

The protective effects of wellbeing and flourishing on long-term mental health risk

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ABSTRACT

Objective: Personal wellbeing reflects individuals' experiences of positive mental health and those with high wellbeing can be described as flourishing. Increasingly, wellbeing and flourishing are informing public health policy and clinical practice. However, the long-term benefit of wellbeing and flourishing on negative mental health outcomes over the life course is not widely explored.

Method: Data were from the Personality and Total Health Through Life study, based in Canberra, Australia. Participants were recruited to three age cohorts (Early Adulthood $n = 991$; Middle Adulthood $n = 1,510$; Later Adulthood $n = 1,432$). Wellbeing was operationalised by positive and negative affect, life satisfaction, morale, resilience and social support. Flourishing status was defined by those reporting the highest levels of wellbeing. Mental Health was operationalised by depression and anxiety symptoms, and any depressive disorder. A sub-set of early ($n = 439$) and middle adulthood ($n = 1,275$) participants completed the Composite International Diagnostic Interview (CIDI).

Results: Associations between individual wellbeing indicators with mental health were mostly attenuated or of small magnitude in multivariate analyses, except for negative affect and low mastery which consistently reported substantial 4-year risk for all age cohorts. In contrast flourishing status reported consistently strong protection against poor mental health outcomes.

Conclusion: Individual wellbeing indicators are not as strongly related to mental health outcomes as a higher-order latent wellbeing factor reflecting flourishing. However, multiple measures of wellbeing are needed to capture the gamut of wellbeing experiences and are related to improved mental health outcomes over the long-term and are generally consistent across adulthood.

1. Introduction

The disease burden associated with clinical dimensions of mental ill-health is increasingly complemented by positive mental health or wellbeing. Both concepts are relevant to the question of what constitutes a well, functional and flourishing life. Multiple wellbeing dimensions are described in a burgeoning literature which emphasises wellbeing as a valid indicator of psychological health with utility for clinical practice (Burns et al., 2011; Fava, 2012, 2016; Fava et al., 1998, 2011; Kim et al., 2016; Trompetter et al., 2017) and in the development of national health policy (Beddington et al., 2008; Jorm & Ryan, 2014; Veenhoven, 2012; Burns & Browning, 2016). Put simply, the focus on individuals'

wellbeing extends psychiatric health outcomes as the primary indicators of psychological health in individuals and populations. Importantly, positive aspects of mental health may not only be of value for their own sake but may buffer and prevent the onset of mental illness. It has been proposed that wellbeing's importance lies in its function to moderate the development of psychopathology (Trompetter et al., 2017). There is however only limited evidence of the long-term protective effects of wellbeing for mental illness (Weich et al., 2011; Wood & Joseph, 2010; Lamers et al., 2015). We therefore examine here the 4-year risk of poor psychiatric health outcomes attributed to low wellbeing and the protective role of flourishing across the life course in a large community sample of adults.

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While mental health is operationalised clearly in terms of the presence of clinically-relevant symptoms of psychiatric distress with formal definitions of clinical dysfunction (e.g. the Diagnostic and Statistical Manual of Mental Disorders (DSM); the International Statistical Classification of Diseases and Related Health Problems (ICD)), definitions of wellbeing have historically been less clearly operationally defined. There has been concerted effort to reconcile wellbeing approaches. For instance, wellbeing research is commonly described as reflecting two traditions (Ryan & Deci, 2001). The Subjective Wellbeing (SWB) approach focuses on individuals' reports of hedonic experiences (i.e. presence of positive affect, absence of negative affect) and cognitive judgements of satisfaction (e.g. with life, relationships, work etc...). The Psychological Wellbeing (PWB) approach focuses on eudaimonic dimensions of psychological functioning. For example, Self-Determination Theory (Ryan & Deci, 2000) posits individuals' well-being is broadly determined through the satisfaction of psychological needs for Autonomy, Competence and Relatedness. A second PWB model (Ryff & Keyes, 1995) emphasise the 3 Self-Determination Theory domains in addition to indicators of Personal Growth, Purpose In Life and Self-Acceptance. There has been concerted methodological evidence to support the position that SWB and PWB reflect two distinct yet correlated dimensions of wellbeing (Ryff & Keyes, 1995; Burns & Machin, 2009; Chen et al., 2013). And the focus on individuals' level of feeling and functioning has been complemented by a focus on the inter-personal relationship between the individual and their social networks (i.e. Social Wellbeing (SoWB)), including their family and broader community, captured by dimensions of altruism, social connection and volunteerism. There have been attempts to rationalise these approaches into unified frameworks including in the Wellbeing module of the European Social Survey (Huppert et al., 2009) and more recently by The Well-being Profile (WB-Pro; Marsh et al., 2020) scale.

Relatedly, flourishing is often defined in terms of levels of SWB, PWB and SoWB. Those high on these dimensions are defined as flourishers in contrast with languishers who score low on these same scales (Huppert & So, 2013; Keyes, 2002). Unfortunately, there is no consistency in how flourishing is defined between multiple frameworks (Huppert & So, 2013; Keyes, 2002, 2005; Diener et al., 2010). Even Keyes has presented two different methods (Keyes, 2002, 2005, 2007), initially defining flourishers based on their wellbeing scores being in the highest tertile across individual standardized wellbeing distributions (Keyes, 2002, 2005). Subsequently, with the development of the Mental Health Continuum – Short Form (MHC-SF) which measured the frequency to which participants experienced multiple wellbeing experiences, Keyes proposed a new definition in which flourishers report experience wellbeing 'everyday' or 'almost everyday', for at least 1 of 3 emotional wellbeing indicators (Happy, Interested, Satisfied), and at least 6 of eleven indicators of psychological (Self-Acceptance, Mastery, Personal Growth, Autonomy, Purpose in Life, Positive Relations with others) and social wellbeing (Social Contribution, Social Integration, Social Actualisation, Social Acceptance, Social Coherence). Similarly, drawing on the European Social Survey (ESS) wellbeing module (Huppert et al., 2009), Huppert and So (2013) defined flourishing in terms of 'agree' to 'strongly agree' on scales of Competence, Meaning, Optimism, Resilience, Self-Esteem, and Positive Relationships, 'most of the time' to 'all or almost all of the time' on scales of Vitality and Emotional Stability, and rate their Positive Emotion as 8 and above on a 0–10 scale bounded by 'extremely unhappy' to 'extremely happy'. Yet another model of flourishing has been that operationalised by Diener et al. (2010) in the Flourishing scale as a univariate dimension comprising items that tap into constructs such as meaning, mastery, relationships, social connection, etc.. Not surprisingly, when Hone and colleagues (Hone et al., 2014) examined the concordance between four different models of personal flourishing, they demonstrated that different operationalisations of flourishing can result in quite different flourishing prevalence. Whether one was defined as flourishing depended on the definition applied as the concordance in flourishing status between definitions ranged from 74 to

81%. That is, even in the best-case scenario, approximately 1 in 5 persons defined as flourishing from one method was not defined as flourishing on another method. Settling on a final and gold-standard measure of flourishing is therefore not clear. Similarly, Schotanus-Dijkstra et al. (2016) reported only moderate correlations ($r = 0.58$) between the MHC-SF (Keyes et al., 2010) and the Flourishing Scale (Diener et al., 2010), two scales frequently used to derive flourishing status; whilst high, this is not sufficiently high enough to reflect the same latent construct. Schotanus-Dijkstra et al. (2016) highlighted that this can be attributed to the scales measuring slightly different wellbeing components, which supports a contention made by Marsh et al. (2020) that there remains ambiguity and 'Jingle Jangle fallacies' in the wellbeing literature, where Jingle fallacies reflect different constructs being named the same, and Jangle fallacies where the same construct is named differently and that even the most established wellbeing scales are sufficiently divergent to question their purported comparability (Marsh et al., 2020).

