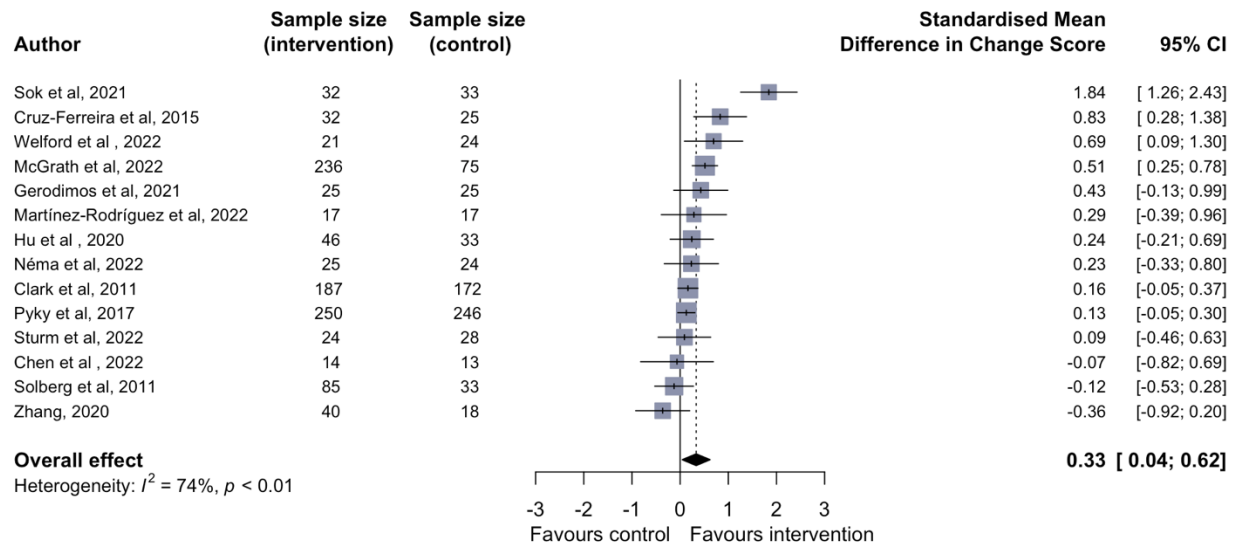


Figure 9. Forest plot demonstrating standardised mean difference in pre-post intervention life satisfaction scores between control and intervention arms for **exercise** interventions (total n=1800)

Exercise interventions were nearly entirely delivered in adults, with half specifically delivered for older adults, while a single broad 12-week physical activity programme was school-based (Whooten et al., 2018). Compared to control, life satisfaction improved in children who participated 3x week with no effect in those participating 2x week. Additionally, this was the sole intervention to report an economic evaluation alongside the main intervention outcomes. The largest effect size was observed in older adults engaging in 2x weekly 50-min balance, gait, and strength sessions with a cognitive component (Sok et al., 2021).

One intervention in this subtheme examined the impact of a ‘negative’ intervention by instructing active young adults to do no exercise for a week and to keep step count under 5000 steps (Edwards & Loprinzi, 2017). This intervention was very detrimental for life satisfaction, with an SMD of -9.33 (-11.61, -7.06), after one week of low activity. Crucially, participants returned to normal life satisfaction levels after resuming their normal activities one week later. Table 16 provides an overview of the six studies not included in meta-analysis.

Table 16. Summary of findings from studies not included in exercise meta-analysis (n=6)

Study	Findings	Sample size (intervention)	Sample size (control)
Finkenzeller et al 2011	No change	Not reported	Not reported
Edwards & Loprinzi 2017	Favours control¹	26	13
Whooten et al 2018	No change	425	282
Seppälä et al 2020	No change	29	47
Hui et al 2022	Favours intervention	366	365

¹Sedentary behaviour intervention. After returning to normal physical behaviour life satisfaction in the intervention group also returned to pre-intervention levels; study excluded from meta-analysis due to negative intervention design.

3.5.2 Health promotion education (n=9)

Health promotion educational interventions (n=9) tended to be more long-term and intensive interventions, which often included individual and group training for one- to nine-months. Five of nine interventions report a significant improvement in life satisfaction in the intervention group compared to the control, suggesting an overall positive effect, however, we conclude there is **mixed evidence** for health promotion education (see Table 17). The greatest improvements in life satisfaction included an adult interdisciplinary lifestyle 10-week education programme, which engaged participants in challenges to improve facets of health such as exercise, diet, and rest (Przybylko et al., 2021), interventions for older adults providing training on traditional medicine techniques such as Qigong or acupuncture (Sok et al., 2022), and a mix of individual and group sessions of occupational therapy and lifestyle education (Johansson & Björklund, 2015).

Table 17. Summary of findings from the health promotion sub-theme (n=9)

Study	Findings ¹	Sample size (intervention)	Sample size (control)
Przybylko et al 2021	1.23 (0.99, 1.47)*	159	162
Johansson & Björklund 2015	0.81 (0.16, 1.46)*	22	18
Sok et al 2022	0.77 (0.29, 1.24)*	37	37
O'Neill 2022	0.25 (0.08, 0.43)*	242	256
Buedo-Guirado et al 2020	0.23 (-0.10, 0.57)	73	68
Roos et al 2016	0.00 (-0.44, 0.44)	43	37
Pirchio et al 2021	0.00 (-0.20, 0.20)	154	253
Lewis et al 2013	Favours intervention	Not reported	Not reported
Arola et al 2020	No change	Not reported	Not reported

*intervention group demonstrated significantly larger improvement in life satisfaction compared to control

¹ SMD provided where sufficient data are reported by study. If not, brief description of direction of statistically significant associations are provided.

Although pre- and post-intervention measures of life satisfaction were not reported in two studies (Lewis et al., 2013; Arola et al., 2023), both reported a beneficial impact of their intervention on life satisfaction. This included non-significant results from a ‘Seniors Meeting’ intervention providing information on ageing, sedentarism, and social activities delivered to older migrants to Sweden (Arola et al., 2023) and significant results from a school-based intervention which involved 70-140 20min lectures on health promotion and social-emotional learning (Lewis et al., 2013). There was evidence in this subtheme that interventions for older adults have significant effect sizes.

3.6 Theme 4 Social media (n=4)

Four interventions examined the impact of reducing social media use, with two coming from similar arms within the same study (see Table 18). The largest effect size was observed where heavy Instagram participants abstained from using the application for one week (Fioravanti et al., 2020). Improvements in life satisfaction were also reported in two intervention arms that mandated reduction or abstinence in smart phone use (Brailovskaia et al., 2022). Finally, the least intense intervention, reducing Facebook use by 20 minutes per day, did not improve life satisfaction compared to the control group (Brailovskaia et al., 2020). While there is some evidence that social media interventions may have potential to improve life satisfaction, overall, there was **insufficient evidence** to provide any reliable conclusions as this subtheme contains four interventions. Additionally, the research in this theme is narrow in scope; for example, these interventions only involve abstinence or reduction of social media use rather than different types of social media use, such as using image-based vs long-form social media.

Table 18. Summary of findings from social media sub-theme (n=4)

Study	Findings¹	Sample size (intervention)	Sample size (control)
Fioravanti et al 2020	0.84 (0.38, 1.30)*	40	40
Brailovskaia et al 2022 (2 arms)	0.19 (0.01, 0.36)*	389	193
Brailovskaia et al 2020	-0.05 (-0.28, 0.18)	140	146

* intervention group demonstrated significantly larger improvement in life satisfaction compared to control

¹ SMD provided where sufficient data are reported by study.

3.7 Theme 5 Music (n=3)

All three music-related interventions were delivered to older adults, two in a nursing home and one at a local theatre (see Table 19). A large effect size was observed for a high-intensity 6-week series of group music sessions (2x group and 2x individual sessions per week), facilitating singing, clapping, or trying instruments among older adults from a residential centre (Castillejos & Godoy-Izquierdo, 2021). There was also a moderate effect size of a 16-week group (2x per week for 2 hours) singing intervention, delivered in a nursing home, which culminated in a public performance (Galinha et al., 2021). Interestingly, when the singing intervention was repeated in a local theatre and targeted towards retired adults, there was no effect on life satisfaction (Galinha et al., 2023). While there appears to be promising life satisfaction benefits for group interventions delivered in nursing homes, overall, there was **insufficient evidence** in this subtheme.

Table 19. Summary of findings from emotional regulation sub-theme (n=3)

Study	Findings ¹	Sample size (intervention)	Sample size (control)
Castillejos & Godoy-Izquierdo 2021	0.86 (0.27, 1.44)*	25	25
Galinha et al 2021	0.37 (0.04, 0.70)*	89	60
Galinha et al 2023	No change	89	48

* intervention group demonstrated significantly larger improvement in life satisfaction compared to control

¹ SMD provided where sufficient data are reported by study. If not, brief description of direction of statistically significant associations are provided.

3.8 Theme 6 Multi-component interventions (n=12)

Finally, there were 12 interventions which did not fit under a single theme above due to their multi-component design. Most frequently, these were multi-faceted wellbeing programmes; for example, some studies combined yoga, meditation, and gratitude (Frost, 2019, Koncz et al., 2023), meditation and blocking blue light from technology before sleep (Ludwigs et al., 2019), CBT training, goal setting, and mindfulness activities (Marrero et al., 2016), and gratitude journaling, acts of kindness, and visualisation (Hearon, 2017). There was **mixed evidence within this subtheme**; similar to the ‘other intrapersonal emotional activities’ subtheme, nuanced interpretation is required due to the substantial diversity in intervention design and delivery.

Four of twelve interventions are described further below, as these each reported significant improvement in life satisfaction from baseline to post-intervention compared to the control group (see Table 20). The three interventions that demonstrated the largest effect sizes were grounded in psychology, although delivered to diverse target groups. For example, a large effect size was reported from a group wellbeing programme for older adults living in a seniors residence intervention (Chamorro-Garrido et al., 2021). This 11-week programme involved group-based sessions led by a psychologist, focusing on topics such as autobiographical memory, forgiveness, gratitude, and sense of humour.

Two other group-based interventions with significant moderate effect sizes were a combined 10 hours of positive psychology training with exercise delivered to teachers over a six-week period (Rahm & Heise, 2019), and a 12-week programme combining elements of CBT with training in happiness, setting life goals, mindfulness, and gratitude (Marrero et al., 2016). Furthermore, Bird et al. (2014) reported that life satisfaction improved in children attending a school-based 'Leadership and Young Professionals' programme at a high poverty school in the USA, which focused on goal setting, wellbeing, problem-solving, employability, and gratitude but did not include sufficient data to determine an effect size. Finally, Haga et al. (2021) had the largest sample size in this subtheme (n=1322), but did not report a significant effect size. **Overall, these studies suggest that complex, multi-component interventions targeted at specific samples may be effective in improving life satisfaction**, however the specific components that make it successful require further exploration.

Table 20. Summary of findings from multi-component sub-theme (n=12)

Study	Findings ¹	Sample size (intervention)	Sample size (control)
Chamorro-Garrido et al 2021	0.92 (0.44, 1.41)*	36	36
Rahm & Heise 2019	0.54 (0.12, 0.97)*	42	47
Marrero et al 2016	0.53 (0.05, 1.11)*	25	23
Koncz et al 2023	0.49 (-0.01, 0.99)	42	26
Ludwigs et al 2019	0.14 (-0.14, 0.42)	96	106
Frost 2019	0.08 (-0.29, 0.45)	56	55
Dambrun and Dubuy 2014	0.02 (-0.85, 0.88)	12	9
Haga et al 2021	0.00 (-0.14, 0.14)	678	644

Flinchbaugh et al 2012 (2 arms)	-0.11 (-0.72, 0.49)	51	22 ²
Hearon 2017	0.21 (-0.56, 0.14)	61	67
Bird 2014	Favours intervention	Not reported	Not reported

*intervention group demonstrated significantly larger improvement in life satisfaction compared to control

¹ SMD provided where sufficient data are reported by study. If not, brief description of direction of statistically significant associations are provided.

