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Positive psychological constructs and association with reduced risk of mild cognitive impairment and dementia in older adults: a systematic review and meta-analysis

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Abstract

Understanding factors associated with dementia risk is important for informing future interventions aimed at dementia prevention. There is accumulating evidence for the association between depression and risk of dementia, however less is known about the association between positive psychological factors and dementia incidence. This review aims to synthesise evidence regarding the association between positive psychological constructs (PPCs) and later risk of MCI and dementia in adults aged 50 and over. Literature searches were conducted in Medline, PsycINFO, and Scopus until March 2021. Papers reporting on the association between at least one PPC and later risk of MCI or dementia in people aged 50+ without cognitive impairment at baseline were included. Results from the meta-analyses revealed that purpose in life was significantly associated with a reduced risk of dementia (HR = 0.81, 95% CI [0.78, 0.85], p < .001), however results for positive affect were non-significant (HR = 0.94, 95% CI [0.76, 1.15], p = .54). Results for other PPCs are described narratively. Mixed findings for different PPCs highlight the importance of investigating these factors individually. Understanding which factors may play a protective role in their association with risk of mild

cognitive impairment and dementia could have important implications for informing dementia prevention interventions.

Keywords:

Positive psychology; Dementia; Mild cognitive impairment; Systematic review; Meta-Analysis.

1. Introduction

Global estimates suggest that over 55 million people are currently living with dementia, with this figure expected to increase to 78 million over the next 10 years (World Health Organization, 2021). As such, research investigating strategies for dementia prevention are of the highest importance. The most recent report from the Lancet Commission proposed actions for dementia prevention, both at policy and individual level, that were based on 12 potentially modifiable risk factors for dementia (Livingston et al., 2020). Of these factors, whilst depression in later life was found to be associated with dementia incidence, it is also noted that there may be a bi-directional relationship. With increasing recognition of mental health problems among older people (World Health Organization, 2017) and their comorbidity (Regan, 2016) and prevalence (Kuring et al., 2018) in dementia, it is important to understand how mental health is associated with cognitive function and risk of dementia. Whilst there is accumulating evidence for negative psychological factors (depression, anxiety, pessimism, hopelessness, negative affect) increasing risk of cognitive decline and dementia (da Silva et al., 2013; John et al., 2019; Sutin et al., 2018a), less is known about the possible protective effects of positive psychological factors, such as psychological wellbeing. Psychological wellbeing (PWB) refers to emotional health and positive functioning (Huppert, 2009). In this respect, PWB is not merely the absence of mental health (Trudel-Fitzgerald et al., 2019). Instead, it has been proposed that PWB is achieved from having a balance or equilibrium between the psychological, social, and physical challenges an individual faces and the resources that individual has to deal with them (Dodge et al., 2012). Drawing from positive psychology, there are

several notable models that aim to identify factors that contribute to PWB. First, Ryff's (1989) six-factor model of psychological wellbeing proposes that self-acceptance, personal growth, purpose in life, environmental mastery, autonomy, and positive relations with others are the key factors that contribute to PWB. Next, Peterson and Seligman's (2004) Character Strengths and Virtues (CSV) handbook was designed to provide a classification system for positive character traits comparable to that provided by the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1994) for mental health. In the CSV, 24 measurable character strengths were identified and grouped into 6 key virtues (courage, justice, humanity, temperance, wisdom and knowledge, transcendence). Finally, Seligman's (2011) wellbeing theory was developed as an alternative to authentic happiness theory (Seligman, 2002) which only considered happiness in terms of life satisfaction. This new theory discussed how wellbeing could be achieved from the 5 elements described in the PERMA model (positive emotions, engagement, relationships, meaning, accomplishments).

There has been growing interest in research looking at the association between positive psychology and different health outcomes (Park et al., 2016). Within this, research that has considered healthy aging has suggested that PWB may play a protective role in increasing lifespan (Steptoe et al., 2015). Whilst a main focus in this area has been physical health outcomes, more recently there has also been a rise in research testing associations between wellbeing and cognitive aging. Consequently, with evidence that positive psychological factors have a positive impact on other health outcomes, it is also important to consider whether there is an association between positive psychological factors and incidence of mild cognitive impairment (MCI) or dementia. A recent meta-analysis of data from the existing literature and new analyses using data from four cohorts has found promising evidence for the association between purpose/meaning in life and risk of dementia (Sutin et al., 2021a). Despite limited research in the area at present, these findings illustrate the value in synthesising the existing evidence. This paper found evidence for the protective effect of purpose in life, however there were limitations in that it included one sample with cognitive impairment at baseline.

Additionally, it is also important to explore whether other positive psychological constructs (PPCs) that contribute to PWB may also be protective, and therefore might inform prevention strategies. The aim of this present review is to synthesise evidence from the current literature regarding an association between positive psychological constructs (PPCs) with cognitive impairment, MCI and dementia in adults aged 50 and over without identified cognitive impairment at baseline. Using a comprehensive list of PPC search terms, this review primarily identified and discusses evidence for positive affect (experience of positive emotions), purpose/meaning in life (sense that life has meaning/purpose), life satisfaction (positive life evaluations), and optimism (positive expectations about the future).

2. Methods

This systematic review was registered on PROSPERO (https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020224669) and reported in accordance with PRISMA guidelines (Page et al., 2021).

2.1. *Search strategy*

Literature searches were conducted in Medline OvidSP, PsycINFO OvidSP, and Scopus from inception until 2nd March 2021. Search terms for positive psychological constructs were based on theories of PWB from Ryff (1989), Peterson and Seligman (2004), and Seligman (2011), as described in the introduction. These were then developed through consultations with experts in the field. Terms that were not psychological constructs (e.g. positive relations with others, knowledge) and those terms that were too broad and could not be contextualized (e.g. interest, elevation, engagement) were removed. Further, papers investigating openness to experience were also excluded as our search terms did not include any of the other big-5 personality traits (De Raad, 2000). Search terms for cognitive impairment, MCI and dementia were based on those used in a recent systematic review

(Desai et al., 2020). Finally, a third concept of age-related terms were also used. These were based on the strategy suggested by ISSG Search Filter Resource (ISSG Search Filter Resource, 2006) for Medline OvidSP with additional relevant terms added (e.g. midlife, late life, retire) and then adapted for use in the other databases. Relevant subject headings for each concept were also applied for searches in Medline and PsycINFO. Searches were re-run in Medline (October 2021) prior to the final analyses to check whether any additional studies should be included. See Appendix A for complete list of search terms.