The issue for those wishing to utilise flourishing as a categorical dimension is that unlike mental illness (e.g. Major Depressive Disorder, Generalized Anxiety Disorder, or Post-Traumatic Stress Disorder), where the presence of a common set of symptoms that impact on daily functioning is generally observable and verifiable, there is no objective equivalent for flourishing. For the purposes of this study we derive flourishing from a global measure of wellbeing derived from several subscales of wellbeing, similar to those concepts measured in the Flourishing Scale (Diener et al., 2010) and use a distribution cut-off as original proposed by Keyes (2002) to define those with the highest wellbeing as flourishing, those with the lowest wellbeing as languishing, and those in-between with moderate wellbeing.

Reconciling the relationship between wellbeing and future mental health is an area that has received limited examination. For example, Burns et al. (2011) demonstrated a causal pathway by which PWB drive SWB which in turn predict mental health outcomes, but these findings, as with much of the literature, has focused on specific individual domains of wellbeing. For example Wood and Joseph (2010) demonstrated how low PWB only, operationalised in terms of Ryff's PWB scales (Ryff & Keyes, 1995), predicted depression outcomes at 10-year follow-up in a large community sample of middle-aged adults as they approached older adulthood. In terms of the relationship between flourishing and mental health, Keyes et al. (2010) identified that 10-year change in flourishing status (increase in wellbeing) decreased risk for mental illness, while declines in wellbeing increased risk for mental illness. We note that both Wood and Joseph (2010) and Keyes et al., 2010 were drawn from American community samples and there is a need to examine these patterns in other cultural contexts. For example, Schotanus-Dijkstra et al. (2017), found flourishing provided protection against 3-year risk for mood, anxiety and substance-use disorders and emphasised the dearth of good longitudinal evidence for the role of wellbeing and flourishing in reducing mental illness. There is an increasing body of evidence that facets of wellbeing/positive mental health are important exposures for a range of health outcomes, including stroke, cardio-vascular health, and functional capacity (Boehm & Kubzansky, 2012; Kim et al., 2016; Kubzansky et al., 2018). Specifically, for mental health outcomes, there is a need for further longitudinal examination at the population level and to examine wellbeing dimensions more broadly and over the life course.

In the current paper, we therefore extend an argument (Schotanus-Dijkstra et al., 2017) that there is need to further examine the association between individual wellbeing indicators and flourishing with long-term mental health outcomes. Three main aims guide our analytical method. First, we compare the associations between multiple well-being indicators and three distinct measures of mental health, including the Brief Patient Health Questionnaire (BPHQ; Spitzer et al., 1999) which has clinical utility against DSM-IV depression criteria, and the Goldberg Depression and Anxiety Scales to assess the impact of low wellbeing on mental health symptomology (Goldberg et al., 1988). Also, a subsample of participants undertook the World Health Organisation's World Mental Health Composite International Diagnostic Interview

(CIDI) which is a comprehensive and fully-structured interview designed for ICD-10 and DSM-IV assessment of mental disorders.

Second, we draw our data from a large longitudinal study that comprises individuals in 3 narrow age cohorts in order that we can compare the importance of different wellbeing indicators on mental health risk across the adult lifespan. Developmental differences are important to consider in this context as an increasing body of literature points to ageing-related gains in mental health and well-being (at least prior to very old age; cf. (Charles & Carstensen, 2010)). Yet, the consistency of mechanisms of wellbeing in moderating trajectories of psychiatric symptomatology across different parts of the life course have rarely been examined.

Third, we include indicators of SWB, PWB and SoWB dimensions in order to compare the utility of different wellbeing indicators. Examining these different indicators could shed light on the relative importance of possible mechanisms underlying their protective effects. For example, there is literature pointing to supportive social relationships (as broadly captured by SoWB) as a key resource for buffering against negative effect of stress exposure on well-being (Thoits, 2011; Burns & Machin, 2012). At the same time, positive affect (a component of SWB) has been hypothesised to have an “undoing” effect on negative emotions and physiological reactions to stress (Fredrickson & Levenson, 1998). After comparing the effects of the individual wellbeing indicators, we derive a measure of overall wellbeing from the individual SWB, PWB and SoWB measures to categorise participants into high (flourishing), moderate, and low wellbeing (languishing) in order to examine the benefits of high wellbeing 1) over and above those conferred on those with just moderate wellbeing and 2) to compare with the protective effects of the individual wellbeing indicators.

2. Methods

2.1. Study design and participants

The participants were drawn from the Personality and Total Health (PATH) Through Life Project (Anstey et al., 2012, 2020), a large community survey focused on the health of randomly selected individuals from the electoral rolls of Canberra or the neighbouring town of Queanbeyan, Australia; voting is compulsory in Australia and the sample is representative of the local region. PATH's sampling frame included adults in one of three age cohorts, who were aged 20–24 (early adulthood), 40–44 (middle adulthood), and 60–64 (older adulthood) years of age at baseline and who have been interviewed every 4 years since 1999/2001. PATH was designed to chart the progression of health across the life course and identify the individual characteristics and the environmental and genetic risk factors for health outcomes. Results presented here concern the 3rd and 4th wave of data collection as some measures were only included in those waves. Therefore, predictors at wave 3 can be considered the baseline and wave 4 outcomes as a measure of the 4-year risk. Of the 7,485 participants commencing the study in Wave 1, there were 4,479 participants who were interviewed at waves 3 and 4. Of these, 569 participants interviewed at these waves were excluded from the main analyses for having some form of depression at wave 3; they were included in sensitivity analyses. Of those participants who met inclusion, 299 participants across the age cohorts (early adulthood $n_{\text{missing}} = 38$; middle adulthood $n_{\text{missing}} = 68$; older adulthood $n_{\text{missing}} = 193$) reported missing information on the socio-demographic variables and risk factors and were excluded from these analyses. The main analyses therefore focus on $N = 3,594$ participants (specifically $n = 908$ participants in the early adulthood cohort, $n = 1,439$ participants in the mid-life cohort, and $n = 1,247$ participants in the older adulthood cohort) who provided information on the key variables at both waves 3 and 4, and were free of depression at wave 3. Participants were mostly assessed in their own homes and completed a questionnaire under the supervision of a professional interviewer. Participants received a full description of the study and provided informed consent. The study was approved by the Human Research Ethics Committee at the Australian National University.