² Control group split across three arms (two included here; original n=33)

3.9 Critical appraisal

The quality of both RCT and quasi-experimental studies included in the review was high, likely due to the review’s stringent inclusion criteria. The RCT checklist was completed for 166 papers, with scores ranging from 7 to 13 (see Figure 10). Almost half of the papers scored 11 and eight papers fulfilled all criteria (i.e. scored 13 of 13).

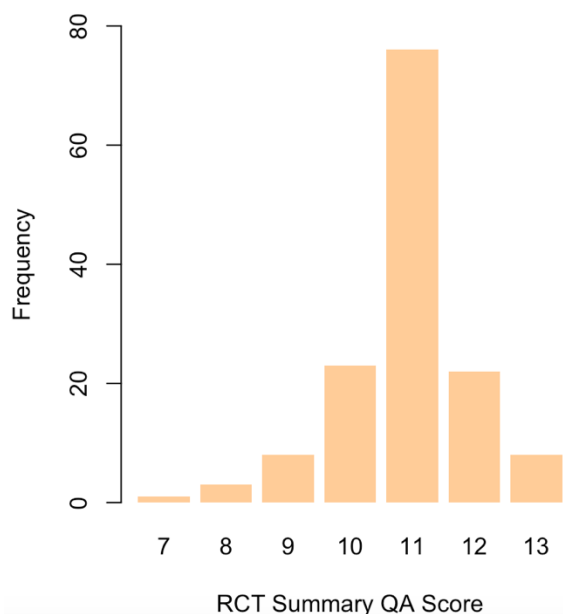


Figure 10. Quality appraisal scores for RCT studies (n=166)

Several criteria were required to be met for inclusion in the review; this included ensuring outcome measures were similar between treatment groups, and that reliable outcome measures were used. Additionally, all papers met the criterion that treatment groups were treated identically other than the intervention delivery. All but one paper fulfilled the three statistics criteria; this included whether participants were analysed in the groups they were assigned, appropriate statistical analysis was used, and the trial design was appropriate. Most studies (n=149) successfully met all three criteria in the selection section; this

included whether true randomisation was used, allocation to treatment groups was blind, and treatment groups were similar at baseline.

The primary area where studies did not meet checklist criteria was blinding, which is logical given that the nature of the included interventions. Specifically, most studies (n=149) failed to meet the criterion that those delivering the intervention were blind, and approximately two-thirds of studies (n=120) failed to meet the criteria that participants were blind to treatment assignment. A total of 57 studies failed to meet criteria that assessors were blind to treatment assignment. A total of 11 studies failed the retention criteria; this was most commonly because there was loss to follow-up throughout the intervention and it was not adequately described.

The remaining 22 papers were quasi-experimental studies. Out of a potential score of nine, 13 studies scored eight and nine papers fulfilled all criteria. Five of the nine criteria on the appraisal check-list were once again required for inclusion in the review: control group, pre-post measures available, pre-post data measured in the same way, reliable outcome measurement, and clear cause and effect. Three other criteria were met by all 22 studies; this included similar participants in control and intervention groups, similar treatment aside from intervention and appropriate statistical analysis used. However, 13 studies failed to meet the final criterion point on whether follow up was complete and, if not, whether it was adequately described. In cases where this criterion was not met, description of incomplete follow-up was most commonly omitted, although several papers mentioned it as a limitation that dropout analysis was beyond the scope of the work (e.g., Lyssenko et al., 2015; Lyssenko et al., 2019).

4. Results: Observational review

4.1 Search results

After de-duplication of records identified in the five database searches, 5128 records underwent the initial title-abstract screening, with 1074 moving forward to full-text screening and 46 studies meeting the inclusion criteria. In the grey literature search, a total of 584 records were identified, with 22 moving forward to full-text screening and three additional studies meeting inclusion criteria. Therefore, a total of 49 studies were included in the observational review; one record including two same-authored papers employing identical data from the same sample (Dolan & Lordan, 2019; Dolan & Lordan, 2013). Hierarchical exclusion reasons for all records that underwent full-text screening in the database or grey literature search are provided in Figure 11. Over 500 non-UK studies met initial criteria but, to manage the scope of the review, were excluded from the review. International literature is therefore an area for further exploration. A list of included studies is included in Appendix D.

4.2 Overview of included records

4.2.1 Characteristics of included studies

Summary characteristics of the included studies are provided in Table 21. Out of the total 49 records included for analysis in the observational review, the majority were peer-reviewed publications (n=45; 91.8%), with the remainder being two research reports and two discussion papers. More than half of studies (n=26; 53.1%) did not report the specific age range of their sample at baseline. Of those that provided details about the age range (n=23), sixteen studies (69.6%) encompassed the full adult lifespan, with participants ranging from a minimum age of 15 to a maximum age of 104, while the remainder focused on a birth cohort (i.e. those born within a single week of one another) (n=7; 30.4%).

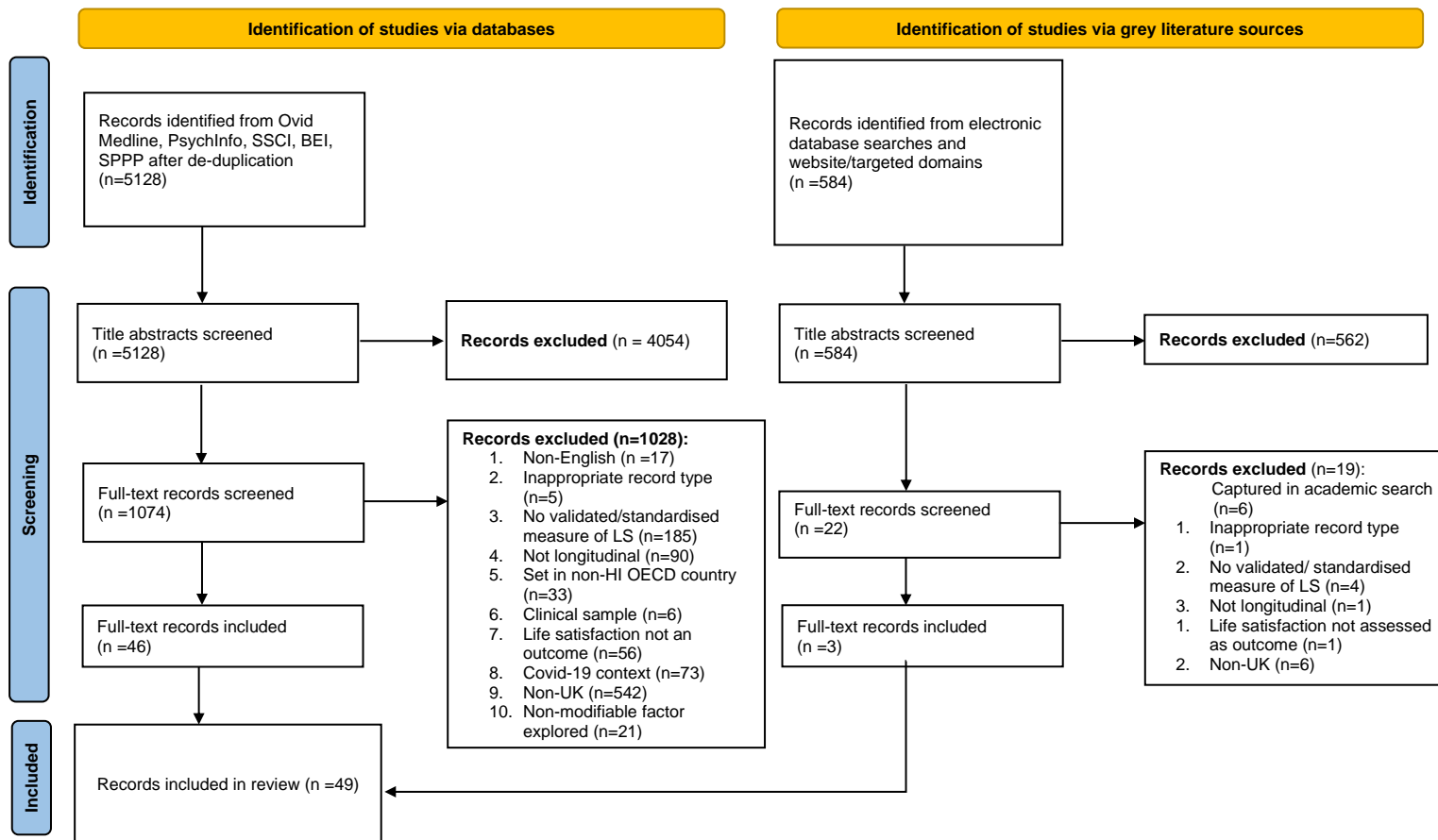


Figure 11. PRISMA diagram outlining records identified in search, screened and included in final observational review

All studies utilised data derived from one or more of eight established longitudinal cohort and panel studies that specifically target populations in England, Great Britain, or the United Kingdom. The most frequently used panel and cohort study was Understanding Society (The UK Household Longitudinal Study), employed by 18 studies (36.7%). It was followed by the British Household Panel Survey (BHPS) (n=16, 32.7%) and the English Longitudinal Study of Ageing (ELSA) (n=10, 20.4%). Seven studies (14.3%) utilised data from multiple cohort or panel studies. Further detail on each of these eight studies is provided in Table 22. Therefore, approximately half of these records investigated sample populations across the entirety of the United Kingdom (n=25; 51.0%), nine studies (18.4%) on the population in Great Britain, and 15 studies (30.6%) focused solely on the population in England.

Sample sizes were large, ranging from 372 (Bartram, 2018) to 352,016 (Braakmann, 2021). The majority of studies had over 10,000 participants (n=28; 57.1%), with only 3 (6.1%) having fewer than 1,000. Follow-up time ranged from 1 (Powdthavee et al., 2019) to 50 (birth cohort born in 1958; Frijters et al., 2014) years, with 5 (10%) studies having over 20 years of follow-up between initial measurement of factor and final life satisfaction outcome measure. Three quarters of the included studies used a single-item measure of life satisfaction; this included a five-point scale (n=1; 2.0%), seven-point scale (n=28; 57.1%) and the ONS 11-point scale (n=9; 18.4%). Twelve (24.4%) studies used the Satisfaction with Life Scale (SWLS) – a five-item instrument with a seven-point scale. One study combined data from two cohorts that used different scales: an ONS 11-point and a five-point scale (Gagné et al., 2022).