2.2. Inclusion criteria

There were no restrictions on date of publication, however only peer-reviewed articles published in English were included. Given that this is still an emerging area, an exploratory and inclusive approach was adopted when designing the inclusion criteria. This review included longitudinal quantitative studies with participants without cognitive impairment at baseline and a mean age of 50 or older at the point of cognitive outcome collection. Further, studies needed to include a measure of at least one PPC (as defined by predetermined criteria – see above) and a binary outcome measure of MCI, dementia, or cognitive impairment. Qualitative studies, individual case studies, and literature reviews were excluded. Additionally, papers that explicitly identified any cognitive impairment in the sample at baseline were excluded.

2.3. Screening procedure

Following the removal of duplicates, the titles, abstracts, and full-texts of the remaining papers were screened in accordance with the inclusion/exclusion criteria and assessed for eligibility by the primary reviewer (GB). A second independent reviewer (TS) screened 10% of the studies identified at each stage. Any disagreements between reviewers were discussed and resolved before proceeding to the next screening stage.

2.4. Data extraction

Information was extracted using a standardized form in Excel, including: author name(s), year of publication, sample size, mean age of sample, demographic information of sample (where provided), country, length of follow up, type of PPC, measures used for predictor and outcome, covariates, and effect sizes.

2.5. Risk of bias (quality) assessment

All papers included in this review were assessed for risk of bias using the Newcastle-Ottowa scale (Wells et al., 2014), with a maximum score of 9. Studies were considered 'low risk' if they scored 7-9, 'medium risk' for 4-6, and 'high risk' if they scored 3 or below (Singham et al., 2021). Results are presented in Appendix B.

2.6. Statistical analysis and data synthesis

Random effects meta-analyses were conducted in R using the *metafor* package (Viechtbauer, 2010). Relevant reported ratios (hazard ratios, odds ratios) were extracted from papers. Primary analyses were performed using adjusted effect sizes from identified studies. 95% confidence intervals were calculated for each outcome. Heterogeneity of effect sizes across studies were assessed using the I^2 statistic and interpreted as either high (75%), moderate (50%), or low (25%) (Higgins et al., 2003). Given that this is an emerging area, effects were synthesised where there were at least 2 studies of the same PPC. Meta-analytic data is presented in forest plots. Due to the small number of studies in each analysis, publication bias was not assessed (Sterne et al., 2011). Where data could not be pooled in the form of a meta-analysis, findings were reported in a narrative synthesis.

3. Results

3.1. Selection process

Database searches yielded 31,914 results. After the removal of duplicates, 19,951 studies were screened by title (reviewer agreement 97.30%). Next, 201 studies were screened by abstract (reviewer agreement 90%). During abstract screening, 4 papers were excluded as their abstracts and full-text was unavailable. Finally, 102 studies were read in full and assessed for final inclusion (reviewer agreement 80%). Overall, 7 studies met eligibility for inclusion. One additional paper was identified when searches were rerun prior to final analysis (Sutin et al., 2021a). This paper included both a review and new analyses using data from four different cohorts. Results from the new analyses were extracted and included in this review, These analyses have been treated as unique studies for the purpose of reporting in this review. See Figure 1 for details.

3.2. Study characteristics and participants

From the 8 papers included in this review (Table 1),studies (*n* = 11) used data from the following datasets: Health and Retirement Study (*n* = 3), Singapore Longitudinal Ageing Study (*n* = 1), Chinese Longitudinal Healthy Longevity Survey (*n* = 1), Rush Memory and Aging Project (*n* = 1), Women's Health and Initiative Memory Study (*n* = 1), Survey of Health, Ageing and Retirement in Europe (*n* = 1), English Longitudinal Study of Aging (*n* = 1), The Irish LongituDinal study on Ageing (*n* = 1), and National Health Trends and Aging Study (*n* = 1). All samples had a mean age of 60+ and included 62,520 unique participants. One paper excluded participants with dementia at baseline and the first follow up (Boyle et al., 2010), 6 papers excluded any cognitive impairment at baseline (Gawronski et al., 2016; Korthauer et al., 2018; Rawtaer et al., 2017; Sutin et al., 2020; Sutin et al., 2018b; Zhou et al., 2020), and one paper (4 studies) did not explicitly specify (Sutin et al., 2021a). Studies were conducted in USA (*n* = 6), Singapore (*n* = 1), China (*n* = 1), England (*n* = 1), Ireland (*n* = 1), and one multinational study covering 14 countries (Denmark, Sweden, Czech Republic, Poland, Austria, Belgium, France, Germany, Switzerland, the Netherlands, Greece, Italy, Spain, Israel). One study reported on multiple PPCs (life satisfaction, positive affect, purpose in life, optimism, perceived mastery) (Sutin et al., 2018b), three studies reported on meaning in life, and one study per PPC for

each of the following: life satisfaction, positive affect, purpose in life, optimism, purpose/meaning in life, psychological wellbeing. Outcomes reported included dementia (*n* = 5), MCI (*n* = 2), dementia-MCI combined (*n* = 1), and cognitive impairment (*n* = 3). Quality assessment scores ranged between 6.5-8, with most studies being rated as having low risk of bias (*n* = 10).

