

A systematic review and meta-analysis of longitudinal studies of the antecedents and consequences of wellbeing among university students

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Abstract: *Background and objectives:* Wellbeing among university students is associated with better academic outcomes and diminished harm from mental illness. This study systematically reviews and meta-analyses longitudinal studies of the antecedents and consequences of wellbeing within this population, providing an overview which establishes a ‘natural history’ of wellbeing to form a background for intervention and policy.

Method: This study was a systematic review and meta-analysis of the peer-reviewed literature, based on a broad range of search terms across four journal databases in psychology, medicine and education. Studies were organised by the domain of their study variables (i.e., Self, Relationships, or Institutional Context) and variables relating to wellbeing were extracted. The incremental effect of study variables measured at baseline upon prospective wellbeing was calculated with semipartial correlation coefficients which controlled for baseline wellbeing. Meta-regressions were used to examine the effect of follow-up interval on effect sizes.

Results: Sixty-two longitudinal studies of university student cohorts were identified. In 57 studies, wellbeing was an outcome variable. Meta-analyses showed that effects were moderated by measurement interval between baseline and follow-up, becoming weaker with longer intervals, and that this was not an artifact of the measurement instrument. The study factors with the strongest positive effect sizes after controlling for baseline wellbeing were authenticity, self-esteem, self-support for autonomy, emotional repair, and ability to regulate distress and despondency; relationship commitment and group memberships; self-identification with the university and time pressure. Study factors with the strongest negative effect sizes were uncertainty regarding university, materialism, a belief in social complexity, depression, and stress. In five studies, wellbeing was an antecedent, showing positive associations with educational outcomes.

Conclusion: This review identified several antecedents of student wellbeing which could be targeted for interventions. These included self-relationship, emotion regulation, and interventions to decrease mental illness. Universities might also make it easier to establish and maintain groups (e.g., study cohorts, interest groups). Many variables which affect wellbeing are not amenable to study with experimental methods, but their study and use in wellbeing interventions should not be neglected. Because the antecedents of wellbeing are numerous and diverse, further research in the area should take advantage of research methods which maximise the variety of data collected and minimise respondent burden, such as passively collected and linked data.

Keywords: wellbeing; life satisfaction; hedonia; eudaimonia; tertiary students; university students; college students; systematic review; meta-analysis; meta-regression

1. Introduction

1.1 University students, mental health, academic performance and wellbeing

University students are at an important juncture in their development. As students they are engaged in a long-term project requiring substantial levels of motivation and effort. Success at university may well open a path to a better life [1], while failure is likely to reduce employment opportunities and may lead to lower mental health and wellbeing [2]. Further, most are in their late teens to early twenties, an important age for psychosocial development [3].

However, this period comes with challenges to mental health and to academic performance. Previous studies have suggested that the transition to university from school is problematic [4] and that the mental health of university students is poorer than that of equivalent age groups in the general population [5;6, see also 7–11]. These problems occur at a time when mental health is arguably of even greater importance than usual, for two reasons. First, poor mental health has been shown to be negatively associated with academic performance in university students [12,13]. Second, there is substantial evidence linking poor mental health with noncompletion of university [14–16] (though there are multiple potential explanations for noncompletion). The scale of this problem is substantial: in the US, 37.6% of first-time students enrolled full-time in four-year Bachelor's degrees do not complete their degrees within six years [17], and in Australian universities, 27.1% of undergraduate students enrolling in 2011 had not completed their degrees by 2019 [18]. Improving students' mental health, then, should also improve their academic performance and rates of completion.

Both mental illness and educational outcomes might be addressed with a focus on students' psychosocial wellbeing. First, wellbeing is associated with mental illness while also being a distinct construct [19,20]. It may function as a protective factor for mental illness: higher levels of wellbeing are associated with lower levels of mental illness [21] and changes in wellbeing are prospectively associated with changes in mental illness [22,23]. Second, wellbeing is also associated with academic performance and university retention. Evidence from longitudinal studies suggests wellbeing may have a causal role in academic performance in university students [24–27], although the evidence is inconsistent [28,29]. An additional complication is that academic performance is also an antecedent of wellbeing [30], suggesting circular causation. Third, there is evidence that wellbeing is protective against the negative effects of mental illness on academic performance. Where mental illness is present in students, wellbeing decreases its impact on academic impairment. There is also a direct relationship: where mental illness is *not* present, wellbeing is also associated with lower academic impairment [21].

We may therefore point to three reasons why wellbeing is important for university students: it has direct associations with mental illness and academic outcomes and an association with academic outcomes mediated through mental illness. Regarded purely in an instrumental way, then, wellbeing is associated with two variables which are highly relevant for university students. In addition to its instrumental value, however, wellbeing has an intrinsic value. It should be a target of policy for its own sake.

1.2 Concepts and antecedents of wellbeing

Wellbeing might be broadly defined as what is good for a person, or as psychological health defined without reference to concepts of illness. There are several concepts of wellbeing in the current literature, and there are ongoing conceptual debates [for recent examples see 31–33] and attempts to resolve the issues [e.g. 34,35]. Hedonic wellbeing centres around happiness and pleasure; eudaemonic wellbeing around meaning, purpose and actualisation of potential, life

satisfaction is a subjective evaluation without theoretical commitments to causes, and subjective wellbeing is a composite of life satisfaction and affective balance [36–38]. All these concepts of wellbeing, however, share substantial common variance [39]. The conception of wellbeing underlying this review is drawn from Well-Being Theory, which posits that humans will pursue five elements of wellbeing as ends in themselves: positive emotion, engagement, relationships, meaning, and achievement [40]. Conceptually, it overlaps with hedonic and eudaemonic wellbeing; empirically, it has been shown to correlate strongly with life satisfaction, eudaemonia, and hedonia [32,41]. (Inasmuch as Well-Being Theory is relatively new and so there are few studies using wellbeing measures explicitly based upon it, this review includes studies based on a broad range of concepts and measures of wellbeing.)

Whichever conception of wellbeing may be preferred, it is a broad concept. If operationalised as life satisfaction, it implicitly takes in the elements evaluated within that judgement. If its operationalisation has an affective component, it takes in anything which may alter those emotions. If operationalised as a composite measure, it explicitly takes in multiple life domains and processes.