Table 21. Characteristics of studies included in the observational review (n=49)

CHARACTERISTIC	N (%)
Evidence type	
Peer-reviewed publication	45 (91.8)
Research report	2 (4.1)
Discussion paper	2 (4.1)
Country	
United Kingdom (England, Scotland, Wales, and Northern Ireland)	25 (51.0)
England	15 (30.6)
Great Britain (England, Scotland, and Wales)	9 (18.4)
Type of panel or cohort study used^a	
Understanding Society (The UK Household Longitudinal Study)	18 (36.7)
British Household Panel Survey	16 (32.7)
English Longitudinal Study of Ageing	10 (20.4)
1970 British Cohort Study	5 (10.2)
1958 National Child Development Study	3 (6.1)
Life Opportunities Survey	1 (2.0)
Next Steps	1 (2.0)
UK Millennium Cohort Study	1 (2.0)
Sample size	
0-1,000	3 (6.1)
1,001-10,000	18 (36.7)
10,001-50,000	21 (42.9)
50,001-100,000	4 (8.2)
100,001+	3 (6.1)
Maximal follow-up time in years^b	
1-5	13 (26.0)
6-10	18 (36.7)
11-15	7 (14.3)
16-20	7 (14.3)
21+	5 (10.0)
Life satisfaction measure^c	
Single-item measure other scale (7-point)	28 (57.1)
Satisfaction With Life Scale	12 (24.5)
Single-item measure: ONS 11-point	9 (18.4)
Single-item measure other scale (5-point)	1 (2.0)

^a Several studies used more than one panel

^b One study compared two cohorts from different studies with distinct follow-up periods

^c One study combined data from two cohorts with different scales (ONS 11-point & single-item 5-point scale)

Table 22. Descriptive of the eight cohort studies that provided data included in the review

Panel/cohort study	Countr(ies)	Info about the panel/cohort study
British Household Panel Survey	GB, UK from '01	Began in 1991 with a stratified random sample comprising residents of 5538 households aged 16 and over; new households were added in subsequent waves
Understanding Society (The UK Household Longitudinal Study)	UK	Began in 2009 and interviewed around 40,000 households, including around 8,000 of the original BHPS households.
English Longitudinal Study of Ageing	England	Collects data from people aged over 50 to understand all aspects of ageing in England; more than 19,000 people have taken part in the study since 2002
Life Opportunities Survey	GB	Carried out between 2009 and 2014 by the ONS for the Office for Disability Issues to understand the lives of disabled people and what needs to be done.
1958 National Child Development Study	GB	Birth cohort: >17,000 people born in a single week of 1958.
1970 British Cohort Study	GB	Birth cohort: >17,000 people born in a single week of 1970.
Next Steps (Longitudinal Study of Young People in England)	England	Birth cohort: previously known as the Longitudinal Study of Young People in England (LSYPE), ~16,000 people born in 1989-90.
UK Millennium Cohort Study	UK	Birth cohort: 19,000 young people born in 2000-02.

4.2.2 Mapping and overview of observational themes

During data extraction and synthesis, a broad range of factors, including micro/personal factors such as health conditions, community participation, social networks, and income changes, as well as meso and macro factors such as environmental surroundings, Brexit, and the financial crisis, were identified. The factors covered in all included studies were categorised into six themes:

- I. Economic and financial situations (n=13);
- II. Education and employment (n=14);
- III. Social capital (n=13);
- IV. Health and wellness (n=11);

- V. Environment (n=4);
- VI. Arts and culture (n=5).

More than a third of all included papers explored more than one factor, with several falling under multiple theme categories. The ‘Education and employment’, ‘Social capital’, and ‘Health and health promotion’ themes each consisted of two subthemes. The mapping summary of the six main themes, covering nine total subthemes, is shown in Figure 12. Results are described by subtheme, with each relevant section containing key details of each included study (and factor). **Complete data on each study is provided in the study look-up table in Appendix E.**

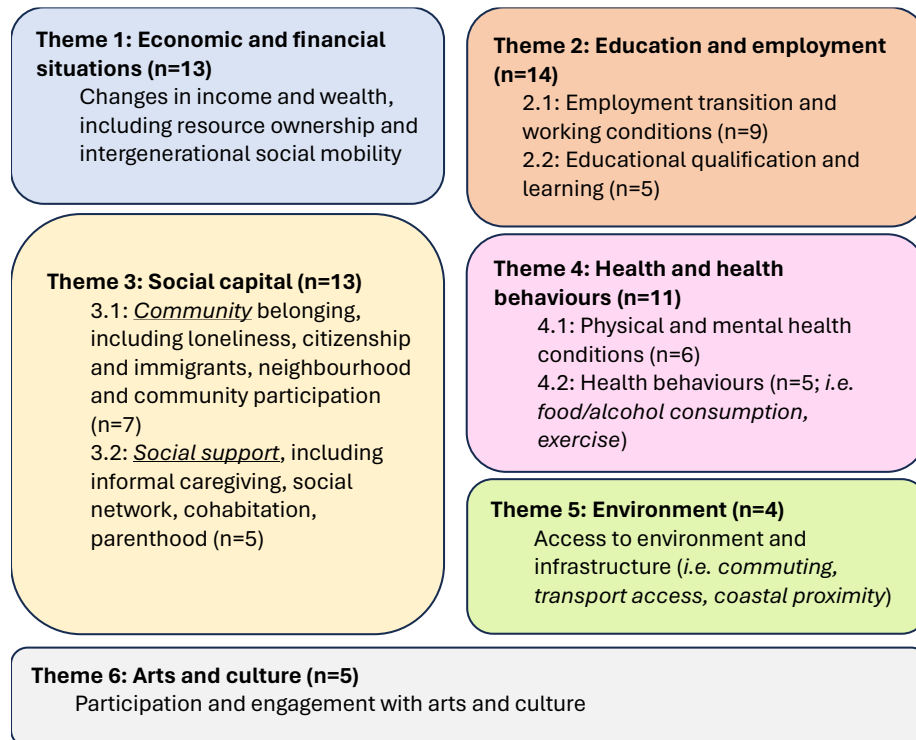


Figure 12. Mapping overview of key themes and subthemes included in the observational review

Table 23. Summary characteristics of (sub)theme and theme descriptions

Theme	Sub-theme	Theme description	Number
1 Economic and financial situations	Income and wealth (n=13)	Economic and financial factors, including resource ownership, income, and macroeconomic situations, that affect individuals' satisfaction with life over time	13
2 Education and employment	2.1 Employment transition and working conditions (n=9) 2.2 Educational qualification and learning (n=5)	Factors encompassing individuals' past and present engagement with learning and training, their work conditions and engagement, and occupational mobility, all influencing individuals' satisfaction with life over time	14
3 Social capital	3.1 Community belonging (n=7) 3.2 Social support (n=5)	Social factors including connections with others, a sense of belonging in the neighbourhood, community, and the nation, as well as active participation in various social groups, that affect individuals' satisfaction with life over time	12
4 Health and health promotion	4.1 Physical and mental health conditions (n=6) 4.2 Health promotion (n=5)	Factors encompassing individuals' health conditions and wellness activities in the pursuit of good health that affect individuals' satisfaction with life over time	11
5 Environment	5.1 Access to environment and infrastructure (n=3) 5.2 Neighbourhood safety (n=1)	Physical environment factors, such as safety, access to nature, and infrastructure, that affect individuals' satisfaction with life over time	4
6 Arts and Culture	Participation and engagement with arts and culture (n=5)	Factors encompassing individuals' participation and engagement with arts and cultural activities, that affect individuals' satisfaction with life over time	5

4.3 Theme 1: Economic and financial situations

A total of 13 papers examined the longitudinal impact of income and wealth on life satisfaction; seven focused on income-related factors, with others exploring resource ownership, and intergenerational social mobility.

INCOME. Seven papers explored various components of income; this included changes in income, relative income mobility, future financial expectations, fuel poverty (as measured based on the income-fuel cost relationship) and the gap between own and partner's income. All seven studies investigating the longitudinal impact of income-related factors (e.g. changes, absolute income, relative perceptions) on individuals' life satisfaction reported a strong positive association between the two (Becchetti et al., 2011; Charles et al., 2019; Cheung & Lucas, 2015; Davillas et al., 2022; Ekici & Koydemir, 2016; Fitzroy & Nolan, 2020; Gash & Plagnol, 2021). Age, gender, and education were identified as important moderating variables (Cheung & Lucas, 2015; FitzRoy & Nolan, 2020; Gash & Plagnol, 2021), with most studies employing complex modelling techniques to explore income and life satisfaction changes over many waves of panel data. In one study, there was evidence to suggest that the effect was non-linear such that the association weakened and then turned negative at very high-income levels (Charles et al., 2019). Another notable study explored differences in pay between heterosexual partners over time. Here, men who earned less than their partner had lower life satisfaction than men who were equal or primary earners and demonstrated improvements in life satisfaction when their proportion of earnings relative to their partner increased. Conversely, there was no association between women's earning position and life satisfaction (Gash & Plagnol, 2021).

RESOURCE OWNERSHIP. Three papers explored whether car and house ownership – both indicators of resource ownership and often higher socioeconomic position – were associated with subsequent life satisfaction over multiple time periods (Charles et al., 2019; Emmerling & Qari, 2017, Gagné et al., 2022). In those born in 1970 (BCS70) and those born in 1989-1990 (Next Steps), those who owned a house by age 25-26 had higher life satisfaction than those still living with their parents (Gagné et al., 2022). Home ownership was strongly associated with higher life satisfaction both before and after the 2008 financial

crisis. Although renting a home was also associated with higher life satisfaction before the financial crisis (1996–2008), this association turned negative after the financial crisis (2009–2014) (Charles et al., 2019). Conversely, car ownership was negatively associated with life satisfaction, initially leading to a decrease in life satisfaction of about one-third overall within five years of a purchase. However, beyond this period, life satisfaction rebounded to the baseline level observed before the purchase was made (Emmerling & Qari, 2017). The longitudinal impact of resource ownership on life satisfaction appears to vary depending on the type and age of resources individuals possess, although the limited number of studies investigating this makes it challenging to draw general conclusions.

INTERGENERATIONAL MOBILITY. Four studies examined the association between intergenerational social mobility – defined as an individual's improvement in living standards and social position relative to that of their parents – and their life satisfaction at a later age (Bridger & Daly, 2020; Dolan & Lordan, 2019; Hadjar & Samuel, 2020). Data from two birth cohort studies – BCS70 (n=16,569) and NCDS (n=17,416) – suggest that upward intergenerational social mobility (measured by current educational attainment, occupational class, and home size compared to parental measures during childhood) positively predicted changes in life satisfaction from ages 30 to 42 (Bridger & Daly, 2020; Dolan & Lordan, 2019). About half of this association was mediated by self-reported financial difficulties and self-rated health. Conversely, data from 12 waves of the BHPS (1996–2008; age range: 25-85) suggested that upward intergenerational social mobility was associated with lower life satisfaction, due to a dissociative effect of leaving one's class of origin (Hadjar & Samuel, 2015). Intragenerational social mobility (e.g. change in socioeconomic position from one data collection wave to the next) had no association with life satisfaction (Hadjar & Samuel, 2015). One study conducted an in-depth exploration of how much childhood factors could predict life satisfaction between ages 22 and 50, looking at 19, 16, 18 and 22 different variables at birth, age 7, age 11 and age 16, respectively (Frijters et al., 2014). They reported that up to 7% of adult life satisfaction could be explained by age 16, although depth and reporting of individual associations was not clear.

Overall, economic indicators were positive determinants of higher life satisfaction, although associations did appear to differ by age, education and gender. Table 24 provides a brief summary of each study in Theme 1, including sample, factors explored and key findings.