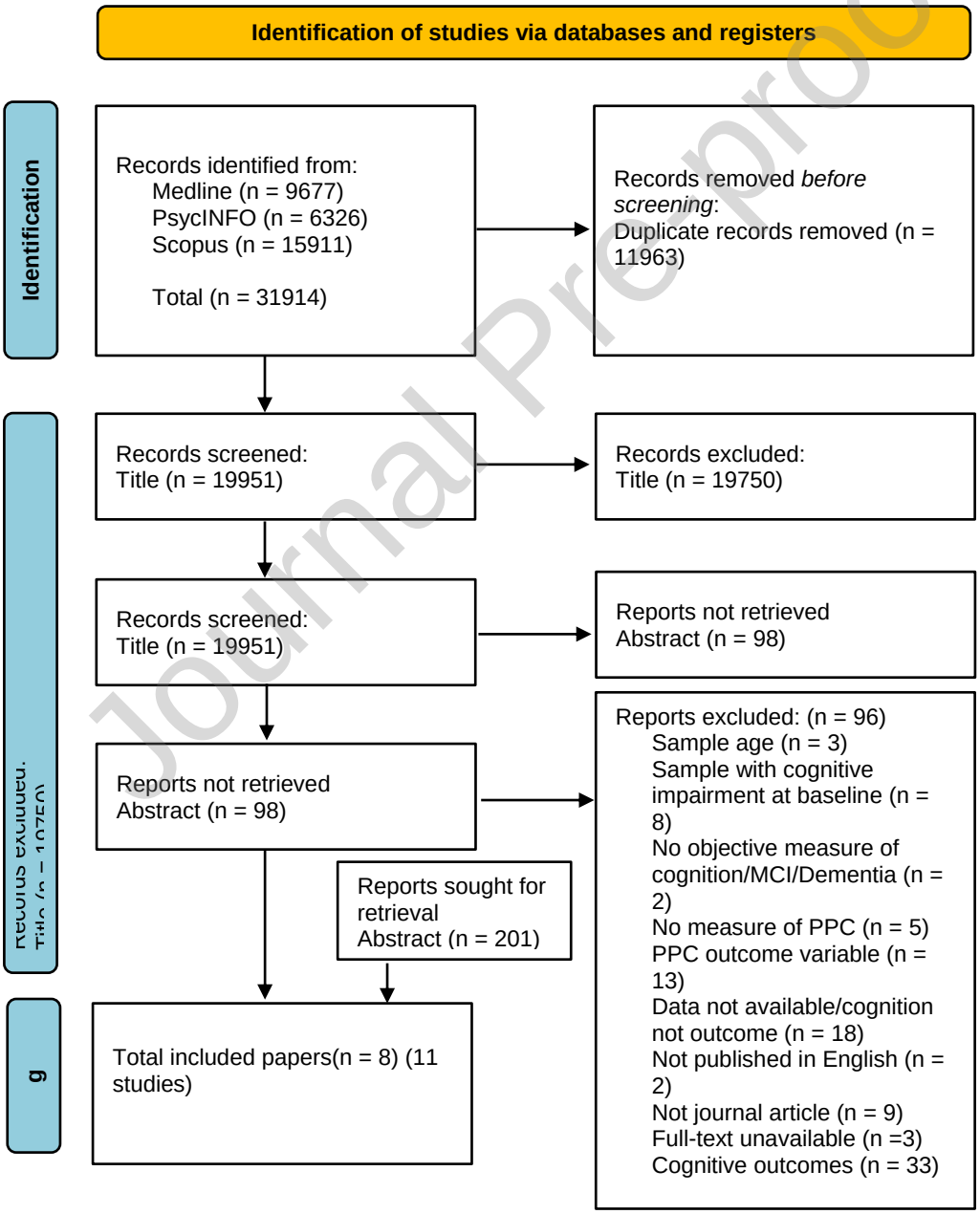

Figure 1: PRISMA flow diagram (Page et al., 2021)

Table 1: Characteristics of included studies

Author	Data source	Country	Sample size	Mean age	Sex (% female)	PPC assessed	PPC measure	Outcome assessed	Outcome measure	Covariates	Follow up length	Risk of bias
Sutin 2018b	HRS	USA	10,099	67.03	60	Life satisfaction Optimism Mastery Positive affect 2006 Positive affect 2008 Purpose in life	SWLS LOT-R 5-item scale 6-items scale 13-items scale 7-item Ryff's PWB subscale	Dementia incidence	TICSm	Age, Sex, Race, Ethnicity, Education, Depressive symptoms, History of a mental disorder	6-8 years	Low
Rawtaer 2017	SLAS	Singapore	1,601	64.9	64.5	Life satisfaction	4-item Life Satisfaction Scale	MCI-Dementia	CDR	Age, Gender, Education, Smoking, Alcohol, Dyslipidemia, Hypertension, Diabetes, Obesity, History of stroke/heart disease, APOE allele status, Depression, Physical activities, Social activities, Productive activities, Living alone, Loneline	8 years	Low

										ss, Marital status		
Boyle 2010	Rush MAP	USA	698	80.4	74.9	Purpose in life	10-item Ryff's PWB subscale	MCI	Clinical diagnosis	Age, Sex, Education	1-7 years	Low
Korthauer 2018	WHISCA	USA	2,137	73.9	100	Positive affect	PANAS	MCI Probable dementia	3MS, neuropsychiatric evaluation	Age, Race, Education, Randomisation arm, Marital Status, Smoking Status, Alcohol consumption, Exercise, BMI, Blood pressure, Antidepressant use, Hypertension, CVD/stroke/TIA, Diabetes, High cholesterol	1-20 years	Medium
Gawronski 2016	HRS	USA	4,624	75	57	Optimism	LOT-R	Incident cognitive impairment	TICSm/ 16-item IQCODE	Age, Sex, Race/ethnicity, Marital status, Education, Wealth, Smoking, Exercise, Alcohol, Heart disease, Hypertension, Diabetes, BMI	4 years	Low