The breadth of the concept is mirrored by the large number of variables associated with wellbeing in the extant literature. These include demographic variables [42], personality [43], satisfaction of psychological needs such as autonomy, competence, and relatedness [44–46], physical activity [47,48], physical health [49,50], education [51], culture [43], and some economic variables, especially unemployment [42,52]. The breadth of the concept is also reflected in the diversity of its antecedents; over and above those already mentioned, there is evidence for associations between wellbeing and genetic inheritance [53], nature connectedness [54], the practice of minimalism [55], and use of social media [56]. Further, there is a substantial literature on interventions to improve wellbeing, introducing still more variables. Hendriks et al. found 188 randomised controlled trials published from 1998 to 2017 [57], and a search of three major wellbeing journals (*Journal of Positive Psychology*, *Journal of Happiness Studies* and *International Journal of Wellbeing*) found a further 40 for the years 2018 to 2021, though the true number is doubtless higher.

1.3 The advantages of longitudinal observational studies

The diversity of variables associated with wellbeing makes it necessary to examine longitudinal observational studies as well as experimental studies to obtain an adequate picture of its antecedents. Many of the variables which may affect wellbeing are not susceptible to experimental manipulation. In the university context, changes which might be made to improve student wellbeing are not all amenable to study with experimental methods. Alterations to policies or to the physical environment aimed at improving wellbeing, for example, necessarily impact all students, so the scope for randomising participants to control and treatment groups for such changes is limited at best. Further, the large number of antecedents of wellbeing means that any changes aimed at improving it occur in a context where it is subject to many other factors. It would be better to make changes with knowledge of this context – which again requires data from longitudinal studies.

Longitudinal observational designs have two further advantages. They may allow some insight into the duration of changes in wellbeing associated with changes in study variables. This relates to the important question of whether interventions and policy changes might be expected to produce transitory or enduring change. In the case of multi-wave designs, they may also suggest possible circular causation, i.e. whether changes in wellbeing are prospectively

associated with changes in other variables which in turn are prospectively associated with changes in wellbeing.

Previous longitudinal studies of wellbeing within the general population, as well as confirming [58] and extending [59–61] cross-sectional findings, have also provided some insight into the dynamics of wellbeing over time. For example, in developed countries, wellbeing tends to describe a U-shape over the life-course with minima in the early 40s to early 50s [62]; some variables appear to have an effect on wellbeing of very long duration [e.g. 63]; and wellbeing may have relationships with other variables of mutually reinforcing causation over time [64].

1.4 The present study

While there have been several reviews of interventions aimed at increasing wellbeing in university students [e.g. 65], as far as we are able to tell, to date there have been no systematic reviews of longitudinal observational studies of wellbeing in university students. Accordingly, the objective of this study was to conduct a systematic review of antecedents and consequences of wellbeing of university students (defined inclusively, as hedonic wellbeing, eudaemonic wellbeing, life satisfaction, or composite measures) focused on longitudinal observational studies, and to use meta-analytic techniques to give an overview of the research results. The specific research questions were:

1. *What are the antecedents of wellbeing in university students?*
2. *What are the consequences of wellbeing in university students?*
3. *What is known about the trajectories of wellbeing over time in this population?*

2. Methodology

2.1 Study design

This study conducted a systematic review of the literature using processes informed by the PRISMA guidelines, which recommend a minimum set of items for reporting in systematic reviews [66]. The main dependent variable of interest was wellbeing, defined as either hedonia, eudaemonia or life satisfaction, though composite measures were also included.

The main study factors of interest related to antecedents of wellbeing, and were grouped into three of McLeroy et al.'s five social-ecological domains [67]: the Self, Relationships, and Institutional Context, i.e., tertiary education setting (see Table 1 below). McLeroy's model is an adaptation of Bronfenbrenner's general human ecological model of micro-, meso, exo- and macro-systems [68] for the more specific context of health promotion. This classification of the variables associated with wellbeing contextualises them in the systems within which the individual is embedded.

2.2 Eligibility criteria

2.2.1 Data sources and search strategy

The search was conducted according to PRISMA guidelines (see Figure 1; below). Databases searched were PsycINFO, ProQuest Psychology, MEDLINE (Ovid), and ERIC; additionally, a small number of studies referred to in the text of articles located by the searches were included. The date of the last search was 19th May 2021.

A broadly inclusive search strategy was adopted, due to the presence of wellbeing and related concepts in several literatures, and the use of different terms to denote the concept of wellbeing in different theoretical traditions. The strategy (see Supplementary Table 1 to Supplementary Table 4) was designed to capture four concepts. First, the study had to have wellbeing as a

dependent or an independent variable. The related terms included were wellbeing, wellness, quality of life, and positive mental health. Other independent variables or dependent variables were not specified. Second, because this review forms part of a larger project which uses a measurement instrument based on Well-Being Theory [69,70], a set of synonyms and some antonyms for each of its five elements of wellbeing (i.e., positive emotion, engagement, relationships, meaning, and achievement) was developed. Some of the more common theoretical terms from the literature were also used as search terms, including life satisfaction, hedonia, and eudaimonia. Further, several recent reviews of wellbeing outside this study's population of interest were examined for additional search terms [71–78]. Third, the population of interest was tertiary students, so this concept restricted results to studies which sampled tertiary students. Fourth, due to the large number of validation studies in this area, a set of terms related to psychometric validation was used as an exclusion criterion. Search terms were run across title, abstract, and keywords.

2.2.2 Study characteristics

Longitudinal observational studies were the focus of this review, to delineate temporal associations between independent variables and wellbeing, which have not previously been clearly articulated in a systematic review of this population. Cross-sectional studies and any other type of study other than a prospective longitudinal study were excluded after review of the title and/or abstract, and if required full-text.

As mentioned above, this study forms part of a larger project; and this influenced the inclusion and exclusion criteria. The larger project is based on Well-Being Theory, which uses a broad composite measure of psychosocial wellbeing, so the concepts measured needed to either be composites themselves, or be constructs known to be influenced by such composites (most notably life satisfaction). Therefore this study considered multiple concepts of wellbeing: hedonia, eudaimonia, and life satisfaction, as well as composites of these such as subjective wellbeing. However, it did not consider non-psychological measures of wellbeing such as access to resources. The emphasis on broad composite measures meant that studies which used only subscales from a wellbeing instrument were excluded (though the two studies which met this description are summarised in Supplementary Table 6). The larger project was planned to develop into a longer study which followed up participants after they had left university, so a measure focused on the general population was required; measures specific to tertiary students were excluded. A 2016 review of wellbeing instruments by Cooke, Melchert & Conner [71] was used as the basis for a list of instruments (see Supplementary Table 5) to be used as an inclusion criterion, because its criteria for inclusion matched well with the requirement of the larger project. That is, that they (i) measure psychological aspects of wellbeing; (ii) measure wellbeing broadly, rather than within a specific domain; and (iii) focus on the general population rather than a specific group.