2.2. Measures

2.2.1. Wellbeing

Subjective Wellbeing (SWB) was assessed in terms of affect and life satisfaction. *Positive* and *negative affect* were assessed with the Positive and Negative Affect Schedule (PANAS; Watson et al. (1988)), a 20-item self-report measure of positive ($\alpha = 0.908$) and negative ($\alpha = 0.884$) affect (10 items per construct). Individuals indicated their response on a 5-point Likert scale, with higher scores indicating greater well-being on that dimension. The ‘past month’ reference was used in this study. *Life Satisfaction* was assessed with the Satisfaction With Life Scale (SWLS; Diener et al. (1985)), a short 5-item self-report measure of global cognitive judgments of satisfaction with one's life. Individuals indicated their response on a 7-point Likert scale, with higher scores indicating greater satisfaction with life ($\alpha = 0.897$).

Psychological Well-Being (PWB) was assessed in terms of *mastery* and *resilience*. *Mastery* was assessed with the Personal Mastery Scale ($\alpha = 0.782$ (Pearlin & Schooler, 1978);). The scale consists of 7 items measuring locus of control (e.g. What happens to me in the future mostly depends on me”, “I can do just about anything I really set my mind to do”). Respondents indicated agreement with each item on a 4-point Likert scale. *Resilience* was assessed in terms of the Connor-Davidson Resilience Scale (CD-RISC; Connor and Davidson (2003)). The CD-RISC ($\alpha = 0.918$) comprises 25 items that measure individuals' sense of resilience and capacity to change and cope with adversity (e.g. “Have a strong sense of purpose”, “Tend to bounce back after illness or hardship”). Respondents indicated agreement with each item on a 5-point Likert scale with higher scores indicating greater resilience. Previous factor analysis of the CD-RISC within PATH suggest this is an uni-dimensional resilience scale invariant across the lifespan; three items that failed to load onto a single resilience factor were excluded from the analyses (Burns & Anstey, 2010).

Social Wellbeing (SoWB) was assessed in terms of social support. Separate indices of positive and negative social support were derived from 3 scales assessing support with partner, family and friend (Schuster et al., 1990). Each dimension was assessed on separate dimensions of positive (friend $\alpha = 0.860$; family $\alpha = 0.847$; partner $\alpha = .878$) and negative (friend $\alpha = 0.712$; family $\alpha = 0.793$; partner $\alpha = .872$) support. The negative scales were aggregated into a measure of global negative social support and the positive scales were aggregated into a measure of global positive social support. As some participants were not partnered, an average was derived from the other support network scales that individuals had responded to.

2.2.2. Flourishing

For the flourishing analyses, an Exploratory Factor Analysis (EFA) of the wellbeing indicators, using a principal axis factor method, derived 1 factor with an eigenvalue >1 (only 1 factor reported an eigenvalue >1) explaining 76.8% of the shared variance. The factor score was saved and then divided into tertile groups to reflect languishing (low wellbeing), moderate wellbeing, and flourishing (high wellbeing). Factorial invariance analysis of the single model across age-cohorts was conducted and overall, the configural and metric models reported comparable fit whilst the scalar model reported worse fit (Supplementary Table A1). We would note that full scalar invariance is difficult to establish in practice, particularly where age-related differences in the means of the various wellbeing measures are commonly reported (Burns, 2020; Charles & Carstensen, 2010). So, we compared the factor score from a model where the factor score was derived under the assumption of full invariance, versus a model where parameters which were significantly different ($p < .05$) between age groups were unconstrained and freely estimated; the correlations between the single factor scores were very high ($r = 0.9984$) and suggest no substantive change in wellbeing score.

2.2.3. Mental health

Mental Health was operationalised in several ways. Mental health symptoms were assessed with the Goldberg Depression and Anxiety

Scales (GADS; Goldberg et al., 1988). The GADS comprises 18 items that list symptoms of depression and anxiety. Participants respond 'yes' or 'no' to whether they have experienced any of the symptoms. The scale reports high sensitivity with DSM-IV diagnosis of depression and anxiety (Goldberg et al., 1988; Kiely & Butterworth, 2015).

Depression was assessed with the 9-item Brief Patient Health Questionnaire (BPHQ; Spitzer et al. (1999)) which incorporates DSM-IV depression diagnostic criteria with relevant classifications of subsyndromal, minor or major depression (Kroenke et al., 2001). In PATH, BPHQ scores have excellent sensitivity and specificity against 30-day diagnoses of any depressive disorder (Area Under the Curve (AUC) = 0.883) against the Composite International Diagnostic Interview (CIDI; Kiely and Butterworth (2015)). For the purposes of this study, those participants categorised with subsyndromal, minor or major depression were classified as 'any depression' and compared to those who participants who reported no depression.

At wave 4, a subset of participants from the early ($n = 439$) and middle ($n = 1, 275$) adulthood cohorts also provided data on the CIDI from which 12-month DSM-IV diagnoses for any Depression and Generalized Anxiety Disorders (GAD) were derived. In addition to these outcomes, those participants who were categorised with either depression or GAD were classified as having either depression or GAD and compared to those who participants who reported no depression or GAD. We also generated a binary variable reflecting either Depression and/or GAD.

2.2.4. Covariates

We adjusted for several covariates that have been linked with wellbeing and mental health (Weich et al., 2011; Thoits, 2011; Ryan & Deci, 2001; Burns, 2019, 2020) including gender (ref: female vs. male), years of education, chronological age (in years), partner status (ref: partnered vs. not partnered), financial distress (ref: no financial problems vs. financial problems sometimes or often) and physical health. Partnered status was defined as those identifying as married or defacto; with not partnered defined as those identifying as divorced, separated, single and widowed. Owing to age-normative differences in the presence of chronic conditions, a general measure of physical health was included. Physical health was assessed with the SF-12 Physical Health Component Score (Ware et al., 1996) which includes items that assess limitations, physical functioning, bodily pain, and general health perceptions.

Participant characteristics at baseline (wave 3) by age group are reported in Table 1. There were slightly more female respondents in early adulthood and they reported slightly higher years of completed education. Whilst partnered status was consistent between age cohorts, there was a decline in physical health with age. There were no substantive differences in wellbeing between age groups, but there was a higher proportion of languishers in mid-life and a higher proportion of flourishers in early adulthood. In terms of mental health, although there are higher numbers of respondents with any depression as measured on the BPHQ with increasing age, there was conversely a decline in symptomology. We compared key baseline (Wave 3) characteristics of the sub-sample who provided information on the CIDI outcomes; comparisons are detailed in Supplementary Table B1. Overall, there were no substantive differences between those who were selected to respond to the CIDI. The correlations and covariances between study variables are reported in Supplementary Tables C1-C10.

2.3. Statistical analysis

Analyses were conducted in Stata v.16 (StataCorp, 2019). Analyses were stratified by age cohort to examine differences in the estimates between age cohorts. Bivariate analyses between the individual wellbeing indicators and the mental health outcomes were first estimated (see Supplementary Tables C1-C10). Regression analyses then examined the association of the individual wellbeing indicators in a multi-variate framework to identify which of the indicators were most strongly

Table 1
Participant characteristics, by age group.