Table 24. Summary of studies included in Theme 1: Economic and financial situations (n=13)

Reference	Description of sample (analytical sample size)	Follow-up (years) ¹	Factor of interest	Description of measurement of factor	Direction of association
Becchetti et al, 2011	BHPS working-age adults (n=71228)	14	Income changes	Continuous variable: personal and household incomes deflated by the price index, £/monthly (changes between waves)	↑ LS
Bridger & Daly, 2020	BCS70 and 1958 NCDS participants aged 42 (n=20948)	42	Intergenerational mobility	Self-report measures: parental occupational class at birth; occupational class at age 42, age when left formal education, and dwelling size (number of rooms), parents' and participants' income (i.e. gross vs. net income; banded vs. continuous measures), parental education (collected at birth in the BCS and when the child was 16 in the NCDS).	↑ LS
Charles et al, 2019	BHPS/UKHLS working-age adults (n=139950)	4 to 6	Income domain	(i) income variable; (ii) spouse/partner's pay	↑ LS
			Housing domain	(i) Home ownership or on mortgage; (ii) Home rental; (iii) Paying for house	↑ LS
Cheung & Lucas, 2015	BHPS adults in paid employment or receiving pension (n=24578)	10	Income changes	Post-tax household income from Cross-National Equivalent File	↑ LS
Davillas et al, 2022	General sample from the US cohort (n=6854)	9	Fuel poverty: fuel cost balance	Two indicators: LIHC (high costs, low income) & 10% fuel poverty indicator (spend 10%+ of the household income on energy)	↓ LS
			Fuel poverty: heating deprivation	IHEAT indicator: inability to keep their accommodation warm during winter (for any possible reason)	
			Fuel poverty: composite measure	Composite (i) IHEAT-LIHC indicator (ii) IHEAT-FP10 indicator	
Dolan & Lordan, 2019	BCS70 participants aged 30 (n=4845)	30	Intergenerational mobility	(i) Self-report family total gross weekly income falls in childhood (ii) At ages 30 and 34 the BCS child was asked to state in £s both their own and their partners usual take home pay after 'all deductions. Income mobility is weekly net income from adulthood (age 30/34 in 2004 prices) minus weekly net income from childhood (age 10 in 2004 prices).	↑ LS

Ekici & Koydemir, 2016	US participants between the ages of 25 and 65 (n=49281)	2	Income expectations (future financial expectations and current realisation)	i) "How well would you say you are managing yourself financially these days?" (5-point scale response) ii) "Looking ahead, how do you think you will be financially a year from now?" (3-point scale)	↑ LS
Emmerling & Qari, 2017	BHPS participants (n=116773)	12	Car ownership	A self-report of the purchase of an automobile and time since the last purchase	↓LS
FitzRoy & Nolan, 2020	BHPS/US working-age adults (n=23748)	19	Income	Monthly household income (relative changes wave to wave)	↑ LS
Frijters et al, 2014	1958 NCDS participants aged 50 (n=4400)	50	High number of childhood determinants	19 variables at birth, 26 variables at age 7, 18 variables at age 11, 22 variables at age 16	↑ LS
			Social class	Father's occupational class	↑ LS
			Household income	Household weekly income at age 16	↑ LS
Gagné et al , 2022	(i) BCS70 tracked from ages 5 to 26; (ii) NS tracked from ages 13-14 to 25-26 (n=16039)	25; 9	Home ownership	Two indicators: whether the young person still lives with their parents and housing tenure.	↑ LS
Gash & Plagnol, 2021	UKHLS matched married co-resident respondents (n=23580)	8	Partner pay gap; relative changes in partner pay gap	Defined as the respondent's total earned income contribution divided by the sum total of own income and the cohabiting spouse's income. Changes between waves also examined	↑ LS
Hadjar & Samuel, 2015	BHPS participants between ages 25 and 85, who mention British as their first citizenship (n=34970)	12	Intragenerational mobility	Change in the class position from the previous year; based on a slightly condensed version of the Erikson–Goldthorpe–Portocarero class scheme	null
			Intergenerational mobility	Relation between participant's position at the time of data gathering (wave) and the highest class position achieved by the parents at age of 14; based on a slightly condensed version of the Erikson–Goldthorpe–Portocarero class scheme	↓LS

British Household Panel Survey (BHPS), 1970 British Cohort Study (BCS70), National Child Development Study 1958 cohort (NCDS), UK Household Longitudinal Study (UKHLS), Understanding Society (US); LS: life satisfaction

¹ Time between first baseline measurement and final follow-up life satisfaction measure

4.4 Theme 2 Education and Employment (n=14)

4.4.1. Employment transition and working conditions (n=9)

A total of nine papers examined the longitudinal impact of individuals' employment transitions or working conditions on their life satisfaction.

UNEMPLOYMENT. Across four studies focusing on unemployment, there was consistent evidence that unemployment was associated with lower subsequent life satisfaction (Clark & Lepinteur, 2019; Gagné et al; Inanc, 2016; Yap, 2012). There were negative impacts both on the individual themselves, and sometimes on the partner (Inanc, 2016), while several studies suggested there were irreversible, long-term effects. For example, total unemployment experience (i.e. from age of leaving education until assessment of life satisfaction at age 30) was associated with lower life satisfaction in the BCS70 birth cohort, even after adjusting for substantial childhood and adult covariates including current unemployment; here, the authors concluded that there are long-term repercussions – or “scarring effects” of unemployment (Clark & Lepinteur, 2019). This was also observed using data from 11 waves of the BHPS data (1996–2000, 2002–2007); here, life satisfaction of those who became unemployed dropped by 0.40 of a point (7-point scale) during unemployment (Average unemployment period: 1.2), and did not return to baseline even after unemployment ended (Yap et al., 2012).

WORKING CONDITIONS. There was a positive impact of job satisfaction on subsequent life satisfaction, although this relationship varied substantially across specific characteristics such as age, education, gender, household member status. For example, in one study, associations between job satisfaction and life satisfaction were stronger in those with higher education, with no evidence of an association in individuals aged over 55 (Bialowolski & Weziak-Bialowolska, 2021). The overall association was also bidirectional, with those experiencing greater life satisfaction also reporting higher subsequent job satisfaction.

Although total number of working hours had no effect, a mismatch between desired and actual working hours (e.g. working fewer or more hours than preferred) was associated with lower life satisfaction (Angrave & Charlwood, 2015). Flexible working policies, however, may

not necessarily be instrumental in improving life satisfaction. One study followed the implementation of the UK Flexible Working Act (2003), amongst a small group of mothers (n=548; children born between Sept 2000 and Jan 2002) whose employers did not previously offer flexible working arrangements. The change was not associated with any effect on the life satisfaction of mothers (Avendano & Panico, 2018).

RETIREMENT TRANSITIONS. Both retirement and returning to employment at an older age were associated with increased life satisfaction. Utilising data from the waves spanning 1996–2000 and 2002–2008 of the BHPS, Lux & Scherger (2017) found that re-entering employment between the ages of 65 and 75 led to a significant improvement in life satisfaction by 0.25 of a point (7-point scale), with minimal differences across low- and high-class occupations. Transition from work into retirement between ages 58 and 64 years (ELSA; 2004–2016 waves) was associated with an increase in individuals’ life satisfaction over a two-year period. However, this association was not consistent for all individuals, with many moderating factors such as income, functional capacities, network size, and social relationships (Wetzel et al., 2023).

Amongst both mixed and insufficient evidence for several work-related conditions, **unemployment demonstrated consistent and long-lasting associations with poor life satisfaction.** Table 25 provides a brief summary of each study in the ‘Employment transition and working conditions’ subtheme, including sample, factors explored and key findings.

Table 25. Summary of studies included in the ‘Employment transition and working conditions’ subtheme (n=9)

Reference	Description of sample (analytical sample size)	Follow-up (years) ¹	Factor of interest	Description of measurement of factor	Direction of association
Angrave & Charlwood, 2015	BHPS working age participants working irregular hours (n=74326)	18	Working hours	"Think about the hours you work, assuming that you would be paid the same amount per hour, would you prefer to work fewer hours, more hours, or the same number of hours?"	mixed
Avendano & Panico, 2018	Mothers of UK MCS employed in 2001–2002 (n=6424)	8	Flexible work policy effectiveness	A self-reported variable on whether their employer offer any of the flexible working arrangements (part-time working, job-sharing, flexitime, home working, special shifts (ie, evening, school hours), 9day fortnights/4day working weeks (for full- time workers), or school term-time contracts)	no association
Bialowolski & Weziak-Bialowolska, 2021	BHPS/UKHLS working-age adults (n=51247)	19	Job satisfaction	Single question: “All things considered, which number best describes how satisfied or dissatisfied you are with your present job overall?” (1-7)	↑ LS
Clark & Lepinteur, 2019	BCS70 participants aged 30 (n=9779)	Up to 30	Unemployment history	A self-reported variable; respondents in the 5th sweep, at age 30, were asked to report their last ten episodes on the labour market. Potential statuses are: full-time employed, part-time employed, full-time self-employed, part-time self-employed, unemployed seeking work, full-time education, government training scheme, temporarily sick/disabled, permanently sick/disabled, looking after home/family, wholly retired, and other.	↓LS
Gagné et al, 2022	(i) BCS70 participants tracked from ages 5 to 26; (ii) NS participants tracked from ages 13-14 to 25-26 (n=16039)	25; 9	Employment status	Measured using information derived by the two cohort studies: 1) full-time employed, 2) part-time employed, 3) unemployed, 4) full-time student, 5) other (e.g., at-home, disability, military).	↑ LS
Inanc, 2018	BHPS participants who are either married or with a cohabiting partner and	17	Labour market insecurity	Constructed by combining data on employment status and contract type, leading to a four-category indicator: i) permanent	↓LS

	in heterosexual relationships. (n=10193)			employee; ii) temporary employee; iii) unemployed; iv) out of labour force (self-employees are excluded from the analysis as they represent a highly heterogeneous group.).	
Lux & Scherger, 2017	BHPS respondents who start to work again after age 65 and respondents without any work between ages 65 and 75. (n=2941)	4	Working status after jobless period in post-pension years (i.e. after retirement)	A self report of their working status: (a) full-time employed, part-time employed, self-employed or marginally/irregularly employed; or (b) currently have some kind of second job; or (c) if they have been engaged in paid work in the last seven days.	↑ LS
Wetzel et al, 2023	ELSA participants aged 50 years and above (n=991)	12	Retirement transition resources	Resource indicators in retirement: (i) Economic resources; (ii) Personal resources; and (iii) Social-relational resources.	↑ LS
Yap et al, 2012	BHPS participants aged 16 or over (n=1458)	17	Unemployment	Experienced at least one bout of unemployment since a previous wave	↓LS

British Household Panel Survey (BHPS), Millennium Cohort Study (MCS), UK Household Longitudinal Study (UKHLS), 1970 British Cohort Study (BCS70), Next Steps (NS), English Longitudinal Study of Ageing (ELSA); LS: life satisfaction

¹ Time between first baseline measurement and final follow-up life satisfaction measure

4.4.2. Educational qualification and learning (n=5)

Five papers examined how differences in educational qualification and continuous participation in learning and training have a longitudinal impact on individuals' life satisfaction. Table 26 provides a brief summary of each study in the 'Educational qualification and learnings' subtheme, including sample, factors explored and key findings.

FORMAL EDUCATION QUALIFICATIONS. Despite an overall positive effect of educational qualifications, the associations were nuanced and differed by generation, gender and age. One study compared associations between having previously obtained a university degree and life satisfaction at the ages of 25-26 in two cohorts from different generations – BCS70 (all born in 1970) and the Next Steps cohort (all born in 1989/1990) (Gagné et al., 2022). Although both reported that males with a university degree had higher life satisfaction than those with no qualifications, this association was only present in females in the BCS70 study. This may indicate that the association between education and life satisfaction may be weaker in recent female generations. Data from another birth cohort study (NCDS; all born in 1958) showed that obtaining adult learning qualifications, accredited training or unaccredited/work training (between ages of 42 and 46) was associated with improvements in life satisfaction from age 46 to age 50 (Duckworth & Cara, 2012). However, adjustment for marital status, current socioeconomic position, and highest educational qualifications in early adulthood attenuated this association. Finally, data from working age adults across nearly two decades (covering 1996 to 2015 in BHPS/UKHLS) confirmed the positive impact of higher education level on life satisfaction trajectories in working age adults (Fitzroy & Nolan, 2020). Associations were complicated by income changes and the recession; for example, life satisfaction among those with lower educational qualifications rose after the crash, despite declining real income. In summary, **there was a strong positive effect of gaining education qualifications on life satisfaction**, although nuanced interpretation is required.

PARTICIPATION IN EDUCATION AND WORK TRAINING. Two studies examined the long-term impact of participation in other learning and work training on life satisfaction (Jenkins,

2011; Tregaskis & Nandi, 2023), revealing variations in the impact based on both the types of training and its intensity. In older adults in ELSA, there was no association between participation in formal education and training courses and change in life satisfaction (Jenkins, 2011). Another study by Tregaskis & Nandi (2023) explored in greater depth the effects of different types and intensities of training over a 10-year period (2010–2020). Broadly, additional training was associated with higher life satisfaction; this included high intensity job-related training, short intensity health and safety training, as well as low intensity participation in non-work training such as hobbies and leisure training.

Broadly, there were ***positive associations between both formal education and training with higher life satisfaction***, although associations appeared to differ by generational, gender, age and learning type.