Studies which focused on a subsample of the student population were excluded unless the research question could only be reasonably examined within that population. Studies which were mainly focused on mental illness or physical health were excluded.

In summary, studies were included if they:

- i. used a prospective observational quantitative study design;
- ii. measured wellbeing, conceptualised as hedonia, eudaemonia, life satisfaction, or a composite of these, either as a prospective dependent variable or a baseline independent variable;
- iii. used a measure of wellbeing from a list of instruments with defined characteristics;

- iv. used tertiary students as a sample;
- v. were published before or during 2020;
- vi. were written in English; and
- vii. were published in peer-reviewed journals.

Studies were excluded if they:

- viii. were a validation study for a survey instrument, an intervention or experimental study, a cross-sectional study, a commentary, opinion piece, or any other kind of study other than one with a prospective observational design;
- ix. did not sample from the student population as a whole (e.g., excluded students with chronic illness), although studies sampling only first-year students were included; studies with subsamples of the student population were included only if the research question could reasonably be investigated within that population, (e.g., a US study focused on race-related issues which sampled only African-American students was included, while a study focused on emotional intelligence which sampled only males was excluded); or
- x. were primarily concerned with mental illness or physical health.

Where it was unclear whether a study should be included this was resolved through discussion leading to consensus between the lead author (AdT) and a co-author (AP).

2.3 Analytic strategy

2.3.1 Data extraction

Data were extracted from identified articles for the following variables: author, year of publication, focus of research question (i.e., categorised into Self, Relationships, and/or Institutional Context); country and number of sites where research was conducted, population of interest, sample size, percentage of females in the sample, measures of central tendency for age, independent variables (i.e., categorised into social-ecological domains, and within domains into themes (see Table 1 below), with the exception of studies where the independent variable was wellbeing), dependent variables, instrument(s) used to measure wellbeing, findings, duration of study, and number of waves of data collection. The population of interest (as distinct from the sample) was either tertiary students or the general population; in several cases this was not explicitly stated and a determination was made, usually from whether the use of university students as the study sample was seen as a limitation of the study. Where a study had collected the data required for meta-analysis (see below) but had not presented all the statistics required, the authors were contacted to request information. Data extraction was done by the lead author (AdT).

The findings focused on the effects of the main study variables on wellbeing. While several papers had other dependent variables in addition to wellbeing, these were not within the scope of this review and hence were not reported. In a few studies, wellbeing was an independent variable; for these, only the effects of wellbeing on the dependent variable are reported. Conversely, some papers had more than one wellbeing variable, and all of these were reported. Cross-sectional findings were not reported; while almost all papers included them, the focus of this review was on longitudinal results. The findings column also included information on whether wellbeing was measured at one point in time or more than one – important because measurement at more than one time point allows analysis of the incremental effects of study

variables. Where a study had more than two waves, the results reported were those for the longest duration between waves available, provided there was a baseline measure of wellbeing in the earlier wave. The measurement of wellbeing at baseline was designated Time 1 or T1, the next measurement designated Time 2 or T2, and so on. Studies were categorised in Table 2 to Table 6 (below) based on where their main study variables fit into a social-ecological model taxonomy [67]. In cases where the main study variables are across more than one domain in this taxonomy, if their focus was predominantly on one domain they appear in only one table, though there were several papers whose study variables were divided fairly evenly between the Self and Relationships domains, and these were placed in Table 5.

Figure 1. Literature search and inclusion / exclusion process using PRISMA guidelines

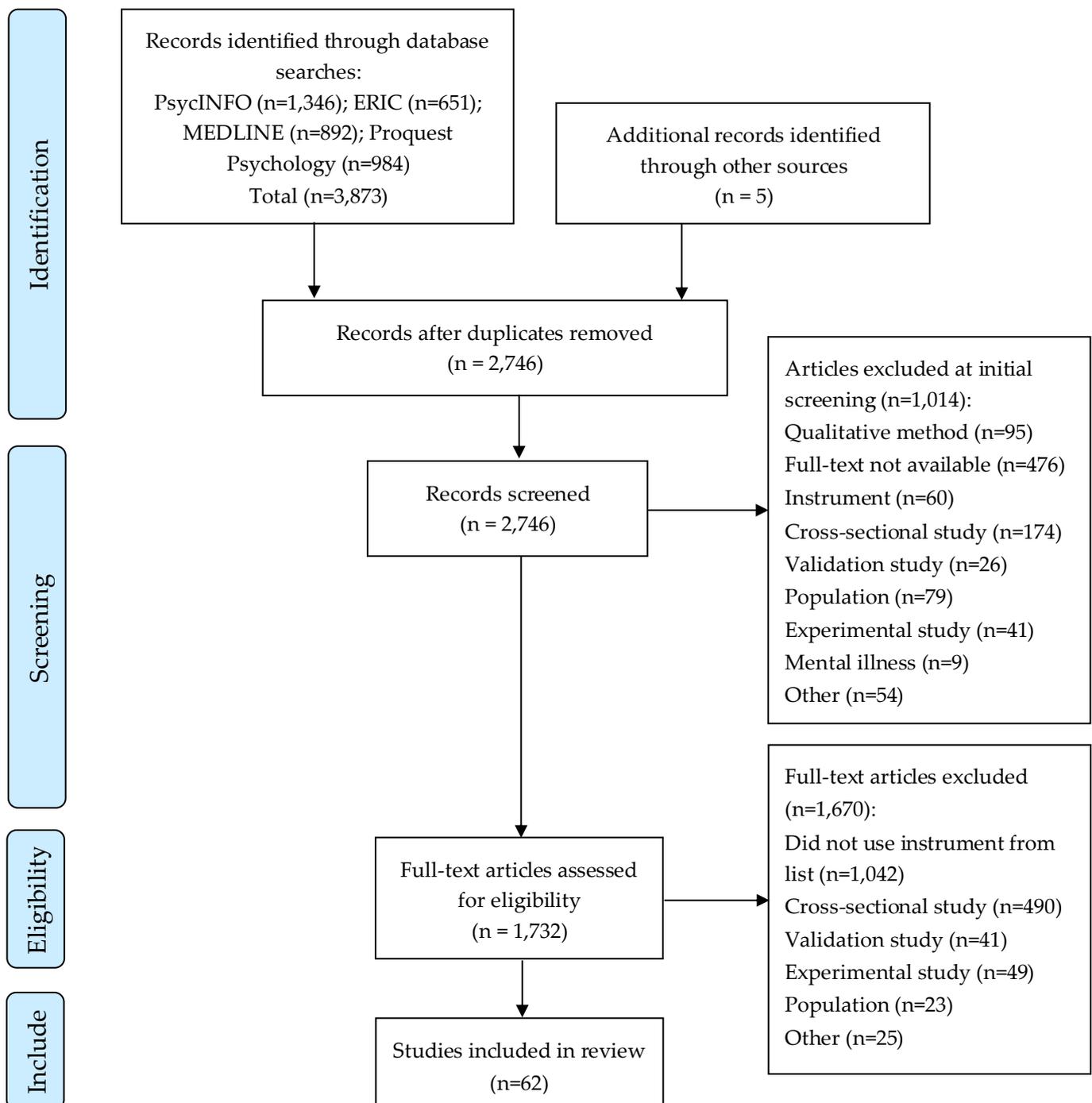


Table 1. A social-ecological model taxonomy based on McLeroy et al. (1988)