	Early Adulthood ($n = 908$)	Middle Adulthood ($n = 1, 439$)	Later Adulthood ($n = 1, 247$)
	N (%)	N (%)	N (%)
Wave 3 - Covariates			
Male	385 (42.4)	682 (47.4)	662 (53.1)
Partnered	720 (79.3)	1, 205 (83.7)	1, 002 (80.4)
Financial Problems	130 (14.3)	184 (12.8)	75 (6.0)
Years of Education, M(SD)	15.59 (1.61)	15.05 (2.15)	14.30 (2.60)
Age, M(SD)	30.66 (1.47)	50.68 (1.50)	70.53 (1.48)
PHC, M(SD)	53.09 (6.47)	51.00 (7.86)	48.49 (9.27)
Wave 3 - Wellbeing			
Life Satisfaction, M(SD)	.23 (.91)	.00 (.99)	.17 (.80)
Positive Affect, M(SD)	.28 (.89)	.10 (.94)	.03 (.94)
Negative Affect, M(SD)	.08 (.89)	-.14 (.79)	-.38 (.62)
Mastery, M(SD)	.32 (.92)	.12 (.98)	-.06 (.90)
Resilience, M(SD)	.09 (.88)	.03 (.96)	.14 (.98)
Positive Social Support, M(SD)	.08 (.95)	-.01 (.99)	.15 (.93)
Negative Social Support, M(SD)	-.01 (.90)	.15 (.98)	-.36 (.91)
Languishing	225 (24.8)	450 (31.3)	318 (25.5)
Flourishing	384 (42.3)	480 (33.4)	465 (37.3)
Wave 4 - Distal Mental Health Outcomes			
Goldberg	2 (0; 3)	1 (0; 3)	1 (0; 2)
Depression, Median (IQR)			
Goldberg Anxiety, Median (IQR)	3 (1; 5)	2 (1; 4)	0 (1; 3)
BPHQ			
Any Depression	130 (14.3)	159 (11.1)	146 (11.7)
CIDI Diagnosis			
12-month Depression	26 (6.1)	64 (5.3)	NA
12-month Generalized Anxiety	23 (5.4)	49 (4.0)	NA
12-month Depression or Anxiety	40 (9.4)	89 (7.3)	NA

Note: CIDI not assessed in older adulthood cohort and assessed in a sub-sample of the early ($n = 536$) and middle ($n = 1, 469$) adulthood cohorts; PHC: SF-12 Physical Health Component Score; CIDI: Composite International Diagnostic Interview; BPHQ: Brief Patient Health Questionnaire.

related to mental health outcomes. Then models were re-estimated to examine whether flourishing status conferred better protection on mental health outcomes in comparison with the individual wellbeing indicators. Wellbeing variables were Z-transformed ($M = 0$; $SD = 1$) so that effects could be interpreted as the risk/benefit associated with a 1SD change in the wellbeing factor. The positive variables were transformed so that a high score reflected low wellbeing (e.g. low positive affect) for ease of comparison with negative wellbeing indicators; estimates could then be interpreted as the risk of a 1SD increase in low wellbeing (i.e. a decline in wellbeing) for all wellbeing indicators.

For the binary outcomes (BPHQ, CIDI), analyses were undertaken using a Poisson regression with robust standard errors to derive estimates expressed in terms of a Relative Risk Ratio (RR) reflecting the relative risk of reporting a mental ill-health outcome. For the GADS, outcomes reflect a count of mental health symptoms; analyses of the depression and negative symptom variables were undertaken with Poisson regressions with estimates expressed in terms of an Incidence Rate Ratio (IRR).

All analyses were adjusted for sex, chronological age, years of education, partner status, financial distress and physical health. Individuals who were identified with some form of depression at wave 3 were excluded from the analysis ($n = 576$); wave 3 depression status was derived from any depression on the BPHQ administered at wave 3. Marginal mean estimates for all outcomes are reported in Supplementary

Tables D1-D3. We also re-estimated our models by including those with depression at wave 3 but controlling for wave 3 mental health status; results are displayed in [Supplementary Tables E1-E4](#). We do not set a particular alpha level at which to determine a significant effect (e.g. $p < .05$) or undertake correction for multiple correction (Feise, 2002); owing to the large sample size, but unbalanced nature of the outcomes, instead we balance those parameters reported with large effect sizes and very high probability values (e.g. $P < .001$; Wasserstein et al. (2019)).

3. Results

Bivariate associations between the individual wellbeing indicators and mental health indicators were reported for all age cohorts ([Supplementary Tables C1-C10](#)). Despite these bi-variate associations, many of these effects were attenuated in multi-variate analysis of the individual wellbeing indicators and subsequent 4-year mental health outcomes suggesting confounding between the multiple wellbeing indicators (see [Table 2](#)). Higher levels of negative affect were consistently identified as the strongest factor associated with any depression (early adulthood: $RR = 1.20$ (95% CI: 1.03; 1.39); mid-life: $RR = 1.37$ (95% CI: 1.19; 1.56); older adulthood: $RR = 1.19$ (95% CI: 0.98; 1.45)) and higher anxiety and depression symptoms for all age cohorts. For those in the early adulthood and mid-life cohorts, resilience was unrelated to all mental health outcomes, and mastery reported only a small association with increased mental health symptoms but not with the likelihood of reporting any depression. In contrast, for those in the later adulthood cohort, low mastery was associated with all mental health outcomes, and low resilience was associated with increased mental health symptoms. Low positive affect consistently reported an association with increased depression symptoms in all age cohorts, but was generally unrelated to the other health outcomes, except for those in the early adulthood cohort, where low positive affect reported a substantive likelihood for any depression status. Low life satisfaction reported only a small increase in depression symptoms in the early and late adulthood cohorts and with anxiety symptoms in the later adulthood cohort only. Overall, most wellbeing effects were of a small magnitude and apart from negative affect were not generally consistent. In the supplementary analyses ([Supplementary Table E1](#)), which included those with poor mental health at baseline and adjusted for baseline mental health, results were generally consistent. Perhaps the most noticeable difference was that associations between negative affect and both depression and anxiety symptoms were strongly attenuated and highlights the confounding between affect and mental health.

We then estimated the associations of the individual wellbeing variables with 12-month depression and generalized anxiety disorders on a subset of participants in the early and middle adulthood cohorts who completed the CIDI ([Table 3](#)). Life satisfaction, positive affect, and both negative and positive social support were generally unrelated to diagnosis. High negative affect reported a substantive association with 12-month depression ($RR = 1.60$ (95% CI 1.30; 1.97) $p < .001$) and generalized anxiety ($RR = 1.69$ (95% CI 1.32; 2.15) $p < .001$) in the mid-life cohort. Comparable point estimates for negative affect were reported in the early adulthood cohort but not reported with similar levels high probability (Depression: $RR = 1.49$ (95% CI: 0.99; 2.23) $p = .051$; Anxiety: $RR = 1.50$ (95% CI: 1.00; 2.34) $p = .049$). This can likely be attributed to the lower caseness reported in the early adulthood cohort since the effect for negative affect on the combined depression/anxiety outcome was still reported with higher probability ($RR = 1.54$ (95% CI: 1.14; 2.09), $p < .001$). Notably, low mastery was associated with 12-month depression in the mid-life cohort ($RR = 1.57$ (95% CI: 1.13; 2.17) $p = .007$), for 12-month generalized anxiety status ($RR = 1.79$ (95% CI: 1.31; 2.44) $p < .001$) and with the combined depression/anxiety outcome ($RR = 1.61$ (95% CI: 1.24; 2.10), $p < .001$). Clearly, low levels of mastery and high levels of negative affect appear to be the more consistent wellbeing factors associated with CIDI outcomes. In the supplementary analyses ([Supplementary Table E2](#)), which included and

Table 2

Impact of current wellbeing on subsequent mental health at 4-year follow-up.