Table 26. Summary of studies included in the ‘educational qualification and learning’ subtheme (n=5)

Reference	Description of sample (analytical sample size)	Follow-up (years) ¹	Factor of interest	Description of measurement of factor	Direction of association
Duckworth & Cara, 2012	NCDS participants aged 42 (n=7940)	8	New educational qualifications in mid adulthood	A self-report of any qualifications gained (accredited learning) since the last survey, including details of the type and level of qualification gained	↑ LS
			Participation in leisure or interest-related learning	A self-report of participation in any leisure or interest-related learning (accredited learning)	↑ LS
			Work-related training	A self-report of participation in work-related training (non-accredited learning)	↑ LS
FitzRoy & Nolan, 2020	BHPS/US working-age adults (n=23748)	19	Education	BHPS data: 3 groups from International standard Classification of Education (ISCED). Understanding Society data: no ISCED codings were available, hence the three-way split was undertaken on the basis of a less sophisticated derived highest qualification variable.	↑ LS
Gagné et al , 2022	(i) BCS70 participants tracked from ages 5 to 26; (ii) NS participants tracked from ages 13-14 to 25-26 (n=16039)	25; 9	Educational attainment	1970 cohort: National Vocational Qualifications (NVQ) scheme Next Steps cohort: used a derived variable created by the study team to measure education at ages 25-26.	↑ LS
Jenkins, 2011	ELSA participants aged 50 years and above living in private households in England (n=5518)	3	Formal education and training	Whether they had taken a formal education or training course in the previous 12 months.	Null
Tregaskis & Nandi, 2023	UKHLS participants aged 16 or over (n=45136)	10	Type of training	Three types of training over last year:: (i) job-related; (ii) hobbies and leisure-related; and (iii) health and safety-related training.	↑ LS

English Longitudinal Study of Ageing (ELSA), 1970 British Cohort Study (BCS70), National Child Development Study 1958 Cohort (NCDS), UK Household Longitudinal Study (UKHLS), Understanding Society (US), British Household Panel Survey (BHPS), UK Household Longitudinal Study (UKHLS), Understanding Society (US ; LS: life satisfaction

¹ Time between first baseline measurement and final follow-up life satisfaction measure

4.5 Theme 3 Social Capital (n=12)

A total of 12 papers examined the longitudinal impact of social factors on individuals' satisfaction with life over time. Social factors included connections with others, a sense of belonging in the neighbourhood, community, and the nation, as well as active participation in various social groups. These studies were categorised under two main sub-themes: (i) Community belonging (n=7) encompassing both micro (e.g. neighbourhood) and macro (e.g. political events) aspects of the sense of belonging; and (ii) Social support (n=5).

4.5.1. Community belonging (n=7)

Seven studies within this sub-theme ranged from micro aspects of belonging (e.g. perceptions towards and participation within neighbourhoods, participation in political and non-political organisations) to macro aspects (e.g. impact of major political events).

MICRO-LEVEL BELONGING. Participation in local neighbourhood activities (such as membership in tenant groups, resident groups, or neighbourhood watch groups) was not associated with life satisfaction over a 10-year follow-up period in ELSA participants aged 55+ (Fancourt & Steptoe, 2018). However, data from a 5-year follow-up in the same cohort demonstrated that perception of worse neighbourhood disorder (a 9-item scale encapsulating area cleanliness/physical neglect, relationship with neighbours and perceived safety) was associated with lower life satisfaction among adults aged 50 years and over, even after adjusting for covariates, with a small effect size (Toma et al., 2015).

Two studies reported weak associations of whether participation in political and non-political associations contributed to life satisfaction in older adults. Ten-year follow-up data from ELSA and data from up to 25 waves of BHPS suggested that participation in both political (e.g., political party, trade union or environmental groups) or non-political activities (e.g., religious groups, charitable associations, social clubs) were not associated with life satisfaction after a ten-year follow-up (Fancourt & Steptoe, 2018; Luhr et al., 2022). Despite no overall association between individual participation and life satisfaction, Luhr et al.

(2022) reported within-individual differences in older adults such that life satisfaction was higher during periods of participation compared to non-participation in those aged 65-75.

MACRO-LEVEL BELONGING. Four studies examined the longitudinal impact of macro-level political events on life satisfaction, with all largely finding no association between these factors and life satisfaction. This included exploring cohort trends of life satisfaction levels before and after the Brexit referendum (null difference; Powdthavee et al., 2019; Braakmann, 2021) and before and after the 2008 recession (null difference; Bayliss et al., 2017), as well as assessing whether immigrants in the UK experienced improvements in life satisfaction as a result of the ‘citizenship process’ (i.e., passing a Life in the UK test, attending a citizenship ceremony; Bartram, 2018). Despite no overall change in life satisfaction post-Brexit in UKHLS, those who indicated a preference for leaving the EU reported a brief increase in life satisfaction five months after the referendum (Powdthavee et al., 2019).

Evidence in this area ***primarily reported null associations*** between micro and macro factors related to belonging and life satisfaction. Table 27 provides a brief summary of each study in the ‘Community belonging’ subtheme, including sample, factors explored and key findings.

Table 27. Summary of studies included in ‘community belonging’ subtheme (n=7)

Reference	Description of sample (analytical sample size)	Follow-up (years) ¹	Factor of interest	Description of measurement of factor	Direction of association
Bartram, 2018	US participants who were non-citizens at Wave 1 (n=372)	5	Gaining UK citizenship	A self-reported variable; whether the respondent is a UK citizen	null
Bayliss et al, 2017	UKHLS working-age adults (n=10254)	6	Recession (the impact of the 2007/8 economic crisis)	Comparison over time from pre-recession to recession period	null
Braakmann, 2021	3 subsets of US participants: 1) EU-born respondents; 2) Did not hold British citizenship before 2015 election; 3) Partners of EU nationals (n=352016)	10	Brexit	Population-wide Brexit circumstances at 4 key timepoints: 1) May 15-June 16 (b/w General Election and referendum); 2) June 15-Jun 17 (b/w referendum and General Election); 3) Jun 17-Nov 18 (b/w General Election and first Withdrawal Agreement); 4) Nov 18-Dec 2019 (b/w Withdrawal Agreement and signing of Withdrawal Agreement)	null
Fancourt & Steptoe, 2018	ELSA participants aged 55+ (n=2548)	10	Community participation Community participation: Other participation	Self-reported whether member of political party, trade union or environmental groups;	null
				Self-reported whether member of tenant groups, resident groups, neighbourhood watch groups;	null
				Self-reported whether member of church or other religious groups;	null
				Self-reported whether member of charitable associations;	null
				Self-reported whether member of social clubs;	null
				Self-reported whether member of any other organisations, clubs or societies.	null
Luhr et al, 2022	BHPS/UKHLS participants in three contrasting age groups that represent distinct life stages with different goals and obligations (n=15568)	25	Voluntary participation	A self report of the frequency of volunteering (“We are interested in the things people do in their leisure time... Tell me how frequently you do each one... Do unpaid voluntary work”; 1–5) and active participation in various voluntary organizations (“Whether you are a member or not, do you join in the activities of any of these organisations on a regular basis?”; 0=no, 1=yes)	null

Powdthavee et al, 2019	UKHLS participants who responded to the question about EU membership preference. (n=18114)	1	Preferences for EU membership	A response to 'Should the United Kingdom remain a member of the European Union or leave the European Union?'	null
Toma et al, 2015	ELSA participants aged 50 years and above (n=6134)	4	Neighbourhood perceptions	A self report of 9-statements about neighbourhood disorder: 'How do you feel about your local area, that is, everywhere within a 20-min walk or about a mile of your home?'	↓LS

British Household Panel Survey (BHPS), UK Household Longitudinal Study (UKHLS), Understanding Society (US), English Longitudinal Study of Ageing (ELSA), English Longitudinal Study of Ageing (ELSA); LS: life satisfaction

¹ Time between first baseline measurement and final follow-up life satisfaction measure

4.5.2. *Social support (n=5)*

Three studies found that entering into marriage or cohabitation led to higher life satisfaction (Blekesaune., 2018; Gagné et al., 2022; Yap et al., 2012). For example, individuals reported a significant increase (increase of 0.31 on a 7-point scale) in life satisfaction in the year of the marriage, although this increase slowly returned to baseline over a 10-year period (Yap et al., 2012). Similar to marriage, the positive impact of parenthood on life satisfaction in the year of childbirth (an increase of 0.24 on a 7-point scale) gradually diminished over time as well (Yap et al., 2012). In a comparison of two birth cohort studies (those born in 1970, those born in 1989-1990), parenthood had no impact on males, with secular differences in mothers aged 25-26 (Gagné et al., 2022). Becoming a widow/widower was associated with a decline in life satisfaction (decrease of 0.81 on a 7-point scale) in the year of losing one's spouse, and there was no rebound bound to normal levels (Yap et al., 2012).

Data from two studies using ELSA data found a positive association between social networks and life satisfaction among older adults aged 50-years and above (Rafnsson et al., 2015; Rafnsson et al. (2017). Higher social network diversity (i.e. children, friends, other family), size (e.g. number of close relationships) and frequency of contact were each independently associated with higher life satisfaction after a 6-year follow-up (Rafnsson et al., 2015). Individuals who reported spousal or child caregiving responsibilities at baseline and 2-years later had lower life satisfaction than those with no caring responsibilities at either age, or those entering or exiting care duties (Rafnsson et al., 2017). Interestingly, those who began caring for other kin (i.e. parents, parent-in-laws, other relatives, friends/neighbours) had higher life satisfaction than those with no care-giving responsibilities (Rafnsson et al., 2017).

Although wider community belonging largely did not show significant associations with life satisfaction, **all factors related to close relationships and support networks, including cohabitation, marriage, childbirth, informal caregiving, and network formation**, were positively associated with life satisfaction. Table 28 provides a brief summary of each study in the 'social support' subtheme, including sample, factors explored and key findings.

Table 28. Summary of studies included in ‘social support’ subtheme (n=5)

Reference	Description of sample (analytical sample size)	Follow-up (years) ¹	Factor of interest	Description of measurement of factor	Direction of association
Blekesaune, 2018	BHPS adults who have never married or who have previously been married (n=2976)	12	Cohabitation and marriage	Data from a family history file with partnership transition and marital history records	↑ LS
Gagné et al, 2022	(i) BCS70 participants tracked from ages 5 to 26; (ii) NS participants tracked from ages 13-14 to 25-26 (n=16039)	25; 9	Relationship status	Single indicator marital status and cohabitation: 1) single, 2) cohabiting with a partner, 3) married, and 4) divorced, separated, or widowed.	↑ LS
			Parenthood	Measured using the household grid questionnaire into a single variable: 1) 0 children; 2) 1 child; 3) 2+ children.	↑ LS
			Social network diversity	Three self-report questions regarding having children, other immediate family, or friends, form a scale from 0 to 3, with higher scores representing greater social network diversity.	null
Rafnsson et al, 2015	ELSA participants aged 50 years and above (n=4116)	6	Social network size	Combined three self-report questions that asked participants about the number of children/friends/ other immediate family (e.g., siblings or cousins) they thought they had a close relationship with (max= 30)	↑ LS
			Social network contact frequency	Combined self-report questions on how often respondents meet up with, speak on the phone to, or e-mail/write to various kin options (their children, other family, or friends) (total contact freq scale: 0 to 18)	↑ LS
Rafnsson et al, 2017	ELSA participants aged 50 years and above (n=4116)	2	Informal care giving	A self report of: (i) ‘Did you do any of the following activities in the last month (i.e. cared for someone)?’; and (ii) ‘Did you look after anyone in the last week (including your partner or other people in your household)? By ‘look after’ we mean the active provision of care.’	mixed
Yap et al., 2012	BHPS participants aged 16 or over (n= 1366; 1,742, 562)	17	Major life events: marriage	A self-report that they had never been married, got married at some point during the study, or stayed married during their participation in the study	↑ LS
			Childbirth	A self-report that they had their first child at some point during their participation in the study.	↑ LS
			Widowhood	Those who married when life satisfaction data collection began, became widowed, and did not remarry during the duration of the study.	↓LS

British Household Panel Survey (BHPS), English Longitudinal Study of Ageing (ELSA), 1970 British Cohort Study (BCS70), Next Steps (NS)

¹ Time between first baseline measurement and final follow-up life satisfaction measure

4.6 Theme 4 Health and health behaviours (n=11)

A total of 11 papers examined the longitudinal impact of changes in health and wellness on life satisfaction. These papers were categorised under two main themes: (i) physical and mental health (n=6) and (ii) health behaviours (n=5).