Original taxonomy		Taxonomy used in present paper	
Level	Description	Domain	Themes
Intrapersonal	Characteristics of the individual	Self	Personality, emotion regulation, self-relations, strengths, physical health, mental illness (anxiety, depression, stress), temporal structure, other
Interpersonal	Social networks and support: family, friends, and colleagues	Relationships	Social support, social rhythm, other
Institutional	Formal and informal institutions with their written and unwritten rules	Institutional Context	Academics
Community	Relationships among institutions	[not present in study variables]	NA
Public policy	Laws and policies	[not present in study variables]	NA

Where multivariate models controlled for baseline wellbeing, study variables which remained in the final model were noted. Given the generally large autocorrelations among successive measurements of wellbeing variables, incrementally predictive variables were of particular interest.

2.3.2 Meta-analytic approaches to independent variables and measurement interval

2.3.2.1 Semipartial correlation coefficients

As wellbeing at a given point in time is typically strongly correlated with earlier measures of wellbeing, zero-order correlations with study variables, while useful for comparisons, are of limited explanatory value. However, semipartial correlation coefficients (also known as part correlations) are a measure of effect size for longitudinal studies involving autocorrelated time series data. Semipartial correlations are the square root of the ΔR^2 statistic, usually reported for regressions with stepped addition of independent variables. They were used to partial out the effect of Time 1 wellbeing on Time 2 wellbeing, isolating the incremental effect of the Time 1 study variable. Therefore, the results presented are for regressions with two independent variables—the earlier level of wellbeing and the independent variable—with the semipartial correlation indicating the increase in R^2 from the addition of the independent variable.

These were calculated with *metafor* and other R packages [79–84] from the subset of studies which reported the requisite information, and presented in forest plots. Regression coefficients were also calculated, but these were strongly correlated ($r = 0.9987$) with the semipartial correlations, and so are not shown here.

2.3.2.2 Meta-analyses with time as moderator

Lastly, two meta-analyses were performed with measurement interval as a moderator, to investigate whether the effects of study variables were moderated by time. As most studies in the review contributed more than one variable to the analysis, the studies and individual independent variables were included as random effects in a multilevel mixed-effects model, with duration between wellbeing measurements as a moderator [80]. The logarithm of the duration was used, reflecting the known decrease in autocorrelation of wellbeing over time. The second meta-analysis included the dependent variable measure (SWLS vs. other) as a second moderator, to investigate if the instrument used might be confounding the effects of the measurement interval (dependent variable measures were divided into SWLS vs. other because of the large number of studies using the SWLS and the relatively small number of studies using any other single measure).

3. Results

3.1 Overview of study characteristics

Sixty-two prospective studies were identified in this review, predominantly from the US (31 studies), China (eight studies), Canada, and Australia (four studies each). Two multi-country studies presented results for different countries separately [85,86], so there are 65 samples detailed in the tables below. Convenience sampling was used in most studies, with the notable exception of the five studies based on Wabash National Study data [87–91]. Several other studies also used samples from larger studies [69,92–95], though none were as large as the Wabash Study. A typical sample was around two-thirds female. Thirty-four of the 62 studies (55%) had two waves and eleven (18%) had three waves; eight (13%) used EMAs or daily diaries. The median duration was 20 weeks, though there were eight studies with durations ranging from four to thirteen years. Fifty-seven of 62 studies (92%) focused on antecedents of wellbeing. Forty-four studies (71%) controlled wellbeing dependent variables for earlier levels of wellbeing, allowing in principle for the incremental effect of study variables to be isolated, although only 29 (47%) presented the data required for calculation of semipartial correlation coefficients and inclusion in the meta-analyses.

Forty-four studies (71%) used the Satisfaction With Life Scale (SWLS), four of which used another instrument as well. Only 18 studies (29%) did not use the SWLS.

Forty-three studies (69%) examined study variables in only one domain, and 19 across two or three domains. Twenty-eight studies (45%) tested processes of moderation or mediation. Studies which focused on tertiary students as a population were more likely to be concerned with causal mechanisms in the Institutional Context domain (21 of 30 studies, with 14 of those concerned with Institutional Context variables only). In contrast, papers focused on the general population (using a sample of university students for convenience) were more likely to be concerned with causal mechanisms located within the self (30 of 32 studies, with 21 of those concerned with Self domain variables only). Supplementary Table 7 stratifies the studies by instrument and population of interest.