	BPHQ		Goldberg Anxiety and Depression Scales			
	Any Depression		Anxiety Symptoms		Depression Symptoms	
	RR (95% CI)	P	IRR (95% CI)	P	IRR (95% CI)	P
Early Adulthood	Case Count n = 130					
Low Satisfaction	1.13 (0.93; 1.37)	.208	1.06 (0.99; 1.14)	.089	1.10 (1.00; 1.20)	.043
Low Positive Affect	1.25 (1.02; 1.53)	.032	1.05 (0.98; 1.12)	.193	1.15 (1.06; 1.25)	.001
High Negative Affect	1.20 (1.03; 1.39)	.016	1.16 (1.10; 1.23)	<.001	1.18 (1.09; 1.27)	<.001
Low Mastery	1.08 (0.89; 1.31)	.440	1.08 (1.01; 1.16)	.025	1.11 (1.02; 1.21)	.018
Low Resilience	1.01 (0.83; 1.23)	.940	1.00 (0.93; 1.08)	.933	1.00 (0.91; 1.10)	.979
Low Positive Support	1.15 (0.92; 1.43)	.235	1.02 (0.95; 1.10)	.636	1.01 (0.92; 1.11)	.885
High Negative Support	1.07 (0.87; 1.30)	.531	1.11 (1.05; 1.18)	<.001	1.09 (1.01; 1.17)	.026
Mid-Life	Case Count n = 159					
Low Satisfaction	1.07 (0.90; 1.28)	.439	1.03 (0.97; 1.09)	.318	1.06 (0.99; 1.14)	.108
Low Positive Affect	1.10 (0.92; 1.32)	.307	1.06 (1.00; 1.12)	.046	1.13 (1.05; 1.21)	.001
High Negative Affect	1.37 (1.19; 1.56)	<.001	1.24 (1.17; 1.31)	<.001	1.30 (1.21; 1.40)	<.001
Low Mastery	1.14 (0.95; 1.37)	.164	1.06 (1.00; 1.11)	.052	1.09 (1.01; 1.17)	.021
Low Resilience	0.91 (0.78; 1.07)	.246	0.96 (0.91; 1.01)	.133	0.93 (0.86; 1.00)	.039
Low Positive Support	1.09 (0.90; 1.32)	.398	1.01 (0.95; 1.08)	.638	1.07 (0.99; 1.16)	.086
High Negative Support	1.00 (0.86; 1.16)	.975	1.13 (1.08; 1.19)	<.001	1.09 (1.03; 1.17)	.005
Later Adulthood	Case Count n = 146					
Low Satisfaction	1.15 (0.94; 1.41)	.178	1.08 (1.00; 1.17)	.051	1.07 (0.98; 1.18)	.114
Low Positive Affect	1.00 (0.82; 1.21)	.983	1.05 (0.98; 1.12)	.187	1.11 (1.03; 1.20)	.009
High Negative Affect	1.19 (0.98; 1.45)	.082	1.30 (1.19; 1.41)	<.001	1.23 (1.12; 1.36)	<.001
Low Mastery	1.35 (1.11; 1.63)	.003	1.10 (1.02; 1.17)	.012	1.15 (1.06; 1.24)	.001
Low Resilience	1.24 (1.03; 1.49)	.020	1.05 (0.99; 1.12)	.096	1.12 (1.04; 1.20)	.002
Low Positive Support	1.04 (0.84; 1.29)	.725	0.96 (0.88; 1.05)	.361	0.93 (0.84; 1.03)	.148
		.831		.003		.018

(continued on next page)

Table 2 (continued)

	BPHQ	Goldberg Anxiety and Depression Scales	
	Any Depression	Anxiety Symptoms	Depression Symptoms
High Negative Support	1.02 (0.85; 1.22)	1.10 (1.03; 1.17)	1.09 (1.02; 1.17)

Controls include continuous age, SF-12 Physical Health, partnered status, sex, years of education, financial problems; BPHQ: Brief Patient Health Questionnaire.

Table 3

Impact of current wellbeing on 12-month depression and anxiety at 4-year follow-up in the Early Adulthood and Midlife.

	Early Adulthood		Midlife	
	RR (95% CI)	P	RR (95% CI)	P
Depression	Case Count n = 26		Case Count n = 64	
Low Satisfaction	0.88 (0.53; 1.48)	.631	0.93 (0.72; 1.21)	.596
Low Positive Affect	1.30 (0.85; 1.97)	.226	0.90 (0.66; 1.22)	.487
High Negative Affect	1.49 (0.99; 2.23)	.051	1.60 (1.30; 1.97)	<.001
Low Mastery	1.57 (1.13; 2.17)	.007	1.32 (0.98; 1.77)	.065
Low Resilience	0.67 (0.43; 1.04)	.072	0.76 (0.56; 1.03)	.076
Low Positive Support	1.59 (0.90; 2.81)	.109	1.21 (0.88; 1.67)	.232
High Negative Support	0.81 (0.45; 1.43)	.464	1.24 (0.96; 1.59)	.102
Generalized Anxiety	Case Count n = 23		Case Count n = 49	
Low Satisfaction	0.81 (0.50; 1.34)	.419	0.89 (0.62; 1.28)	.547
Low Positive Affect	0.77 (0.42; 1.42)	.410	0.91 (0.64; 1.29)	.603
High Negative Affect	1.50 (1.00; 2.34)	.049	1.69 (1.32; 2.15)	<.001
Low Mastery	1.79 (1.31; 2.44)	<.001	1.41 (0.98; 2.02)	.065
Low Resilience	0.99 (0.66; 1.50)	.977	0.84 (0.61; 1.15)	.270
Low Positive Support	1.04 (0.53; 2.05)	.908	0.87 (0.55; 1.38)	.562
High Negative Support	1.18 (0.69; 1.55)	.875	1.22 (0.89; 1.67)	.213
Depression or Anxiety	Case Count n = 40		Case Count n = 89	
Low Satisfaction	0.83 (0.56; 1.22)	.340	0.88 (0.69; 1.13)	.315
Low Positive Affect	1.05 (0.70; 1.59)	.809	0.87 (0.67; 1.13)	.309
High Negative Affect	1.54 (1.14; 2.09)	.005	1.60 (1.34; 1.90)	<.001
Low Mastery	1.61 (1.24; 2.10)	<.001	1.38 (1.08; 1.77)	.011
Low Resilience	0.78 (0.54; 1.11)	.167	0.83 (0.64; 1.08)	.169
Low Positive Support	1.27 (0.78; 2.09)	.340	1.06 (0.79; 1.43)	.677
High Negative Support	0.98 (0.67; 1.44)	.933	1.16 (0.93; 1.45)	.181

Controls include continuous age, SF-12 Physical Health, partnered status, sex, years of education, financial problems.

adjusted for baseline mental health, may of the effects identified in the main analyses were attenuated, despite comparable point estimates. An exception was for the risk of high negative affect for depression and depression or anxiety in the middle adulthood cohort only. This suggests that in terms of the CIDI outcomes, individual wellbeing factors are not associated with mental health over and above effects of baseline mental health. However, this could be attributed to the low numbers of ill health the CIDI sensitivity analyses for the young cohort especially.