Sutin 2020	SHARE	14 European countries	22,514	63.88	55.7	Meaning in life	Single question (4-point scale)	Incident cognitive impairment	Memory recall and animal naming	Age, Sex, Education, Marital status	3-9 years	Low
Zhou 2020	CLHLS	China	6,998	80.97	51.2	Psychological wellbeing	4 positive items and 3 negative items	Cognitive impairment	Chinese revised version of MMSE	Age, Gender, Education, Baseline cognitive function, Working status, Diabetes, CVD, Activities of daily living disability, BMI, Smoking, Alcohol, Exercise	3 years	Low
Sutin 2021	HRS	USA	11,520	67.85	59.7	Purpose in life	7-item Ryff's PWB subscale	Dementia incidence	TICSm	Age, Gender, Race/ethnicity, Education, Diabetes, Hypertension, Smoking, Obesity, Depression, Physical activity	10-12 years	Low
Sutin 2021	ELSA	England	7,781	64.10	55.1	Meaning in life	Single question (4-point scale)	Dementia incidence	Clinical diagnosis IQCODE	Age, Gender, Race/ethnicity, Education, Diabetes, Hypertension, Smoking, Obesity, Depression, Physical	16 years	Low

										activity		
Sutin 2021	TILDA	Ireland	4,917	61.88	55.9	Meaning in life	Single question (4-point scale)	Dementia incidence	MMSE	Age, Gender, Race/ethnicity, Education, Diabetes, Hypertension, Smoking, Obesity, Depression, Physical activity	6 years	Low
Sutin 2021	NHATS	USA	4,354	76.84	59.2	Purpose/ meaning in life	Single question (3-point scale)	Dementia incidence	3 tasks (word recall, orientation, clock drawing) Clinical diagnosis AD8	Age, Gender, Race/ethnicity, Education, Diabetes, Hypertension, Smoking, Obesity, Depression, Physical activity	8 years	Low

MCI = Mild cognitive impairment; BMI = Body mass index; CVD = Cardiovascular disease; TIA = Transient ischaemic attack; SWLS = Satisfaction with life scale; LOT-R = Life Orientation Test; PANAS = Positive and Negative Affect Schedule; TICSm = modified Telephone Interview for Cognitive Status; CDR = Clinical Dementia Rating Scale; 3MS = Modified Mini-Mental State Examination; IQCODE = Informant Questionnaire on Cognitive Decline in Elderly; MMSE = Mini-Mental State Examination; AD8 = AD8 Dementia Screening interview; HRS = Health and Retirement Study; SLAS = Singapore Longitudinal Ageing Study; Rush MAP = Rush Memory and Aging Project; WHISCA = Women's Health Initiative Memory Study (cognition and affect); SHARE = Survey of Health, Ageing and Retirement in Europe; CLHLS = Chinese Longitudinal Health Longevity Survey; ELSA = English Longitudinal Study of Aging; TILDA = The Irish LongituDinal study on Ageing; NHATS = National Health Trends and Aging Study.

3.3. Positive affect

Two studies, including 3 distinct samples, reported on the association between positive affect and risk of dementia. Korthauer et al. (2018) found that there was a significant association between negative affect and risk of MCI and dementia, however no significant association was found for positive affect for either outcome. Results for dementia have been used in the analysis in this review. Sutin et al. (2018b) reported results for two separate subsamples. One sample (*N* = 5390)

completed a 6-item scale in 2006 and the other (*N* = 4709) completed a 13-item scale in 2008. Findings from this paper revealed that the association between positive affect and risk of developing dementia was significant in the 2008 sample only.

Pooling these results in the form of a meta-analysis found that positive affect was not significantly associated with future risk of dementia (HR = 0.94, 95% CI [0.76, 1.15], p = .54, I^2 = 58.23%) (Figure 2). The test for heterogeneity was non-significant (Q = 4.85, df = 2, p = .09).

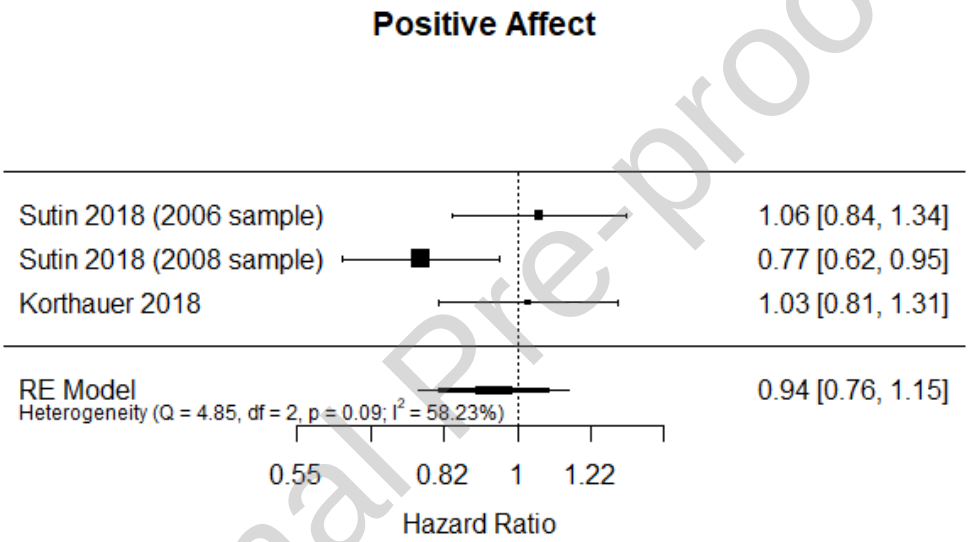

Figure 2: Forest plot for positive affect and risk of dementia

3.4. Purpose/Meaning in life

Three papers (including data from 6 different samples) reported on purpose/meaning in life (Boyle et al., 2010; Sutin et al., 2021a; Sutin et al., 2020). Data for purpose in life from Sutin et al. (2018b) have not been included in the analyses in this section as Sutin et al. (2021a) provides updated findings using the same data source. Further, whilst Boyle et al. (2010) investigated both dementia and MCI as outcomes, only results for MCI were included in these analyses as participants with MCI at baseline were present in the dementia analysis.