Table 2. Reviewed papers – Self domain

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Boyratz, 2014 [96]	US (2)	G 232 (76.3%)	23.34 (7.29)	Authenticity	LS, MH	SWLS	T2 LS correlated with T1 LS ($r = 0.56$), authenticity (0.35) and distress (-0.28 ; $ps < 0.01$). In a cross-lagged model controlled for temporal stability, T1 authenticity associated with T2 LS ($\beta = 0.37$).	6 wk (2)
Du, 2017 [97]	China (1)	G 74 (63.1%)	19.26 (1.15)	Self-esteem: personal (PSE), relational (RSE), collective (CSE)	LS	SWLS	T2 LS correlated with T1 LS ($r = 0.82$, $p < 0.001$), PSE ($r = 0.55$, $p < 0.001$), RSE ($r = 0.52$, $p < 0.001$), and CSE ($r = 0.26$, $p < 0.05$). In an hierarchical multiple regression, T2 LS was associated with T1 LS ($\beta = 0.87$, $p < 0.001$) and T1 RSE ($\beta = -0.30$, $p < 0.05$ —the negative sign likely indicating a suppression effect).	1 mth (2)
Extremera, 2011 [98]	Spain (1)	G 155 (83.2%)	23.37 (5.12)	Trait meta-mood (or emotional intelligence)	Happiness	Subjective Happiness Scale	T2 happiness correlated with T1 happiness ($r = 0.72$), emotional repair ($r = 0.52$), and mood clarity ($r = 0.33$, all $ps < 0.01$). An hierarchical multiple regression controlled for sex and age showed T2 happiness associated with T1 happiness ($\beta = 0.60$, $p < 0.01$) then emotional repair ($\beta = 0.20$, $p < 0.01$).	7 wk (2)
Harris, 2005 [99]	US (1)	G 147 (73.5%)	21.7 (6.1)	Personality, constructive thinking	SWB	SWLS	T2 LS correlated with T1 LS ($r = 0.76$), neuroticism ($r = -0.27$), extraversion ($r = 0.23$), and constructive thinking ($r = 0.28$; all $ps < 0.01$). In a hierarchical regression, the only variable significantly prospectively associated with T2 LS was T1 LS ($\beta = 0.75$, $p < 0.001$).	4 wk (2)
Heller, 2007 [100]	Canada (1)	G 101 (68.3%)	18.59 (1.35)	Personality traits and states, goals	SWB	SWLS	In a pooled multiple regression, state LS was associated with state extraversion ($\gamma = 0.07$, $p < 0.01$) and state neuroticism ($\gamma = -0.12$, $p < 0.01$). A multilevel mediation model found state extraversion (Sobel test = 3.68, $p < 0.01$) and neuroticism (Sobel test = 3.89, $p < 0.01$) mediated goals and LS, together mediating 61%.	10 days (30)

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Hope, 2014 [101]	Canada (1)	S 159 (72%)	18 (1.04)	Self-compassion, goals, goal motivation (ex- / intrinsic), goal progress	LS, affect, psychosocial adjustment	SWLS	A hierarchical multiple regression found T1 self-compassion associated with T4 LS six mth later ($\beta = 0.17, \Delta R^2 = 0.02, p < 0.05$) with T1 LS controlled.	7 mth (12)
Iyer, 2011 [102]	UK (1)	G 120 (80%)	19.3 (2.15)	Nostalgia, identity continuity	LS; perceived academic obstacles	SWLS	T3 LS correlated with T2 LS ($r = 0.70, p < 0.05$). (NB T1 data not used.) Nostalgia was associated with LS only at low levels of identity continuity (one SD below mean; $\beta = -0.15, p = 0.049$).	4 mth (2)
Kashdan, 2007 [103]	US (1)	G 97 (66%)	19.75 (3.2)	Trait curiosity, meaning in life, and affect; personality; daily curiosity, growth-oriented and hedonistic behaviours	LS	SWLS	T1 LS correlated with daily meaning ($r = 0.58, p < 0.001$), curiosity ($r = 0.27, p < 0.01$), and growth behaviour ($r = 0.20, p < 0.05$) (aggregated daily measures). Multilevel models controlled for previous-day LS showed current-day LS associated with high trait curiosity ($B\gamma_{01} = 0.05, p = 0.02$), and previous-day NA ($B = -0.02, p = 0.02$).	3 wk (22)
Lai, 2007 [104]	Hong Kong (1)	G 78 (57.5%)	98 ppts < 21; 15 ppts 21-30. (NA)	Five social axioms, (i.e., beliefs about the world: Social Cynicism, Social Complexity, Reward for Application, Religiosity, Fate Control)	LS, self-esteem	SWLS	LS at T2, T3 and T4 correlated with earlier LS ($r_s 0.65 - 0.71, p_s < 0.01$) and earlier self-esteem ($r_s 0.44 - 0.50, p_s < 0.01$). T2-T4 mean LS correlated with cynicism ($r = -0.39, p < 0.01$), complexity ($r = -0.23, p < 0.05$). In a multiple regression, axioms associated with mean LS ($R^2 = 0.26$); cynicism was only sig. independent variable ($p < 0.01$), mediated by mean self-esteem (Sobel $z = -3.21, p < 0.01$). Hierarchical multiple regressions showed complexity was the only axiom associated with mean LS w/o mediation ($\Delta R^2 = 0.06, p < 0.01$).	1 yr (4)

Author, Year	Country (no. sites)	Pop. <i>n</i> (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Lightsey, 2013 [105]	US (2)	G 65-127 (NA)	19.72 (5.12)	Self-efficacy for emotion regulation, incl. subscales: Self-efficacy for regulating: .. negative emotions (SERN), .. despondency & distress (SEDes), .. anger (SEAng), and .. experience, and expression of positive emotions (SEPos).	LS, PA, NA	SWLS	Correlations between LS across waves were 0.75-0.81, $ps < 0.001$. T2 LS correlated with T1 SEDes ($r = 0.50$), T1 NA ($r = -0.42$), and T1 SEAng ($r = 0.37$, $ps < 0.01$). In multiple regressions controlled for T1 LS and T1 NA, T2 LS associated with T1 SEDes ($\beta = 0.24$, $p = 0.001$, incl. SEAng and interactions); T3 LS associated with SEDes ($B = 0.157$, $p = 0.047$) and T4 LS ($B = 0.21$, $p = 0.017$). Regressions controlled for T1 LS, with a monolithic term for SEDes, SEAng and their interaction with T1 NA, associated with LS at T2, T3 and T4 ($\Delta R^2 0.028-0.033$, $ps < 0.04$), but w/o moderation of the effect of T1 NA on T2-T4 LS. Multiple regressions found that SEPos associated with unique variance in LS at T3 ($\beta = 0.23$, $p = 0.004$, $\Delta R^2 = 0.065$, $p < 0.007$) and T4 ($\beta = 0.26$, $p < 0.004$, $\Delta R^2 = 0.067$, $p < 0.009$), displacing other SEAR variables.	7 wk (4)
Emmons, 1995 [106]	US (1)	G 105 (84.8%)	21 (NA)	Emotional ambivalence, fear of intimacy, repressive defensiveness, social support	LS, social support, happiness, anxiety, depression	SWLS	LS measured only at baseline; no significant results for LS as an independent variable.	3 wk (22)
Harris, 2017 [95]	US (1)	G 393 (60%)	18.1 (NA)	Extraversion, social experiences (numerous aspects)	LS; happiness	SWLS	Previous-year self-reported social variables correlated with current-year LS (abs. value 0.11 – 0.37, $ps < 0.05$). Peer-reported social variables for the first yr of college mostly correlated with second-year LS (abs. value 0.12 – 0.15, $ps < 0.05$). A cross-lagged model showed pre-college extraversion associated with LS four years later, mediated by self-rated social connection ($a*b = 0.10$, 95%CI[0.02, 0.23], model $p < 0.001$) and belonging ($a*b = 0.11$, 95%CI[0.02, 0.25], model $p < 0.001$).	4 yr (5)