3.1. Protective effects of flourishing on mental health

Having compared the associations of individual wellbeing dimensions with mental health outcomes, we then examined the association of the overall wellbeing or Flourishing construct. Analyses revealed that moderate wellbeing and flourishing conferred protection against any depression and mental health symptoms in all age cohorts in comparison with languishers; i.e. those with low wellbeing (Table 4). Whilst flourishing appears to confer greater protection than moderate wellbeing alone, inspection of the marginal means (Supplementary Table D2; Fig. 1) suggests that most of the benefit appears to be conferred between

the languishing (low wellbeing) and moderate wellbeing group; flourishing provides only a smaller additional benefit. In comparison with the supplementary analyses (Supplementary Table E3) which adjusted for baseline mental health, results were consistent for the BPHQ any depression for all cohorts and suggests Flourishing/Languishing protect against future mental health, over and above that attributed to prior mental health. However, for the middle and older cohorts, moderate wellbeing was no longer associated with anxiety symptoms and depression symptoms for the older cohort. The association for flourishing with anxiety and depression symptoms was reported in all age cohorts and consistent with the main analyses.

Owing to small cell sizes in the CIDI outcomes, flourishing/languishing groups and age cohort, analyses of the CIDI outcomes were estimated on the early adulthood and mid-life cohorts conjointly, but with age group included as a covariate in the estimation model. Results are presented in Table 5. Flourishing clearly confers protection for future mental health in comparison with languishers, but despite sizeable effect sizes, the evidence for moderate wellbeing was mixed. For example, despite sizeable point estimates, moderate wellbeing was unrelated to 12-month depression (RR = 0.72 (95% CI: 0.45; 1.14) p = .164), generalized anxiety (RR = 0.66 (95% CI: 0.40; 1.09) p = .103), and either depression/anxiety (RR = 0.72 (95% CI: 0.49; 1.05) p = .090). Greater evidence for the association of both moderate wellbeing and flourishing on the 12-month combined depression and/or anxiety variable was reported. Inspection of the marginal means for 12-month diagnosis by age group (Supplementary Table D2-D3.) reveal the reduced probabilities of 12-month diagnoses with moderate wellbeing and additional with flourishing (Fig. 2). In the sensitivity analyses (Supplementary Table E4), point estimates were of comparable magnitude although the effect sizes for flourishing were attenuated. But again, these effects are not reported with any degree of probability and is likely due to a lack of statistical power to detect effects when adjusting for baseline mental health.

4. Discussion

The primary purpose of this paper was to compare the differences in the association between several indicators of wellbeing with 4-year mental health outcomes. Despite bivariate associations, results from the multi-variate analyses of the BPHQ and Goldberg measures suggest high negative affect was consistently associated with all of the poor mental health outcomes across the lifespan. Otherwise, individual wellbeing factors were not consistent across mental health outcomes nor were the reported associations consistent between the 3 age cohorts. This contrasts with previous findings (Wood & Joseph, 2010). Of course, a

Table 4

Impact of Flourishing and Moderate Wellbeing on subsequent mental health at 4-year follow-up.

	BPHQ	Goldberg Anxiety and Depression Scales	
	Any Depression RR (95% CI) Case Count n = 130	Anxiety IRR (95% CI)	Depression IRR (95% CI)
Early Adulthood			
Languishing (ref)			
Moderate WB	0.54 (0.37; 0.78)	0.72 (0.63; 0.82)	0.67 (0.57; 0.79)
Flourishing	0.40 (0.27; 0.59)	0.60 (0.52; 0.68)	0.48 (0.41; 0.57)
Mid-Life	Case Count n = 159		
Languishing (ref)			
Moderate WB	0.74 (0.54; 1.02) ⁰⁶²	0.79 (0.71; 0.88)	0.68 (0.59; 0.78)
Flourishing	0.41 (0.27; 0.64)	0.61 (0.54; 0.69)	0.49 (0.43; 0.57)
Later Adulthood	Case Count n = 146		
Languishing (ref)			
Moderate WB	0.52 (0.37; 0.73)	0.74 (0.65; 0.84)	0.76 (0.66; 0.89)
Flourishing	0.30 (0.19; 0.45)	0.53 (0.46; 0.61)	0.46 (0.39; 0.54)

Controls include continuous age, SF-12 Physical Health, partnered status, sex, years of education, financial problems. All estimates p < .001 except where indicated; BPHQ: Brief Patient Health Questionnaire.