Overall, studies revealed that purpose/meaning in life was significantly associated with reduced risk of cognitive impairment (Sutin et al., 2020), MCI (Boyle et al., 2010), and dementia (Sutin et al., 2021a). Findings from Boyle et al. (2010) revealed that baseline purpose in life was significantly associated with reduced risk of MCI. Findings remained significant in a sensitivity analysis accounting for persistent MCI (present at 2 or more examinations). Next, Sutin et al. (2020) explored the association between meaning in life and cognitive impairment in a sample of over 22,000 participants across 14 different countries. Findings from this study revealed that lower meaning in life was associated with greater risk of cognitive impairment. This result remained stable across sensitivity analyses (excluding participants under age 65, excluding participants who developed impairment within 5 years, controlling for income) and separate analyses of each European region. Finally, Sutin et al. (2021a) found consistent significant findings for purpose/meaning in life across separate analyses of 4 different cohorts controlling for sociodemographic factors (age, gender, race/ethnicity, education). These results remained significant when also controlling for known clinical and behavioural risk factors for dementia (depression, obesity, diabetes, hypertension, smoking, physical inactivity).

Results from meta-analyses revealed that purpose in life was significantly associated with a reduced risk of MCI-dementia (HR = 0.82, 95% CI [0.77, 0.86], $p < .0001$, $I^2 = 0.00\%$) (Figure 3a) and meaning in life was significantly associated with a reduced risk of cognitive impairment-dementia (HR = 0.81, 95% CI [0.76, 0.85], $p < .0001$, $I^2 = 0.00\%$) (Figure 3b). Next, a meta-analysis was run to test the combined effect of purpose/meaning in life with all outcomes (MCI, dementia, cognitive impairment). Results revealed a significant association of purpose/meaning in life with reduced risk of cognitive impairment, MCI or dementia (HR = 0.81, 95% CI [0.78, 0.84], $p < .0001$, $I^2 = 0.00\%$) (Figure 3c). Finally, a meta-analysis looking solely at dementia outcomes found that purpose/meaning in life was significantly associated with reduced risk of dementia (HR = 0.81, 95% CI [0.78, 0.85], $p < .0001$, $I^2 = 0.00\%$) (Figure 3d). No significant heterogeneity was found in any of the models (Figure 3).

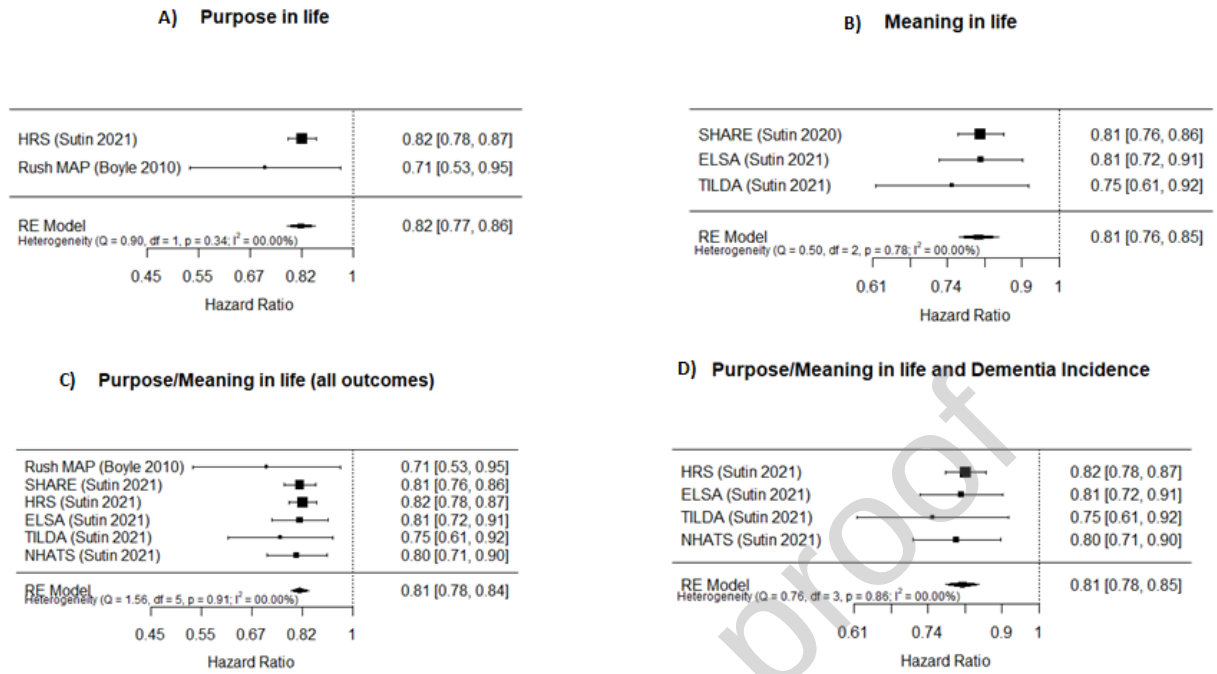

Figure 3: Forest plots for purpose/meaning in life

3.5. Life satisfaction

Two papers reported on life satisfaction, however as one paper used a continuous measure of life satisfaction (Sutin et al., 2018b) and the other used a binary measure (Rawtaer et al., 2017) it was decided that it was not appropriate to pool them together in the form of a meta-analysis. Sutin et al. (2018b) found a significant association between life satisfaction and risk of dementia, however this effect was no longer significant when controlling for depressive symptoms. Rawtaer et al. (2017) controlled for depression and reported a significant association between being very satisfied with life and a reduced risk of developing MCI-dementia, this effect remained significant across all models.

3.6. Optimism

Two papers reported on optimism (Gawronski et al., 2016; Sutin et al., 2018b). Both used data from the Health and Retirement Study so were not combined in a meta-analysis. Sutin et al. (2018b)

found no significant association between optimism and dementia incidence (defined as ≤ 6 out of 27 on TICSm). Gawronski et al. (2016) found that optimism was significantly associated with a reduced likelihood of developing cognitive impairment (defined as ≤ 10 out of 35 on TICSm). This effect persisted across models, including when adjusting for symptoms of depression and anxiety and when excluding participants with outcome scores within one standard deviation of the threshold used to indicate cognitive impairment.