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Grund, 2015 [107]	Germany (1)	G 58 (69%)	24.1 (3.2)	Affect; motivational form; want or should conflict; self-control, mindfulness	LS; affect	SWLS	A hierarchical multiple regression showed T2 LS associated with 'should' conflicts ($\beta = -0.37, p < 0.01$), T1 mindfulness ($\beta = 0.23, p < 0.05$), and T1 self-control ($\beta = 0.22, p < 0.05$); $R^2 = 0.34$. 'Should' conflicts interacted with mindfulness ($a*b = 0.09, CI[0.01, 0.25]$) and self-control ($a*b = 0.13, CI[0.03, 0.30]$).	1 week (42)
Hope, 2016 [108]	Canada (1)	S 341 (74%)	19.4 (1.8)	Participants: life aspirations, perfectionism, self-criticism; goals and their self-concordance Informants: life aspirations, other- and self-oriented perfectionism, personality	SWB; type of aspiration (ex- or intrinsic); goal self-concordance	SWLS	T2 SWB correlated with T1 SWB ($r = 0.61, p < 0.001$). An hierarchical multiple regression of T2 SWB (controlled for T1 SWB) found prioritising extrinsic aspirations was associated ($\Delta R^2 = 0.02, p < 0.01$).	10 wk (2)
Jiang, 2016 [109]	China (2)	S 428 (61.2%)	19.8 (0.95)	Disciplinary culture, materialism	SWB, affect	SWLS	Materialism correlated with later SWB, $r = -0.21$ to -0.33 ($ps < 0.01$). A SEM showed prior materialism associated with current SWB ($\beta = -0.21$ and $-0.23, ps < 0.01$) controlled for prior SWB; there was no moderation by disciplinary culture.	1 yr (3)
Arria, 2016 [110]	US (1)	S 932 (57%)	Mode 27	Trajectory of marijuana use	LS, health, drug use; service usage; impairment	SWLS	Compared to the non-use group, the chronic, low-stable, late-increase and early-decline groups had worse yr 10 LS, while the college-peak group had better LS. Marijuana use trajectory associated with risk of low LS (< 15 on the SWLS) at yr 10 ($p = 0.014$): 6% for the non-use group, 7% for college-peak, 12% for low-stable and chronic, and 16% for early-decline.	10 yr (9)

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Coffey, 2016 [69]	US (1)	S 149 (31%)	18.1 (0.4)	Elements of PERMA: positive emotion, engagement, relationships, achievement	LS, job interviews, distress, vitality, college satisfaction, GPA, health	SWLS	T6 LS was associated with T4 PER(M)A ($\beta = 0.47, p < 0.001$). Looking at individual PERMA elements, T6 LS correlated with T4 positive emotion ($r = 0.54, p < 0.001$), T4 engagement ($r = 0.35, p < 0.001$), and T4 achievement ($r = 0.50, p < 0.001$).	4 yr (6)
Frazier, 2013 [111]	US (4)	G 1281 (73%)	88% aged 18-21 (NA)	Trauma	LS, distress; affect; meaning in life; prosocial behaviour	SWLS	No significant results for wellbeing.	8 wk (2)
Denovan, 2017 [112]	UK (1)	SS 192 (82.8%)	19.68 (2.91)	Stressor exposure; covitality factors (strengths)	LS, PA, NA; stress; Grade Point Average	SWLS	No significant results for wellbeing.	6 mth (2)
Perera, 2014 [113]	Australia (1)	S 236 (64%)	17.74 (0.68)	Optimism, engagement coping	Academic adaptation, wellbeing	WEMWBS	A SEM had both a direct path from optimism to wellbeing (0.58, $p < 0.01$) and a mediated path, from optimism to engagement coping (0.54, $p < 0.01$) to wellbeing (0.31, $p < 0.01$). R^2 for wellbeing was 0.62. However, wellbeing not measured at T1.	8 wk (3)
León, 2013 [114]	Spain (1)	S 272 (85.3%)	21.76 (5.17)	Relatedness, competence, autonomy	LS, SWB, self-esteem	SWLS	T2 LS was associated with T1 competence (0.12, $p = 0.02$) and T1 relatedness (0.15, $p = 0.01$)	3 mth (2)
Jankowski, 2015 [115]	Poland (2)	G 117 (86.3%)	22.2 (1.9)	Sleep variables	LS; mood; sleep	SWLS	No significant longitudinal results for life satisfaction except correlations of repeated measures.	9 wk (4)
Pilcher, 1997 [116]	US (1)	G 87 (71.3%)	18.9 (1.1)	Sleep quality and quantity	PA, NA, LS, subjective health,	SWLS	Sleep quality averaged over the week of the study correlated with LS ($r = 0.28, p < 0.05$) with the effects of sleep quantity partialled out.	1 wk (8)

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
					mood			
Pilcher, 1998 [117]	US (1)	G 75 (72%)	18.9 (0.83)	Sleep quality and quantity	Wellbeing (LS, PA, NA, mood), health	SWLS	For the first wave, av. sleep quality correlated with LS ($r = 0.22$, $p < 0.05$) with effects of sleep quantity partialled out; results from 2nd and 3rd waves n.s.	11 wk (24)
Robinson, 2000 [118]	US (1)	G 129 (NA)	NA	Self-esteem Life events Mediator: mood states	Eudaimonic wellbeing	PWBS	Hierarchical multiple regression controlled for T1 wellbeing showed pasttwo weeks' life events were associated with T2 and T3 wellbeing, across both two week periods ($\beta = 0.15$, 0.21 , $ps < 0.01$) and the four week period ($\beta = 0.12$, $p < 0.05$). Similar results for recent mood states, across both two week periods (PA: $\beta = 0.11$, $p < 0.05$ and $\beta = 0.16$, $p < 0.01$; NA: $\beta = -0.16$, $p < 0.01$ and $\beta = -0.13$, $p < 0.05$) and the four week period (PA: $\beta = 0.29$, $p < 0.05$; NA: $\beta = -0.05$, n.s.).	4 wk (3)
Schonfeld, 2019 [119]	China (3)	G 2160 (51.3%)	19.03 (1.19)	Daily stressors, self-efficacy	Positive mental health; depression, anxiety and stress	PMHS	T3 positive mental health correlated with T1 daily stressors ($r = -0.22$, $p < 0.01$), self-efficacy ($r = 0.32$, $p < 0.001$), depression ($r = -0.28$, $p < 0.001$), anxiety ($r = -0.27$, $p < 0.001$), stress ($r = -0.31$, $p < 0.001$), and T1 positive mental health ($r = 0.40$, $p < 0.001$). A longitudinal mediation analysis with SEM fit the data well: $\chi^2(2214) = 9,017.329$, $p < 0.001$, RSMEA = 0.038 (0.037, 0.039), SRMR = 0.049, CFI = 0.930.	2 yr (3)
Whillans, 2019 [120]	Canada (1)	G 1060 (71.9%)	20.63 (4.15)	Prioritisation of time or money; SWB	SWB; activity motivation	SWB	Students who valued time more than money at T1 reported greater SWB at T2 ($\beta = 0.12$, $p < 0.001$). Controlled for T1 SWB, sex, family SES and materialism, the effect remained significant ($\beta = 0.07$, $p = 0.009$).	15 mth (2)