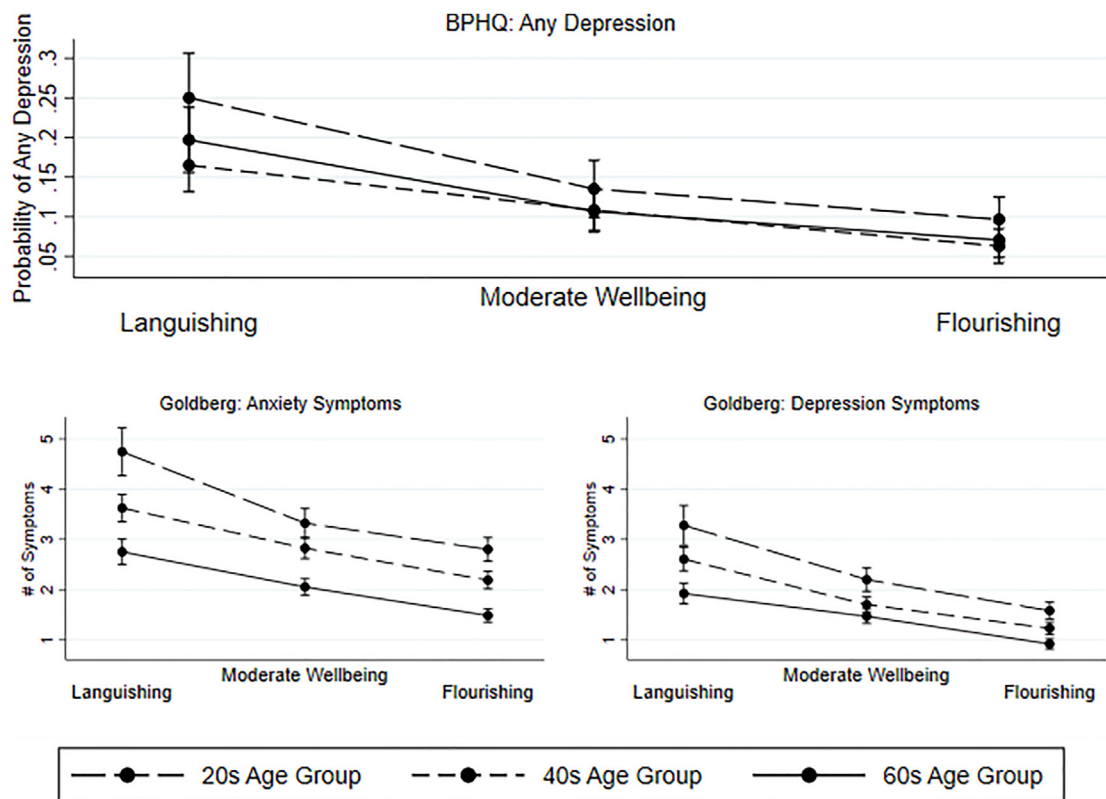


Fig. 1. Differences in marginal probabilities between Flourishing levels by age group on the BPHQ and Goldberg Anxiety and Depression Scales.

Table 5

Impact of current wellbeing on 12-month depression and anxiety at 4-year follow-up in Early Adulthood and Midlife.

	RR (95% CI)	P
12-month Depression	Case Count n = 90	
Languishing (ref)		
Moderate Wellbeing	0.72 (0.45; 1.14)	.164
Flourishing	0.48 (0.28; 0.83)	.009
Generalized Anxiety	Case Count n = 72	
Languishing (ref)		
Moderate Wellbeing	0.66 (0.40; 1.09)	.103
Flourishing	0.42 (0.23; 0.78)	.006
Depression or Anxiety	Case Count n = 129	
Languishing (ref)		
Moderate Wellbeing	0.72 (0.49; 1.05)	.090
Flourishing	0.52 (0.33; 0.81)	.004

Controls include continuous age, SF-12 Physical Health, partnered status, sex, years of education, financial problems.

direct comparison cannot be made since Wood and Joseph (2010) utilised measures of PWB only to predict depression outcomes at 10-year follow-up, whilst the current study utilised measures of SWB, PWB and SoWB.

Generally, low resilience was unrelated to mental health outcomes except for the older adulthood cohort who reported small increases in anxiety and depression symptoms. Low mastery was associated with BPHQ depression in the older adulthood cohort only, but was associated with very small increases in anxiety and depression symptoms for all age cohorts. Low positive affect was consistently associated with increases in depressive symptoms only for all age cohorts, but only for the early adulthood cohort was low positive affect strongly associated with likelihood of reporting any depression. The evidence for the role of life satisfaction as an indicator for future mental health outcomes was not supported; estimates were either of a small magnitude or reported with

low level of probability. This is a particularly important outcome since life satisfaction is frequently the sole measure of individual wellbeing in larger population and health policy studies (Burns & Browning, 2016; Jorm & Ryan, 2014; Veenhoven, 2012). The differences in effects across the lifespan is in line with others findings; one analysis of wellbeing indicators from the European Social Survey (Burns, 2020), found that vitality and self-esteem were more strongly endorsed by older adults, and positive emotions and life satisfaction were more strongly endorsed by younger and middle-aged adults. Perhaps one exception worth noting is the role of low mastery in the sub-sample of participants who provided data on the gold-standard CIDI outcomes.

Analyses of the subsample of participants in the early and middle adulthood cohorts on the gold-standard CIDI measure generally confirmed with the BPHQ and Goldberg analyses in relation to the role of negative affect. Unfortunately, the generally low rate of CIDI diagnoses in the sub-sample, when analyses were stratified by age cohort, likely undermined the power to report statistically significant effects, despite notable effect sizes. However, the combined depression/anxiety outcome confirmed the particularly strong role of negative affect for poor mental health outcomes for both early and middle adulthood cohorts. We acknowledge that there is likely some possible circularity in our measurement of wellbeing and mental health, particularly in relation to negative affect; whilst negative affect is part of the symptomatology often captured in measures of depression, our own preliminary exploratory factor analysis of the BPHQ and PANAS items for example, derived 3 factors reflecting BPHQ, positive and negative affect. Otherwise, low mastery was the only other wellbeing indicator that reported consistent substantive risk for poor mental health outcomes on the CIDI outcomes.

In contrast to the individual wellbeing indicators, flourishing and moderate wellbeing status were strongly protective on all mental health outcomes for all age cohorts. Of particular note was that much of the protection was derived from reporting at least moderate wellbeing. Whilst flourishing was associated with higher benefit, these findings suggest that moderate wellbeing may be sufficient to improve population

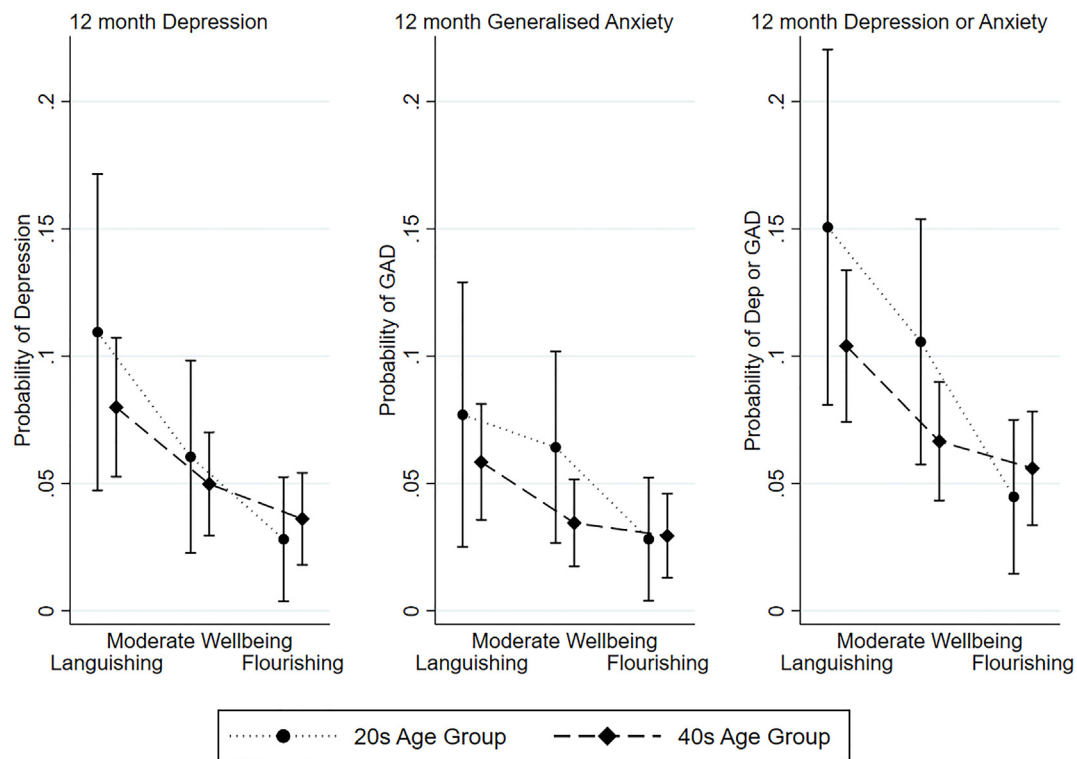


Fig. 2. Differences in marginal probabilities between Flourishing and Languishing on a subsample of participants who completed the CIDI.

mental health outcomes. In contrast to the individual wellbeing factors, the role of overall wellbeing, operationalised in terms of flourishing, moderate wellbeing and languishing, exhibited substantial association with mental health and is consistent with previous research specifically in the area of mental health (Keyes et al., 2010; Schotanus-Dijkstra et al., 2017), but also for the broader role of wellbeing in promoting positive health outcomes (Boehm & Kubzansky, 2012; Kim et al., 2016; Kubzansky et al., 2018).