3.7. Other PPCs

Due to insufficient number of studies for the remaining PPCs, results have been summarized below. One paper reported results for perceived mastery and one paper investigated overall PWB. Sutin et al. (2018b) found no significant association between perceived mastery and risk of dementia incidence. Next, Zhou et al. (2020) used data from the Chinese Longitudinal Health Longevity Survey to explore the association between psychological wellbeing and cognitive impairment. The measure of PWB was comprised of 4 positive items (optimism, conscientiousness, sense of personal control, and positive feelings about aging) and 3 negative items (neuroticism, loneliness, and perceived loss of self-worth). Results from this paper suggested that higher PWB was significantly associated with reduced odds of cognitive impairment.

4. Discussion

This review aimed to synthesise evidence regarding an association between PPCs and risk of MCI and dementia. Findings from meta-analyses revealed that higher purpose/meaning in life was significantly associated with a reduced risk of all cognitive impairment outcomes, however results for positive affect were non-significant. Significant findings for purpose/meaning remained stable across analyses, suggesting that higher purpose/meaning in life is associated with a reduced rate of clinically significant cognitive impairment by nearly 20%. Whilst these results should be interpreted

with caution due to the small number of studies, the significant findings for purpose/meaning are consistent of that from another recent meta-analysis (Sutin et al., 2021a). Our present analysis builds on Sutin's findings by exploring effects of purpose and meaning individually and their combined effect on risk of dementia in a sample without identified impairment at baseline.

There are several possible pathways this effect could be operating through (causal, reverse causality, prodromal). If this effect is causal, then several possible mechanisms could be proposed, including direct causality through neurobiological mechanisms, indirect effects through behavioural mechanisms, or a mixture of both. Previous research has suggested that purpose in life may be associated with faster recovery to baseline cortisol levels after experiencing stress (Fogelman and Canli, 2015). With growing evidence for the association between higher cortisol levels and risk of dementia (Ouanes and Popp, 2019), it is possible that there may be a protective neurobiological effect of purpose/meaning through its association with response to and recovery from stressful events. Further, previous cross-sectional research has suggested that higher purpose in life is associated with lower pro-inflammatory cytokines (Friedman et al., 2007). Considering the association between depression, inflammation and dementia (Leonard, 2007), it is possible that purpose/meaning in life may play a protective role through their association with important dementia-related biomarkers, such as neuroinflammation and cellular stress response (see Calabrese et al., 2010; Cornelius et al., 2013; Pennisi et al., 2017). At present, little research has investigated these possible neurobiological mechanisms in relation to individual PPCs, thus this should be directly tested in future research. Finally, one possible behavioural mechanism could be through purpose/meaning in life decreasing other dementia risk factors (e.g., depression). Whilst its expression may differ between individuals, purpose in life is often characterized by goal-oriented pursuits and engagement in activities and experiences the individual finds purpose in (Sutin et al., 2021b). As such, people with a higher sense of purpose in life may be more likely to engage in other behaviours and activities that are associated with healthier lifestyles (e.g. exercise or social involvement) which may contribute to the protective effect and may also in turn increase resilience

regarding possible risk factors (e.g. depression, physical inactivity, obesity). Similarly, one possible explanation as to why significant results were found for purpose/meaning but not for positive affect may relate to differences between eudemonic and hedonic approaches to wellbeing. Broadly speaking, eudemonic wellbeing (e.g. purpose/meaning in life) is characterized by the pursuit and experience of meaning, personal growth, and excellence, whereas hedonic wellbeing (e.g. positive affect) is characterized by the pursuit and experience of pleasure and comfort (Huta, 2017). In this sense, it is possible that people with higher PPCs associated with eudemonic wellbeing may be more likely to engage in activities that are associated with reduced risk (e.g. exercise, social interactions). More research is needed to understand the possible mechanisms for the protective effect of purpose/meaning in life with risk of dementia.

From the narrative synthesis, the mixed results observed for optimism and life satisfaction may highlight the importance of considering how these factors are related to the effects of negative psychological factors. Arguably, as positive and negative psychological factors are independent but related (Karademas, 2007), it is important to consider both in parallel. The definition of optimism varied across studies, which may explain in part the mixed results observed in this synthesis. Both studies used data from HRS which measured optimism using the revised version of the Life Orientation Test. However, Sutin et al. (2018b) used only the 3 positive items whereas Gawronski et al. (2016) combined both the positive and negative (reversed scored) items as a composite. In addition to exploring different cognitive outcomes (cognitive impairment, dementia), findings from these papers are not comparable due to the predictors measuring fundamentally different concepts of optimism. One regards optimism independently from pessimism, whereas the other defines optimism in terms of optimism presence and absence of pessimism. A recent paper that investigated the association between optimism/pessimism as independent but related factors and physical health outcomes found a stronger effect for the absence of pessimism, although the presence of optimism was significantly associated (Scheier et al., 2021). This may lend some explanation as to why significant results were found by Gawronski et al. (2016) but not by Sutin et al. (2018b). Similarly,

Sutin et al. (2018b) showed that effects of life satisfaction on dementia risk was no longer significant after controlling for depressive symptoms. The authors propose that anhedonia (inability to feel pleasure) experienced in depression may explain this finding and that this may suggest that the association between life satisfaction and risk of dementia is not independent of negative emotions. Conversely, Rawtaer et al. (2017) found a significant association even when controlling for depression. The mixed findings for life satisfaction studies may be related to the measures used to capture this concept. Whilst both studies used shorter scales (4-5 items), Sutin et al. (2018b) treated life satisfaction as a continuous variable whereas Rawtaer et al. (2017) coded participants as either very satisfied with life or not. It is possible that treating life satisfaction as a categorical variable may increase the risk of a false positive result (Altman and Royston, 2006).