Table 3. Reviewed papers – Relationships domain

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Impett, 2005 [121]	US (1)	G 153 (54.9%)	20.1 (2.4)	Relational sacrifice for approach or avoidance motives	LS, affect, rel. quality and conflict	SWLS	Today's LS associated with yesterday's LS (unstd. coeff. 0.21, $p < 0.001$). 14 day average LS correlated with T1 hope for affiliation ($r = 0.16$, $p = 0.05$) and fear of rejection ($r = -0.23$, $p = 0.004$). Approach motivation mediated hope for affiliation and LS ($\beta = 0.38$, $p < 0.001$; Sobel $z = 2.89$, $p < 0.01$).	2 wk (15)
Iyer, 2009 [122]	UK (1)	G 261 (75.9%)	18.7 (NA)	Incompatible identities; multiple grp memberships; PA; depression, social class, uncertainty & support re: uni., goal ach., academic / financial obstacles	LS; personal self-esteem; depression; Identification with student group	SWLS	T2 LS correlated with T1 LS ($r = 0.51$), T1 self-esteem ($r = 0.39$), T1 depression and T1 uncertainty ($r_s = -0.38$), T1 multiple grp memberships and support ($r_s = 0.16$) (all $p_s < 0.05$). Full mediation model showed T2 LS associated with T1 LS ($\beta = 0.42$) and paths from T1 identity compatibility ($\beta = 0.19$) and T1 multiple grp memberships ($\beta = 0.25$) to T2 ID as uni student, which associated with T2 LS ($\beta = 0.42$) (all $p_s < 0.05$).	3 mth (2)
Praharso, 2017 [123]	Australia (1)	G 79 (68.4%)	21.97 (3.62)	Social support, group memberships	LS, perceived stress, depression	SWLS	T2 LS correlated with T1 LS ($r = 0.63$, $p < 0.01$), depression ($r = -0.45$, $p < 0.01$), stress ($r = -0.41$, $p < 0.01$), and no. impt grp memberships ($r = 0.22$, $p < 0.05$). In a hierarchical multiple regression controlled for T1 LS, T1-T2 Δ impt grp memberships associated with T2 LS ($\beta = 0.19$, $p = 0.044$; $\Delta R^2 = 0.05$, $p < 0.05$).	4 mth (2)
Vrangelova, 2015 [124]	US (1)	S 666 (62.5%)	18-24 (NA)	Hookups: definitions based on relationship length and physical intimacy	LS, depression, anxiety, self-esteem	SWLS	Multiple regressions controlling for T1 LS and other variables found that in females, T2 LS associated with oral hookups in any relational context.	16 wk (2)

Author, Year	Country (no. sites)	Pop. <i>n</i> (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Bahrassa, 2011 [125]	US (1)	SS 82 (56.1%)	18.5 (0.34)	Family conflict	Grade Point Average (GPA) in first semester	SWLS	T1 LS correlated with T2 GPA ($r = 0.42, p < 0.01$). Hierarchical multiple regression showed LS*family conflict ($\beta = 0.30, p = 0.01$; $\Delta R^2 = 0.055$); high LS protected GPA from family conflict.	4 mth (2)
Cai, 2017 [126]	China (1)	G 2031 (79.8%)	19.89 (0.91)	Social rhythm (regularity of engaging in basic social activities)	Positive mental health	PMHS	T3 positive mental health correlated with T1 social rhythm ($r = 0.20, p < 0.01$). A repeated-measures MANOVA showed a main effect for time on positive mental health over the study ($F = 96.29, p < 0.0001, \eta_p^2 = 0.05$). A cross-lagged panel analysis was a good fit ($\chi^2 (2) = 34.01, p < 0.0001, CFI = 0.99, SRMR = 0.029$).	2 yr (3)

Table 4. Reviewed papers - Institutional Context domain

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Cruwys, 2015 [127]	Australia (4)	SS 91 (82.4%)	23.93 (5.07)	Thesis completion, grades, grade aspirations	LS, NA, depression, self-esteem	SWLS	A multiple regression controlled for T1 LS found T2 LS associated with T1 academic aspirations ($\beta = -0.27, p < 0.05$) and thesis grade ($\beta = 0.25, p < 0.05$). Discrepancy between aspired-for and received thesis grade associated with T2 LS ($F_{\Delta} [1,88] = 12.76, p = 0.001, \eta^2 = .07$).	4 wk (2)
Figueira, 2017 [97]	Portugal (1)	S 128 (82%)	21 (4)	Perceived time pressure, role clarity, working conditions and peer social support	Personal wellbeing: subjective, psychological and social wellbeing	MHC-LF	T1 working conditions correlated with T2 social wellbeing ($r = 0.36, p < 0.01$) and T2 SWB ($r = 0.21, p < 0.05$); T1 peer social support correlated with T2 social wellbeing ($r = 0.19, p < 0.05$) and T2 eudaimonic wellbeing ($r = 0.20, p < 0.05$). A SEM showed T2 SWB associated with T1 SWB (coeff. $0.56, p < 0.001$), T1 time pressure and working conditions (both $0.20, ps < 0.05$), and role clarity ($-0.21, p < 0.05$). T2 eudaimonic wellbeing associated with only by T1 eudaimonic wellbeing ($0.52, p < 0.001$).	8 mth (2)
Goodman, 2014 [88]	US (48)	S 6,610 (NA)	NA	Good teaching, academic challenge	Eudaimonic wellbeing, leadership	PWBS	In well-controlled multiple regressions, good teaching associated with overall wellbeing and all subscales for white students; for African-American students only self-acceptance was significant. Academic challenge associated with overall wellbeing and all subscales for African-American and white students.	8 mth (2)
Hevel, 2015 [89]	US (17)	SS 2,027 (NA)	NA	Fraternity or sorority affiliation	Eudaimonic wellbeing, educ. dependent variables	PWBS	Fraternity or sorority membership was not associated with wellbeing at the end of college.	4 yr (3)