4.6.1. Physical and mental health (n=6)

There was a strong negative effect of declining physical health and disability acquisition on life satisfaction over time among adults of all ages (Aitken et al., 2021; Charles et al., 2019). For instance, data from the Life Opportunities Survey found that the life satisfaction score, as measured by a ONS 11-point scale single-item question, was 0.76 (95% CI: -0.59, -0.52) of a point lower for people who acquired a disability over a 5-year period compared to those who remained disability-free (Aitken et al., 2021). Mediation analysis suggested that a third of this association was mediated by the experience of barriers to participation in work, economic life, transports, community, leisure/civic activities, social contact and accessibility.

Three studies used ELSA data to explore different aspects of health on life satisfaction in adults aged 50+ (Matthews et al., 2017, Moreno-Agostino et al., 2022; Rouxel et al., 2018). First, a model assessing the presence of bidirectional associations over four waves of data (~8 years) reported that there was only evidence of an association in one-direction between overall health (45-item composite measure) and subsequent life satisfaction levels (Moreno-Agostino et al., 2022). Another study reported no association between changes in oral-related difficulties (improvement or deterioration) over a five-year period and changes in life satisfaction (Rouxel et al., 2018). However, those who lost their natural teeth over this period experienced a substantial decline in life satisfaction (-2.54 (95%CI: -3.62, -1.46) on the 35-point SWLS scale). Similar findings were reported for changes in vision over a 10-year period (Matthews et al., 2017). Deterioration in vision from wave to wave (~2 years) was associated with declining life satisfaction. Notably, those who reported their vision improving from good to excellent between waves demonstrated improvements in life satisfaction.

Notably, only one study in the review examined the impact of mental health on life satisfaction (Marquez et al., 2023), and similar to the composite health study above, assessed bidirectional associations from ages 17 to 19 to 21. While no associations were found in either direction between age 17 and age 19, there was a bidirectional association that mental health contributed to life satisfaction and life satisfaction contributed mental health between ages 19 and 21. This association was stronger in males than females. Table 29 provides a brief summary of each study in the ‘physical and mental health’ subtheme, including sample, factors explored and key findings. In summary, there was strong evidence to suggest that ***declining overall health and acquiring disabilities or medical conditions which may affect function, such as poor vision and teeth loss, is associated with lower life satisfaction.***

Table 29. Summary of studies included in the physical and mental health subtheme (n=6)

Reference	Description of sample (analytical sample size)	Follow-up (years) ¹	Factor of interest	Description of measurement of factor	Direction of association
Aitken et al, 2022	LOS adult participants with or without new disability (n=2354)	5	Disability acquisition	A self-reported variable whether they experienced both: (i) 'moderate', 'severe' or 'complete' difficulty with functioning in a particular domain (e.g., seeing, hearing, speaking, mobility, dexterity, breathing, learning, pain, chronic health conditions, intellectual, social or behavioural, memory, emotional or psychological, other); and (ii) limitations to the amount or kinds of activities that they could do.	↓LS
Charles et al, 2019	BHPS/UKHLS working-age adults (n=139,950)	4 to 6	Overall health	Self-reported health (excellent, good, fair, poor and very poor)	↑LS
Marquez et al, 2023	US young adult participants transitioning from age 17 to 21 (n=661)	4	Mental health	Short version of General Health Questionnaire (GHQ-12)	null age 17-19; ↓LS age 19 -21
Matthews et al, 2017	ELSA participants aged 50 years and above (n=8581)	10	Changes in self-reported eye vision	A self report of their eyesight, using glasses or corrective lenses as usual as: excellent, very good, good, fair or poor. A sixth category of registered blind was added, where participants spontaneously provided this answer. [change in wave to wave]	↑LS
Moreno-Agostino et al, 2022	ELSA participants aged 50 years and above (n=11667)	8	Overall health	Overall score generated from 45-health related items covering: walking, sight, hearing, balance, dizziness, memory, orientation in time, cognition, pain, energy, sleep, incontinence, mobility, and limitations in Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs)	↑LS
Rouxel et al, 2018	ELSA participants aged 50 years and above (n=6294)	4	Oral health-related quality of life	Measured through a modified version of the Oral Impacts on Daily Performances (OIDP) questionnaire	null
			Edentulism	Self-reports of the presence/absence of natural teeth and grouping respondents into dentate (with natural teeth) versus edentate (without any).	↓LS

Life Opportunities Survey (LOS), British Household Panel Survey (BHPS), UK Household Longitudinal Study (UKHLS), Understanding Society (US), English Longitudinal Study of Ageing (ELSA); LS: life satisfaction

¹ Time between first baseline measurement and final follow-up life satisfaction measure

4.6.2. Health behaviours (n=5)

There was mixed evidence on various aspects of health behaviours and their subsequent impact on life satisfaction; this included aspects of diet, exercise, alcohol consumption and sleep. Greater quantity and frequency of fruit and vegetable consumption revealed a strong positive association with life satisfaction over three waves of data in the UKHLS (Ocean et al., 2019). There was no association between participating in gym and exercise at baseline and life satisfaction at 10-year follow-up or change in life satisfaction over a 3-year period (ELSA; aged 50+; Fancourt & Steptoe, 2018; Jenkins, 2011). Although an increase in self-reported alcohol consumption was initially associated with reduction in life satisfaction from age 30 to 42, this was fully attenuated after adjustment for covariates (BCS70 birth cohort; Geiger & Mackerron, 2016). However, development of drinking problems (measured using the CAGE Alcohol Scale) between ages 30 to 40 was associated with a -0.36 (95% CI not reported, $p < 0.001$) lower score on the 11-point ONS life satisfaction scale. Finally, despite initial detrimental associations of short sleep duration and high sleep disturbance (e.g., waking up several times a night, difficulties falling asleep) on life satisfaction, associations were fully attenuated when self-rated health and longstanding illness were included in models (Cadar et al., 2021). Table 30 provides a brief summary of each study in the 'health behaviour' subtheme, including sample, factors explored and key findings.

Overall, there was ***insufficient evidence to draw conclusions on individual health behaviours and life satisfaction.***

Table 30. Summary of studies included in the ‘health behaviours’ subtheme (n=5)

Reference	Description of sample (analytical sample size)	Follow-up (years) ¹	Factor of interest	Description of measurement of factor	Direction of association
Fancourt & Steptoe, 2018	ELSA participants aged 55+ (n=2,548)	10	Community/sport participation	Self-reported whether they are a member of sports clubs, gyms, exercise classes;	null
Geiger & MacKerron, 2016	BCS70 participants aged 30 (n=10107)	12	Alcohol consumption	A self report to a single question: "“In the last seven days, that is not counting today but starting from last [day], how much [drink] have you had?”", repeated for beer, wine, spirits, fortified wines and alcopops"	null
Jenkins, 2011	ELSA participants aged 50 years and above living in private households in England (n=5518)	3	Leisure participation	A self report of their membership of sports clubs, gym and exercise classes.	null
Ocean et al, 2019	UKHLS participants aged 15 or over (n=99897)	7	Vegetable consumption : quantity and frequency	A self report of: i) “On a day when you eat fruit or vegetables, how many portions of fruit and vegetables in total do you usually eat?” and ii) A self report of how often they consumed fruit and how often they consumed vegetables in a usual week. (Four categories: Never; 1–3 days per week; 4–6 days per week; Every day)	↑ LS
Cadar et al, 2021	ELSA participants aged 50 years and above (n=4110)	10	Sleep duration	Open-ended question asking participants how many hours they have slept on an average weeknight; categorised into short sleep (<6 h), medium (6-7 h), optimal sleep (>7 to 8 h) and long sleep (>8 h or more’).	null
			Sleep disturbance	Assessed by 3 4-point items derived from the Jenkins Sleep Problems Scale (i.e., the most frequent insomnia symptoms, including difficulties falling asleep, waking up several times a night, and waking up in the morning feeling tired during the past month). Quintiles were derived from average scores, with higher scores suggesting greater sleep disturbance.	null

English Longitudinal Study of Ageing (ELSA), 1970 British Cohort Study (BCS70), UK Household Longitudinal Study (UKHLS) ; LS: life satisfaction

¹ Time between first baseline measurement and final follow-up life satisfaction measure

4.7 Theme 5 Environment (n=4)

Four papers examine the longitudinal impact of where people live in on their life satisfaction (White et al., 2013; Chatterjee et al. 2019; Clark et al., 2020; Nowok et al., 2013). All studies examined adults of all ages; factors studied included environmental and infrastructural factors such as coastal proximity (i.e. distance in km from home to the coast), fresh water and green space coverage in Lower-layer Super-Output Area (LSOA) (White et al., 2013), perception of local public transport services (Chatterjee et al., 2019), commute time and moving locations within the UK (Clark et al., 2020; Nowok et al., 2013).

Coastal proximity and freshwater coverage were not associated with life satisfaction, however there was a strong association between greater green space in the LSOA that an individual lived in and life satisfaction (White et al., 2013). Data from 12 waves of the UKHPS demonstrated that changing environment, moving either locally or long-distance was also associated with initial increases in life satisfaction (Nowok et al., 2013). Moves often followed a period of declining life satisfaction and were associated with a rebound to normal levels. Effect sizes were small; for example, average life satisfaction was 5.15 (on a 7-point scale), which was significantly higher by 0.05 than life satisfaction levels preceding the move.

Perceptions of individuals towards their local public transport also played a role in life satisfaction. Individuals who rated public transport in their local area as 'poor' were 1.3 times more likely to report feeling dissatisfied with life in the subsequent year than those rating it as 'good' (Chatterjee et al., 2019). There was also evidence of small associations

between longer commutes and lower life satisfaction between individuals (-0.014 points on a 7-point scale for every extra 10 min each way). However, there was no evidence of within-individual differences (e.g. where commute time changed across the six waves within an individual; Clark et al., 2020). There were similar findings for commuting mode; those who commuted by rail had higher life satisfaction than those who commuted by car, however changing from rail transport to car transport was not associated with individual improvements in life satisfaction. The authors hypothesised the lack of within-individual differences may be due to being compensated with higher salary or better housing (Clark et al., 2020).

In summary, there was ***mixed evidence across a diverse range of factors relevant to where people live and how they experience their environment***, due to an insufficient number of studies exploring each factor. Table 31 provides a brief summary of each study in the 'Environment' theme, including sample, factors explored and key findings.