That moderate wellbeing itself is predictive of future mental health outcomes is an important finding as it suggests that clinical interventions and broader public health initiatives may have important preventative implications for reducing the burden of poor mental health outcomes (Reavley & Jorm, 2010; Ormel et al., 2019; Carbone, 2020), particularly as current substantive investments in increasing access to treatment does not appear to be having substantial impact on reducing burden of psychological distress in the broader community (Jorm, 2018). Within a clinical context, there exists substantial evidence that focusing on wellbeing or positive components of mental health have considerable clinical utility. One model is Fava et al. (1998) Wellbeing Therapy (WBT) which was developed to treat unresolved residual symptoms of patients otherwise successfully treated by traditional behavioural management and pharmacological treatment. In comparison with Cognitive Behavioural Therapy (CBT), WBT focuses on individuals' recognition of their positive mental health rather than the dysfunctional thinking and behaviour that underpins illness. WBT has been shown to report increases in wellbeing and a greater reduction in symptomatology in comparison with CBT-only and that a combination of WBT and CBT reports better remission outcomes than CBT alone (Fava, 2012, 2016). Owing to the long-term protection afforded by Flourishing in the current study, there is an argument that wellbeing should be targeted in preventative mental health care.

At a population level, Rose's population strategy of prevention (Rose, 2001) holds considerable merit for improving population mental health; simply, instead of focusing on high-risk individuals at the most diseased end of the spectrum, improving the mental health of the average may have the most important impact on mental health burden. This implies, moving beyond simply addressing and treating mental illness, but also,

following the limited benefit attributed to moderate wellbeing from this study, not necessarily focusing on building optimal wellbeing or flourishing in the population. Instead, "average" may simply be good enough. The finding also suggests that wellbeing in its totality, rather than the risk/benefit attributed to individual wellbeing indicators, has greater role in promoting mental health outcomes. This suggests that wellbeing research needs to capture broad range of wellbeing indicators (Huppert et al., 2009; Keyes, 2002; Marsh et al., 2020) to inform health policy and clinical practice, rather than focusing on a narrow subset of indicators.

There are limitations to the current study which should be considered when interpreting the results. Firstly, there are many 'models' of wellbeing which differ in the extent to which different wellbeing dimensions are proposed as reflecting wellbeing (Huppert et al., 2009; Ryff & Keyes, 1995; Spitzer et al., 1999). However, this should be balanced by a methodological literature base which generally show multiple wellbeing domains are reflected by either a correlated factor structure, or a higher-order and Bi-factor model which suggest a single latent factor underlies these different wellbeing dimensions (Burns, 2019; Burns & Machin, 2009; Chen et al., 2013; de Bruin & du Plessis, 2015; Hervás & Vázquez, 2013; Longo et al., 2020; Marsh et al., 2020; Ryff & Keyes, 1995). That is, whilst multiple dimensions of wellbeing may capture a broad array of different wellbeing domains, it appears that these multiple domains reflect the same underlying latent factor(s). It is still important to recognize that the PATH study had only 3 measures of SWB, 2 measures of PWB, and 2 measures of SoWB. To address this, the wave 5 data collection of the PATH early adulthood cohort has included multiple indicators from the European Social Survey wellbeing module (Huppert et al., 2009).

A second issue relates to the measures used. The outcomes measures are all self-report and lack clinical rigour. And whilst the CIDI is an important and gold-standard interview schedule, only a sub-sample of participants from the early and middle adulthood cohorts were administered the CIDI. It would be important to extend these analyses with a measure as robust as the CIDI but with a larger sample. However, that the results of the CIDI generally confirmed with the analyses of the whole sample provides some internal validation of the results of the BPHQ and

Goldberg measures. It is important to balance the lack of clinical diagnosis in the whole sample with the capacity to model long-term mental health risk in a large longitudinal community survey. Relatedly, it would be important for future research to consider potential confounding that may occur owing to medication use. The issue of medication use would not be straightforward since if prescribed medication, we might well expect that participants could well be considered “treated” and not necessarily with depression, anxiety or low wellbeing. Indeed, we would advocate that those under treatment have capacity to experience wellbeing.

Further, whilst models were conditioned for key socio-demographic characteristics including sex, age, partnered status, years of education, physical health and financial distress it would be important consider the interaction or even potential mediation paths between these confounds, wellbeing and mental health. Unfortunately, with a two-wave design, it is not possible to clearly model pathways between these socio-demographic characteristics, wellbeing and mental health. Finally, we recognize that our outcome measure was derived from a single measurement occasion and ignores the fluctuation in responses on the affect and mood measures especially which was not captured in this research design. However, there is evidence from other studies that wellbeing is a strong indicator of future mental health outcomes (Trompetter et al., 2017; Weich et al., 2011; Wood & Joseph, 2010; Fava, 2012; Fava et al., 2011).

To conclude, we have sought to examine the 4-year risk of multiple wellbeing indicators, namely: life satisfaction, positive and negative affect, resilience, mastery, and social support on poor mental health outcomes. Overall, life satisfaction was consistently not a strong risk factor for future mental health; in contrast, negative affect was consistently a strong risk for future mental health outcomes. The risk of low wellbeing on the other wellbeing indicators was not consistent between age cohorts, perhaps indicating that people value different wellbeing indicators over the lifespan. In comparison with the individual wellbeing indicators, an overall wellbeing factor was far more strongly related to mental health. Whilst Flourishers, those with the most optimal wellbeing, reported the best mental health outcomes, it is noted that even moderate amounts of wellbeing reported very good protection for poor mental health. We strongly encourage wellbeing researchers to continue to examine the prospective role of wellbeing for future mental health outcomes, and to expand on the current paper by incorporating larger numbers of wellbeing indicators. Of particular interest will be a consideration of the role of wellbeing in other severe several mental illnesses (e.g. psychosis, eating disorder) and treatment-resistant disorders.

Author contribution

All authors made contributions to the conception or design of the work AND either the acquisition, analysis, or interpretation of data for the work. All authors have contributed to developing the intellectual direction of the paper. RAB was primarily responsible for drafting the final manuscript with revisions made by co-authors. Authors approve the final version to be published.

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Declaration of competing interest

The authors report no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ssmmh.2021.100052>.

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