Whilst our primary interest was to explore individual PPCs that contribute to PWB, our searches did identify one paper investigating PWB comprising of several different factors combined. Zhou et al. (2020) used a measure that comprised of both positive and negative (reverse scored) items and found a significant association between PWB and cognitive impairment. Arguably, PWB is characterized by both a higher presence of PPCs and a lower presence or absence of negative psychological factors. In this respect, whilst this is a notable finding from Zhou et al. (2020), it does not provide any indication whether some of these factors may be stronger predictors than others. As this measure of PWB also included negative factors associated with depression (e.g. neuroticism, perceived loss of self-worth), it is unclear whether this significant finding is the result of having higher positive factors, lower negative factors, or a combination of both. Previous research using Ryff's scale found that whilst PWB did not significantly predict risk of functional disability, frailty, and mortality, there was an indirect effect that was mediated by depression (Rao et al., 2017). Thus, future research investigating PWB and risk of dementia should be mindful of both positive and negative aspects.

4.1. Strengths and limitations

Strengths of this research include using an extensive list of PPCs that were informed by both the literature and experts in the field. To our knowledge, this is the first review to explore evidence for the association of a wide range of individual PPCs and risk of MCI and dementia. Conversely, due to the broad nature of this topic, there was some difficulty in contextualising and optimising the search terms. As a result, whilst this review used a comprehensive list of search terms for PPCs, there are others that were not covered (e.g. engagement, elevation). Further, there were limited papers on individual PPCs, and in some cases (e.g. life satisfaction) different studies were not directly comparable. As such, we were unable to statistically synthesise evidence for some PPCs. Lastly, MCI and dementia are separate clinical diagnoses. However due to the small number of papers identified and the early stages of this research area, these outcomes were combined in some analyses, which may affect interpretation of findings Although in the case of purpose/meaning in life, where it was possible to disaggregate these outcomes, effects remained the same. Moreover, across papers reporting dementia outcomes, measures used were not consistent and whilst this is common practice in meta-analyses looking at dementia as an outcome (e.g. Peters et al., 2019; Sutin et al., 2021a), this is still a notable limitation. With clinical diagnosis of dementia being the gold standard, combining these with outcome measures using cut-off scores from TICSm and MMSE may present some uncertainty to the validity of these findings, particularly when the cut-offs used are not dissimilar to those used by other studies to indicate pre-clinical cognitive impairment. For example, Gawronski et al. (2016) used a cut-off score of ≤ 10 out of 35 on TICSm to indicate cognitive impairment, whereas Sutin et al. (2018b) used a cut-off of ≤ 6 out of 27 to indicate dementia. However, it should be noted that no significant heterogeneity was observed in any meta-analysis in this review.

4.2. Implications and future directions

This review highlights a promising area for further exploration. With significant findings for purpose/meaning in life, future research should also consider whether this protective effect differs

between types of dementia diagnosis. Further, in light of some promising results from individual studies for other PPCs, future research should build upon the current evidence and explore the individual effects of PPCs that contribute to PWB and their association with MCI and dementia. Understanding which PPCs may be potentially modifiable protective factors has important implications for informing interventions for those at greater risk of developing dementia. With evidence for the benefits of behavioural interventions for improving PWB (Weiss et al., 2016), future research could investigate the efficacy of these interventions for reducing the risk of dementia. Moreover, research could also explore promoting PWB through psychological health promotion interventions for older people. Next, as previously mentioned, it is important to consider the relationship with negative factors when investigating PPCs. Thus, research should continue to explore the associations between both positive and negative psychological factors and how this relates to risk of MCI and dementia. Finally, there are a number of potential pathways, such as nutritional status (Devore et al., 2010), lifestyle (Dhana et al., 2020) and stress response (Calabrese et al., 2012; Ouanes and Popp, 2019), that may help explain findings, however these were not explored by the studies included in this review. At present, little research has investigated the possible mechanisms for these associations. Future research should explore the potential protective pathways, both neurobiological and behavioural, through which purpose/meaning in life may reduce risk of dementia and mild cognitive impairment.

5. Conclusions

This review synthesised data on the association between positive psychological constructs and risk of dementia and MCI. Findings provide a synthesised foundation on which to further explore this area. The mixed findings for different PPCs highlight the importance of investigating factors that contribute to PWB individually. We conclude that this is a promising area for future research which may have important implications for dementia prevention.

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Appendices

A) List of search terms

1 Cognition/ (102155)
2 Executive Function/ (15674)
3 memory/ or memory, episodic/ or memory, long-term/ or memory, short-term/ or mental recall/ (120714)
4 cognition disorders/ or cognitive dysfunction/ (84548)
5 dementia/ or alzheimer disease/ or dementia, vascular/ or frontotemporal lobar degeneration/ (144963)
6 memory.tw. (258923)
7 dement*.tw. (118390)
8 alzheimer*.tw. (151915)
9 "cognition".tw. (71976)
10 "Mild Cognitive Impairment".tw. (17723)
11 "cognitive function*".tw. (64896)
12 "cognitive impairment*".tw. (68228)
13 "cognitive decline".tw. (23789)
14 "cognitive deficit*".tw. (22140)
15 "cognitive loss*".tw. (445)
16 "cognitive abilit*".tw. (14162)
17 "cognitive status".tw. (5352)
18 "cognitive change".tw. (1610)
19 "cognitive performance".tw. (19728)
20 "cognitive dysfunction*".tw. (15551)
21 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 (693276)
22 Optimism/ (712)
23 Psychology, Positive/ (51)
24 courage/ or forgiveness/ or happiness/ or hope/ or love/ (9810)
25 Creativity/ (7102)
26 spirituality/ (7799)
27 "positive psycholog*".tw. (1879)
28 "well-being".tw. (81834)
29 "self-acceptance".tw. (755)
30 "purpose in life".tw. (862)
31 courage.tw. (2120)
32 bravery.tw. (121)
33 valo?r.tw. (1315)
34 authenticity.tw. (4210)
35 honesty.tw. (1889)