Table 31. Summary of studies included in Theme 5: Environment (n=4)

Reference	Description of sample (analytical sample size)	Follow-up (years) ¹	Factor of interest	Description of measurement of factor	Direction of association
Chatterjee et al, 2019	UKHLS/ELSA working-age adults residing in England (n=22995)	6	Access to transport	Access to transport is measured in relation to: (i) Personal car access; (ii) Bus service availability near to the home; (iii) Rating of local public transport; (iv) Concessionary bus pass holding.	↓LS
Clark et al, 2020	Understanding Society participants residing in England (n=26551)	5	Commuting time	Single question of "About how much time does it usually take for you to get to work each day, door to door (in minutes)?" with an integer number of minutes as a measure	↓LS
			Commuting mode	Single question of "And how do you usually get to your place of work? (mode used for longest part of journey)" with the following categorical variables: (i) drive by car or van, (ii) get a lift, (iii) motorcycle, (iv) taxi, (v) bus, (vi) train, (vii) metro, (viii) cycle, (ix) walk, and (x) other	null
Nowok et al, 2013	BHPS participants aged 15 or over (n=12000)	12	Moving within the UK	A self report of whether they still live at the same residence as before 1 September of the previous year (includes both local and long-distance moves)	↑LS
White et al, 2013	BHPS participants in England (n=12360)	17	Coastal proximity	Coastal proximity was defined as the linear distance (in km) to the coast from the population-weighted centroid of the Lower-layer Super-Output Area (LSOA) where individuals lived; three distinct distance categories created: (a) 0–5 km; (b) 45–50 km; and (c) >50 km.	null

British Household Panel Survey (BHPS), UK Household Longitudinal Study (UKHLS), Understanding Society (US), English Longitudinal Study of Ageing (ELSA); LS: life satisfaction

¹ Time between first baseline measurement and final follow-up life satisfaction measure

4.8 Theme 6 Arts and culture engagement (n=5)

All five papers in this subtheme reported positive associations of arts and culture engagement on life satisfaction. Three studies reported that any participation in or engagement with music, arts, or evening classes reported at a single timepoint had a small but significant association with life satisfaction levels after 3-5 years (Wang et al. 2020) and 10-year follow-ups (Fancourt and Steptoe, 2018) and on change in life satisfaction over a 2-year follow-up (Jenkins, 2011). In the latter, attending such classes were associated with a 0.72 higher life satisfaction score than those who did not (7-point scale) (Jenkins et al., 2011). Another reported that sustained engagement with the arts (defined as attending galleries, exhibitions, and museums every few months or more over 4-6 waves) had stronger associations with higher life satisfaction than short-term (1 wave) or frequent (2-3 waves) engagement (Tymoszuk et al., 2020).

Two studies of adults of all ages reported that attending culture events (e.g. theatres, exhibitions, museums, heritage sites) was associated with higher life satisfaction; effect sizes were small (Mak et al., 2021; Wang et al., 2020). For example, those who attended cultural events at least 1-2 times per year had 0.13 (95% CI 0.05, 0.21) higher life satisfaction score than those who had not participated in these art activities or cultural events (using a 7-point scale) (Wang et al., 2020).

Together this evidence suggests that ***participation in cultural activities, including music, arts, and culture classes or events, is strongly associated with higher life satisfaction, although the size of the effect requires more exploration of type of engagement and art/culture type.*** Table 32 provides a brief summary of each study in the 'Arts & Culture engagement' theme, including sample, factors explored and key findings.

Table 32. Summary of studies included in Theme 6: Arts and culture engagement (n=5)

Reference	Description of sample (analytical sample size)	Follow-up (years) ¹	Factor of interest	Description of measurement of factor	Direction of association
Fancourt & Steptoe, 2018	ELSA participants aged 55+ (n=2,548)	10	Arts & culture engagement	Self-reported whether they are a member of education, arts or music groups or evening classes;	↑ LS
Jenkins, 2011	ELSA participants aged 50 years and above living in private households in England (n=5518)	3	Social participation	A self report of whether they were members of any education, arts or music groups or evening classes	↑ LS
Mak et al, 2021	US adult participants living in England who engage in community culture (n=14783)	3	Community cultural engagement	A self report of how often they had attended any of the cultural events, visited museums/galleries and visited heritage sites in the past 12 months (categorised as ‘not once in the last 12 months’, ‘1 in the last 12 months’, ‘2 in the last 12 months’, ‘less often than 1/month but at least 3- 4x a year’, ‘less often than 1 a week but at least 1x a month’ and ‘at least 1 a week’.)	↑ LS
Tymoszuk et al, 2020	ELSA participants aged 50 years and above (n=3188)	10	Arts engagement	A self report of their frequency of visits to (a) the cinema, (b) art galleries, exhibitions or museums, and (c) the theatre, concerts, or the opera. Each arts engagement item was assessed on a 5-point scale: 0 (never), 1 (less than once a year), 2 (once or twice a year), 3 (every few months), and 4 (once a month or more). Frequency was binary coded: the responses 0 (engaging never or at most twice a year) and 1 (engaging every few months or more often).	↑ LS
Wang et al, 2020	UKHLS participants aged 16 or over (n=23660)	3	Frequency of arts engagement	Arts engagement measured using 28 questions that categorise participation in active arts participation (e.g., dance, singing, musical instrument, opera, musical, painting, photography, etc) or attending cultural events (“e.g., attending a film or visiting an exhibition, street arts or a public art display or installation, a ballet). Frequency measured using five categories for participation in arts participation and four categories for attendance at cultural events	↑ LS

British Household Panel Survey (BHPS), UK Household Longitudinal Study (UKHLS), Understanding Society (US), English Longitudinal Study of Ageing (ELSA), Understanding Society (US); LS: life satisfaction

¹ Time between first baseline measurement and final follow-up life satisfaction measure

4.9 Critical appraisal

The quality of the observational studies included in the review was high. Out of 49 studies, one (2.0%) received 7 out of 11 points, 26 studies (53.1%) scored 9 points, five studies (10.2%) scored 10 points, and 17 studies (34.7%) received the full 11 points. Due to the nature of this rapid review, which only includes studies investigating longitudinal associations between any factor and life satisfaction, all included studies received a full score for seven out of the 11 critical appraisal elements.

Since all studies utilised large-scale, well-established, and publicly available cohort or panel study datasets, with participants initially free of the outcome at the study's outset and throughout each follow-up point, they all received 1 point for both 'population (within-changes)' and 'sample validity' criteria. As no comparator (i.e., intervention/control group) criteria were applied in this rapid review, meaning there were no separate exposed and unexposed groups, all studies received 1 point for 'measurement' and 'measure validity' for clearly explicating the factor they are measuring and how they are measuring it. All studies received 1 point for 'outcome,' indicating the use of a valid life satisfaction scale such as the ONS 11-point scale, SWLS (7-point scale), or other single-item scales. All studies received 1 point for 'follow-up,' for reporting a valid follow-up time long enough for outcomes to occur (≥ 1 year). Finally, all studies used appropriate statistical analytical approaches, hence receiving 1 point for 'analysis'.

Nearly all studies recognised the importance of confounding factors in influencing the measures, with just 1 study scoring 0 ('Can't tell') for not clearly reporting confounding factors and 3 studies scoring 0 for 'addressing confounding factor'. Both the 'attrition' and 'representativeness' criteria recorded lower scores due to limited reporting and exploration of reasons for loss to follow-up, as well as insufficient employment of strategies to address the loss. Here, 23 out of 49 studies (46.9%) scored 1 in 'attrition,' either by completing a 100% follow-up on the initial population sample or by providing valid reasons for loss to follow-up. Out of 49 studies, 24 (49.0%) failed to meet the 'attrition' criteria by not reporting drop-out rates or comparing the characteristics of dropouts to those who participated in

follow-ups. Finally, half of all included studies (n=27, 55.1%) did not employ or report strategies used to address incomplete-follow-up.

5. Discussion

5.1 Main findings

In this technical report of two rapid reviews, we identified 189 studies encompassing 234 intervention arms aimed at improving life satisfaction in high-income OECD countries and 49 studies exploring the longitudinal determinants of life satisfaction in the UK. Evidence was synthesised across six main themes in each review, with each review providing complementary but distinct evidence bases. The six themes identified in the intervention review were: 1) emotion-based activities (intrapersonal and interpersonal); 2) didactic emotional development; 3) health promotion, 4) music, 5) social media, and 6) multi-component interventions. The six themes identified in the observational review were: 1) economic and financial situations, 2) education and employment, 3) social capital, 4) health and health promotion, 5) environment, and 6) arts and culture. Together, the two reviews provide a broad and encompassing overview of factors associated with life satisfaction, identifying potential intervenable or modifiable factors at the individual and population level for practitioners, researchers, and policy makers alike.

5.1.1 Intervention review

In the intervention review, interventions related to emotional skill development, mindfulness, gratitude, therapy, exercise, and health education had small to moderate effect sizes in improving life satisfaction. There was some evidence that emotional regulation and health education were also effective, although many themes had insufficient evidence to adequately explore and draw appropriate conclusions (e.g. social interventions, music interventions, and social media reduction amongst others). Several trends emerged across all themes. We observed that interventions which are more intensive (i.e., longer duration with greater contact time), delivered in group-settings, and specifically targeted at a specific age group (i.e., school-based, or older residential home programmes) may be

more successful at improving life satisfaction, although further exploration by subtheme and formal subgroup analysis is needed.

School-based interventions appear promising for improving life satisfaction and were more common in the didactic emotional development subtheme. For example, interventions focused on building resilience and emotional skill development were overwhelmingly targeted at school-aged children and accordingly several effective interventions in this subtheme were long-term school-based programmes. Similarly, interventions for groups of older people appear promising for improving life satisfaction across themes and especially in the music theme, however, the three music interventions provide insufficient evidence for making meaningful conclusions. Health promotion educational interventions also showed promising evidence in adults and older people, with large effect sizes in some studies; more research is needed to better understand the components of a successful intervention.

The multi-component theme comprised interdisciplinary and holistic interventions; this theme had mixed findings likely due to extremely high heterogeneity between diverse interventions but generally were successful in improving life satisfaction. It was notable that the greatest improvement in life satisfaction in this review was reported for a multi-component wellbeing programme for older adults living in a senior residence (Chamorro-Garrido et al, 2021). The topic of sessions ranged from the benefits of practicing autobiographical memory, forgiveness, gratitude, and cultivating a sense of humour, and several sessions involved group discussion. We hypothesise that trends for increased success in school-aged children and older adults is likely mediated by intervention intensity; many of the themes where these trends were observed included longer-lasting programmes with more contact time and the opportunity for group interaction.

Importantly, this review is focused on assessing what works to improve life satisfaction, therefore interventions which have a significantly positive effect are described thoroughly to highlight existing evidence of effective interventions. However, the dichotomy of significance (either from p-value thresholds or the 95% CI crossing zero) in frequentist statistics can be problematic as rejecting the null hypothesis is not synonymous with

supporting the null hypothesis. For example, studies which report no significant change in life satisfaction between intervention and control groups should be interpreted as having an effect of some size, however, we can't be statistically certain if the effect is positive or negative. For this review, studies with these findings may not be directly useful for policymakers, however, in the wider context of life satisfaction research, these findings indicate that certain study designs or themes may require further investigation to determine their true effect.

5.1.2 Observational review

In the observational review, there was strong evidence to indicate that positive change across various stages of people's lives in factors related to education, income, health, social capital, and employment were associated with either higher life satisfaction at a single time point or increasing life satisfaction trajectories over time. Specifically, there was consistent evidence across the UK cohorts of a positive association in the following areas: (i) income changes, (ii) attainment of accredited educational qualifications, (iii) nurturing close relationships and support networks, (iv) improvements in or maintenance of physical health, and (v) involvement in community cultural activities and participation in the arts. However, effect sizes were often not clearly provided due to complex modelling strategies which aimed to better understand mediation pathways, moderating factors, trajectories over time, and economic impact of key factors in relation to life satisfaction. There was a negative association for unemployment and declining health conditions. Finally, there was insufficient evidence across other key areas such as commuting time, environment, mental health, and health behaviours, therefore, further research is warranted in these areas.

5.2 Insights from the two reviews

The core evidence generated from each of these reviews covers complementary, but poorly overlapping, targets for life satisfaction. Where observational studies allow broad insight into key determinants of life satisfaction in population-representative samples, causal associations cannot be inferred. Conversely, well-designed and conducted randomised control studies allow researchers to determine what works to improve life satisfaction

through assessment of intervention effectiveness. Drawing on the observational review findings, it could be suggested that the predominant focus of existing interventions, primarily centred on enhancing life satisfaction through individual-level interventions, is overly restrictive in its scope. The observational review identified numerous broader factors encompassing socioeconomic determinants such as income, unemployment, and education, alongside social, health, and environmental determinants. These findings suggest there may be a need for broader intervention strategies and strategic delivery methods. Promising areas for policy considerations include higher-level targets such as addressing socioeconomic inequalities, declining physical health, and insufficient social support networks. Interventions in this area may be more resource-, time-, and cost-intensive, however, ambitious attempts to address low income, educational opportunities, social networks, and physical health could yield additional benefits across a wide range of wellbeing, health, and economic outcomes.

The findings of the intervention review suggest that engaging in emotional activities (i.e., emotional skill development, mindfulness, gratitude, therapy) or health promoting activities (i.e., exercise, health education) can have beneficial effects for improving individual life satisfaction. Cultivating these skills over the long term is anticipated to facilitate positive emotional wellbeing and provide the tools needed for individuals to manage emotions and provide perspective on life. Group-based activities across diverse intervention types, including emotional activities, health promotion, music, or social activities, appeared especially successful for improving life satisfaction, more so than educational interventions on the benefits of social groups. This provides a useful parallel to the observational review in which the potential of social networks and support systems emerged as pivotal for achieving high levels of life satisfaction.

Furthermore, while the observational review supports a strong positive association between engagement in arts and culture activities and life satisfaction, the intervention review provides insufficient evidence regarding the impact of music interventions on life satisfaction, albeit exhibiting promising evidence in the minimal studies available.

Conversely, the observational review yielded limited evidence concerning the association between health behaviours and life satisfaction, whereas the intervention review provided substantial evidence indicating that exercise and health education interventions had moderate effect sizes in improving life satisfaction. Further investigation into the effects of specific types of arts, cultural, and health-related activities, along with their delivery modalities on a wider target population appears necessary.

5.3 Consideration for future research

This review offers a comprehensive synthesis of factors associated with life satisfaction, drawing on both intervention studies delivered in high-income OECD settings and observational studies conducted on UK samples over the past 13 years. It is evident that existing studies in the intervention evidence-base has thoroughly explored emotional activities, with nearly two thirds of the evidence in the review falling under this theme. Several different individual or group-based emotional activities do appear to improve life satisfaction with small to moderate effect sizes. Further economic evaluation of the potential benefits of interventions is needed to determine cost effectiveness of minimally invasive interventions. It was interesting to note that most interventions required an individual to engage in emotion-based activities in a group, followed with at home activities by themselves, putting additional burden and onus on the individual. In contrast, the most robust factors in the observational review associated with life satisfaction were related to larger structural socioeconomic factors such as income and education, or physical health and social capital.

There was a huge breadth of interventional studies identified in this review. Despite the stringent inclusion criteria requiring a validated life satisfaction measure and a control group, there are several areas of methodological improvement. For example, studies did not always address drop-out or attrition within their analysis, with many studies also providing insufficient data to be included in meta-analyses. Use of multi-item life satisfaction measures were clearly preferred – which contrasts with observational studies – although this presents challenges in comparing changes in life satisfaction between scales. This

necessitated the use of standardised mean differences in synthesis, which may not be easily interpretable especially for policy makers. Although clear trends emerged in certain components of successful interventions (e.g., group-based, in-person, longer duration), there remains insufficient understanding of the successful ingredients of an intervention. This is partially due to substantial heterogeneity across interventions, multi-component interventions, and poor reporting of various aspects of design and delivery. Therefore, there is a need for more research; key areas could include trialling individual components separately (which do not already have sufficient evidence) to see separate and combined impacts in complex interventions, better reporting of who is delivering the intervention (i.e., skills/training/role), and adherence to intervention and setting.

Interpretation of SMD effect sizes were done by comparing to well-known SMDs indicative of small, medium and large effects, originally recommended by Cohen and widely utilised for interpretation of such results (Brydges, 2019). Further work is needed to explore how these effect sizes translate directly to life satisfaction – and broader wellbeing – research. This is particularly relevant from an economic perspective, given that intervention with small effect sizes may demonstrate excellent cost effectiveness. Only one study explored an economic evaluation; given advances in wellbeing economics and the need to translate intervention findings to policy considerations, this should be incorporated into more reporting and analyses.

A further challenge in both the use of SMDs and continuous life satisfaction scales (e.g. 0-10, 5-35) is that effect sizes are calculated with sample means – ignoring intra-individual changes in life satisfaction – and the linear life satisfaction scale may not accurately represent individual’s self-scoring perceptions. For the latter, a 1-point change from 3 to 4 on the 0-10 ONS scale is not equivalent to a change from 8 to 9, while there are clear inter-individual differences with regards to floor and ceiling effects (i.e. some may refuse to give a score of 9 to 10, despite feeling wholly satisfied with life).

In the observational review, the positive associations with life satisfaction identified from improvements in education, income, employment, health, and increased cultural or

community participation, highlight the importance of socioeconomic, social, and health factors in people's evaluation of their lives. Material and social factors have long been understood to pattern how people experience their world (Marmot, 2010). Studies in this review reported strong associations between perception and objective social conditions, suggesting efforts to change life satisfaction would need to target underlying social factors. However, additional research is needed to explore the degree and mechanisms by which changes in these domains interact with people's life satisfaction. Several studies reported nuances in some associations, such as the non-linear effect of life satisfaction reducing at very high-income levels or certain effects being moderated by age, gender, or economic factors, suggesting relationships between real life circumstances and life satisfaction are not always straight forward.

As all evidence in the observational review was drawn from UK-based cohort studies, analytical samples were generally nationally representative. However, characteristics of those lost to follow-up were often not clearly provided. Furthermore, while there is a clear need for more complex modelling approaches to better understand mechanisms, trajectories, and complex economic factors, effect sizes are not always readily translatable to policy. Therefore, there is also a need to provide simple effect sizes associated with key determinants. Of the eight cohort studies included in this review, two birth cohort studies (1958, 1970) are currently using the 11- point ONS scale. Given the wealth of data collected over study participant's lives and the age homogeneity, this may be an excellent place to estimate the effect of various life course factors on wellbeing-adjusted life years. Both studies are ongoing (most recent data collection in 2024).

Future work must investigate how the effects of different factors on life satisfaction differ by participant characteristics. Good health, and material and social opportunities are not equally dispersed among the population. In several of the observational studies associations between a given factor and life satisfaction commonly differ by age, education, and gender. It is unclear whether interventions or societal changes would have the same magnitude of effect on life satisfaction for people across the social gradient. One promising

avenue for future exploration could be utilising the PROGRESS-Plus concept to identify individual and societal characteristics that may impact effectiveness of interventions on life satisfaction or modify associations between key factors of interest and subsequent life satisfaction (O'Neill et al., 2014). The acronym of PROGRESS-Plus refers to: Place of residence, Race/ethnicity/culture/language, Occupation, Gender/sex, Religion, Education Socioeconomic position, Social capital, where the Plus captures personal characteristics associated with discrimination (e.g., age, disability, etc.) and relationship features including time-dependent aspects.

5.4 Strengths and limitations

Both reviews followed rigorous registered and independent protocols and were conducted at a rapid pace over a short period of time, providing a comprehensive synthesis into two different evidence bases covering different methodological approaches to understand what can improve life satisfaction. To reduce publication bias, grey literature sources were searched. Key strengths of the intervention review included the high diversity of intervention type, meta-analysis for key subthemes, capturing evidence on children and adults across the life course, and the high quality of studies due to mandatory control group and pre-post measures. Key strengths of the observational review included the relatively homogenous group of cohort studies included in the review, the generalisability of findings directly to the UK population, and longitudinal study design with long periods of follow-up across multiple waves.

There were some limitations. Both rapid review protocols had deviations to full systematic review methodologies; for example, there was a single screener for the majority of each screening stage, data extraction and critical appraisal. Searches were restricted to five academic databases (alongside grey literature) and those published between 2011 and the time of the search; therefore, it is possible that some eligible studies were missed. Data extraction was streamlined, with a focus on pre and post intervention scores in the intervention review and minimal exploration of subgroups, mediators and moderators of

associations across both reviews. The number of high-income OECD countries that met criteria for the observational review was beyond scope/capacity, and therefore the introduction of the UK only criteria was adapted as an amendment to the original protocol. As highlighted above, non-UK studies that met the remaining criteria were documented and are available on the project page.

Crucially, the available intervention evidence was skewed heavily towards emotion-based activities. Interventions were entirely individual-centric due to requirements to have control groups and pre-post measures, as a result we did not include natural experiments (i.e. experiments where experimental and control groups are exposed to conditions determined by nature or which are outside of the researchers control). Additionally, while the diversity of interventions can be a strength, this also resulted in high heterogeneity which limits our ability to draw effective conclusions for what definitively improves life satisfaction. Furthermore, sample sizes were often small, with only seven studies including >500 participants (and only three including >1000). Subgroup analysis was unfortunately beyond the scope of this review but could potentially identify further trends and key targets for interventions. Finally, only three interventions reported significantly negative effects, leading us to question the degree to which publication bias may be possibly masking an ambiguous distribution of findings. Similarly, the majority of studies which did not report pre-post measures tended to have non-significant study results; a wider recommendation for academic research is to avoid reporting bias by including full results regardless of study outcome, so that results can be interpreted beyond the dichotomy highlighted above.

Due to the unexpected high number of full-text results, the observational review was limited to UK-based studies only. While this allows better evidence to be drawn from for relevant policy recommendations in the local context, it also provides an incomplete picture on what factors may positively or negatively contribute to life satisfaction. Therefore, results must be interpreted with caution, particularly where there was insufficient evidence in the area (e.g., green and blue spaces). Quantitative synthesis of observational findings was not possible due to heterogeneity in approach, where effect sizes were often not provided in a meaningful

way. The overall lack of information regarding effect sizes, coupled with a general deficiency in reporting attrition information (49.0% of studies failing to meet the ‘attrition’ criteria in the JBI checklist) or providing details of strategies employed to address incomplete follow-up (44.9% of studies failing to meet the ‘representativeness’ criteria), has the potential to limit the robustness of our findings. Loss to follow-up can significantly impact a study's effect size by reducing statistical power and potentially leading to underestimation or overestimation of effects. Subgroup analysis was out of scope, and hence not extracted in isolation, although where possible we embedded any meaningful findings in main results.

Heterogeneity in intervention type and concept was determined to be low enough in six subthemes to perform meta-analyses: mindfulness, gratitude, therapy, meditation, emotional skill development, and exercise. However, heterogeneity is generally high due to the diversity of interventions, especially for interventions in the subtheme other interpersonal emotion-based activities and multi-component interventions. Some themes, such as resilience and emotional regulation, have heterogeneity which could be driven by the tendency for interventions in these themes to be longer-lasting, more intensive, and therefore more specific. There was also substantial heterogeneity across studies in the observational review, including differences in sample characteristics (e.g., age, cohort), factors examined, sample follow-up years (min. 1 year – max. 42 years), statistical approaches, and life satisfaction scale used for outcome.

5.4 Conclusions

These rapid reviews bring together the key findings of interventions and observational studies focusing on life satisfaction, conducted since 2011 and highlight directions for future investigation. Key interventions that can help to improve life satisfaction have been identified, with the majority of evidence focusing on intrapersonal emotional activities; the next steps include translating this research into practice and exploring under-researched areas. The observational review highlighted larger factors such as socioeconomic circumstances (i.e., education, income, employment), social capital, and health which were positively associated with life satisfaction. Together, this may suggest that addressing

overall socioeconomic and health factors at a population-level could be an important complementary approach to currently more prevalent individual-centric interventions for improving overall life satisfaction in the general population.

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(see Appendices B & D for list of included studies from both reviews)

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List of Appendices

Appendix A. PRISMA checklist for intervention and observational review

Appendix B. List of all studies included in the intervention review (n=189)

Appendix C. Study look-up sheet for intervention review (see Excel)

Appendix D. List of all studies included in the observational review (n=49)

Appendix E. Study look-up sheet for observational review (see Excel)