36 love.tw. (8617)
37 kindness.tw. (1020)
38 generosity.tw. (831)
39 nurturance.tw. (524)
40 compassion.tw. (6160)
41 temperance.tw. (305)
42 forgiveness.tw. (1091)
43 mercy.tw. (1616)
44 humility.tw. (1168)
45 modesty.tw. (439)
46 prudence.tw. (910)
47 "self-regulation".tw. (8263)
48 "self-control".tw. (5874)
49 transcendence.tw. (1245)
50 gratitude.tw. (1628)
51 hope.tw. (52990)
52 optimism.tw. (9052)
53 "future-mindedness".tw. (3)
54 "future orientation".tw. (437)
55 humo?r.tw. (14629)
56 playfulness.tw. (262)
57 spirituality.tw. (6833)
58 religiousness.tw. (802)
59 faith.tw. (7186)
60 "positive emotion*".tw. (4931)
61 engagement.tw. (70190)
62 (meaning* adj3 life).tw. (2648)
63 accomplishment*.tw. (8674)
64 "positive affect".tw. (5988)
65 "life satisfaction".tw. (8168)
66 "personal growth".tw. (1578)
67 "environmental mastery".tw. (157)
68 perseverance.tw. (1559)
69 industriousness.tw. (57)
70 vitality.tw. (12694)
71 zest.tw. (288)
72 enthusiasm.tw. (7863)
73 vigo?r.tw. (5646)
74 justice.tw. (18858)
75 loyalty.tw. (1792)
76 fairness.tw. (3921)
77 humanity.tw. (3800)
78 "social intelligence".tw. (257)
79 "emotional intelligence".tw. (2226)
80 "personal intelligence".tw. (12)
81 "appreciation of beauty".tw. (22)
82 "appreciation of excellence".tw. (0)
83 awe.tw. (555)
84 wonder.tw. (2524)
85 wisdom.tw. (7900)
86 creativity.tw. (6628)
87 originality.tw. (4306)
88 ingenuity.tw. (4067)
89 curiosity.tw. (3792)
90 "novelty-seeking".tw. (1830)
91 "openness to experience".tw. (942)
92 "open-mindedness".tw. (188)

93 "critical thinking".tw. (3907)
94 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87 or 88 or 89 or 90 or 91 or 92 or 93 (399695)
95 21 and 94 (22343)
96 aged.tw. (599003)
97 aging.tw. (187688)
98 ageing.tw. (43266)
99 elder*.tw. (265821)
100 ((old or retired) adj2 (people* or patient* or inpatient* or in-patient* or outpatient* or out-patient* or client* or person* or individual* or wom?n or man or men or age)).tw. (401432)
101 older*.tw. (454179)
102 geriatr*.tw. (51135)
103 gerontolog*.tw. (7262)
104 senior*.tw. (42852)
105 senescen*.tw. (41674)
106 retiree*.tw. (1611)
107 sexagenarian*.tw. (97)
108 septuagenarian*.tw. (400)
109 octagenarian*.tw. (42)
110 nonagenarian*.tw. (1464)
111 centenarian*.tw. (2073)
112 supercentenarian*.tw. (105)
113 veteran*.tw. (37456)
114 aging/ (233106)
115 aged/ (3164510)
116 "aged, 80 and over"/ (947495)
117 "frail elderly"/ (12168)
118 "health services for the aged"/ (17926)
119 "homes for the aged"/ (14211)
120 geriatrics/ (30358)
121 midlife.tw. (5983)
122 "mid-life".tw. (1432)
123 (late* adj2 life).tw. (32164)
124 Middle Aged/ (4465061)
125 Retirement/ (9812)
126 retire*.tw. (21801)
127 96 or 97 or 98 or 99 or 100 or 101 or 102 or 103 or 104 or 105 or 106 or 107 or 108 or 109 or 110 or 111 or 112 or 113 or 114 or 115 or 116 or 117 or 118 or 119 or 120 or 121 or 122 or 123 or 124 or 125 or 126 (6192412)
128 95 and 127 (9677)

B) Newcastle-Ottawa Quality Assessment Scale (*N* = 11)

Cognitive impairment/ MCI/ Dementia studies	Boyle 2010	Korthauer 2018	Sutin 2020	Gawronski 2016	Rawtaer 2017	Zhou 2020	Sutin 2018	Sutin 2021 (HRS)	Sutin 2021 (ELSA)	Sutin 2021 (TILDA)	Sutin 2021 (NHATS)
SELECTION **Representativeness of the exposed cohort**											
Representative of the	**1**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

average in the community ?											
Selected group of users		**0**									
No description											
Selection of the non-exposed											
Drawn from the same community as the exposed cohort ?	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Drawn from a different source											
No description											
Ascertainment of exposure											
Secure record OR structured interview ?											
Written self-report	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
No description											
Demonstration that outcome of interest was not present at start											
Yes ?	**1**	**1**	**1**	**1**	**1**	**1**	**1**				
No								**0**	**0**	**0**	**0**
COMPARIBILITY **Comparability of cohorts on the basis of the design or analysis**											
Study controls for age and gender ?	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Study controls for any additional factor (education, depression) ?	**½**	**½**	**½**	**1**	**1**	**½**	**1**	**1**	**1**	**1**	**1**
OUTCOME **Assessment of outcome**											
Independent blind assessment OR record linkage ?	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Self-report											
No description											

Was the follow up long enough for outcomes to occur?											
Yes	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
No											
Adequacy of follow up of cohorts											
Complete follow up OR subjects lost to follow up and description provided of those lost	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
No description of those lost											
No statement											
TOTAL	**7.5**	**6.5**	**7.5**	**8**	**8**	**7.5**	**8**	**7**	**7**	**7**	**7**

CRediT authorship contribtuion statement

Georgia Bell: Conceptualisation, methodology, formal analysis, investigation, writing – original draft. **Timothy Singham:** Methodology, writing – review and editing. **Amber John:** Conceptualisation, formal analysis, writing – review and editing, supervision. **Joshua Stott:** Conceptualisation, formal analysis, writing – review and editing, supervision. **Rob Saunders:** Formal analysis, writing – review and editing.

Highlights

- Evidence for depression and dementia risk, less known about psychological wellbeing
- Purpose/meaning in life is associated with reduced risk of dementia
- Positive affect was not significantly associated with risk of dementia
- Mixed findings for optimism and life satisfaction
- Promoting purpose/meaning in life might inform dementia prevention interventions