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Martin, 2011 [90]	US (11)	SS 1,786 (62.8%)	NA	Fraternity or sorority affiliation	Wellbeing, intercultural effectiveness, educ. outcomes	PWBS	A multiple regression controlled for T1 wellbeing and a wide range of covariates found fraternity or sorority membership was not associated with T2 wellbeing.	9 mth (2)
Martin, 2015 [128]	US (49)	S 4,000 (NA)	NA	Commuting, college experiences	Psychological wellbeing	PWBS	Membership of a learning community was a significant incremental predictor of wellbeing over the first year and over four years of college.	4 yr (3)
Murai, 2008 [129]	Japan (1)	SS 485 (100%)	18 (0.2)	Wellbeing; health; stress; college life variables	Leave or dropout from uni	GWBS	GWBS subscale for LS and emotional stability associated with leave or dropout (OR = 1.09, 95%CI[1.01-1.18], $p = 0.034$ for one point change).	1 yr (2)
Wakefield, 2018 [130]	Spain (1)	S 216 (77.3%)	21.45 (1.26)	LS, uni identification, uni contact	LS, uni identification, uni contact	SWLS	T2 LS correlated with T1 LS ($r = 0.44, p < 0.001$), T1 university identification ($r = 0.27, p < 0.001$), and gender ($r = -0.17, p < 0.05$). T2 LS was associated with T1 LS and T1 university identification in a cross-lagged model.	7 mth (2)
Maddi, 2012 [131]	US (1)	G 377 (78%)	21.7 (NA)	LS, hardiness	Grade Point Average (GPA)	SWLS	LS correlated with GPA six months to two years later ($r = 0.182, p < 0.001$). In a multiple regression with hardiness as the other independent variable, LS was also associated with GPA ($\beta = 0.144, p = 0.033$).	6 mth to 2 yr (2)
Bowman, 2011 [94]	US (1)	S 416 (43%)	~18 (NA)	Racial / cultural diversity	Wellbeing, prosociality, volunteering, recognition of discrimination	SWLS; PWBS subscales	No significant results for life satisfaction – however, see Supplementary Table 6 for results for PWBS Mastery and Growth subscales.	13 yr (3)

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Bowman, 2013 [87]	US (49)	S 8615 (NA)	NA (NA)	Diversity interactions	Wellbeing, leadership, intellectual engagement, intercultural effectiveness	PWBS	T2 wellbeing associated with squared interracial interactions ($\beta = 0.038, p < 0.01$) and squared overall diversity interactions ($\beta = 0.049, p < 0.001$). Wellbeing benefits greater for non-white students for both interracial ($\beta = 0.055, p < 0.01$) and overall diversity interactions ($\beta = 0.040, p < 0.05$).	~8 mth (2)
Cole, 2008 [132]	US (1)	SS 99 (67%)	18.06 (0.91)	Outgroup comfort, status legitimating beliefs, academic concerns	Wellbeing, academic concerns, interracial contact	GWBS	T2 wellbeing correlated with T1 academic concerns ($r = -0.23, p < 0.05$). A multiple regression showed T2 wellbeing associated with gender x outgroup comfort ($\beta = 0.37, p < 0.05$). For women, T1 outgroup comfort was associated with T2 wellbeing.	6 mth (2)
Seder, 2009 [133]	US (1)	S 93 (62.4%)	17.98 (0.42)	Ethnic/racial homogeneity of Facebook friendships; felt misunderstanding and understanding; personality; religiosity; political conservatism	LS, PA, NA	SWLS	For the non-white sample, T2 LS was correlated with T1 LS ($r = 0.53, p < 0.01$), felt understanding ($r = 0.38$), felt misunderstanding (-0.34), extraversion (0.47), neuroticism (-0.35), and openness (0.44 ; all other $ps < 0.05$). For the white sample T2 LS associated with T1 LS ($r = 0.80, p < 0.01$), % white on-campus friends ($r = 0.47, p < 0.01$), % white other-school friends ($0.29, p < 0.05$); broadly similar correlations among other variables.	3 mth (2)
Bowman, 2010 [93]	US (1)	S 416 (43%)	~18 (NA)	In-college community engagement, prosocial orientation, volunteering, service-learning courses	LS, eudaimonic wellbeing, volunteering	SWLS, PWBS	T2 volunteering had sig. correlations with all T3 wellbeing variables: growth ($r = 0.13, p < 0.05$), mastery ($r = 0.18, p < 0.005$), purpose ($r = 0.14, p < 0.05$), and LS ($r = 0.15, p < 0.01$). T2 service-learning correlated with mastery ($r = 0.12, p < 0.05$).	13 yr (3)

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Kilgo, 2016 [91]	US (46)	S 4402 (62%)	NA (NA)	Participation as orientation leader, residential assistant, peer educator; intramural sports, no. student org.	Eudaimonic wellbeing	PWBS	A well-controlled multiple regression found T3 overall wellbeing associated with being a resident assistant ($\beta = 0.09, p < 0.05$), sports participation ($\beta = 0.07, p < 0.01$) and student organisation membership ($\beta = 0.08, p < 0.001$).	4 yr (3)
Lent, 2009 [134]	Portugal (1)	S 252 (86.1%)	21.48 (4.75)	LS, PA; Academic env. resources, self-efficacy, goal progress, sat., stress	Same as independent variables	SWLS	T2 LS correlated with all T1 independent variables, r_s 0.24 - 0.47. Path model showed T2 LS associated with T1 LS ($\beta = 0.66$) and T1 academic adjustment ($\beta = 0.37$).	15 wk (2)
Lent, 2012 [135]	Portugal (1)	S 158 (57.6%)	21.33 (4.77)	LS, PA; academic env. resources, self-efficacy, goal progress, sat., stress	Same as independent variables	SWLS	T2 LS correlated with all T1 independent variables, r_s 0.39 - 0.48. Path model showed T2 LS associated with T1 LS ($\beta = 0.62$) and T1 academic satisfaction ($\beta = 0.12$).	15 wk (2)
Singley, 2010 [136]	US (1)	S 769 (65%)	NA (NA)	LS, PA; academic env. resources, self-efficacy, goal progress, sat., stress	Same as independent variables, except PA	SWLS	T2 LS correlated with all T1 independent variables, r_s 0.32 - 0.42. Path model showed T2 LS associated with T1 LS ($\beta = 0.68$), T1 PA ($\beta = 0.06$), T1 academic goal progress ($\beta = 0.06$).	8 wk (2)

Table 5. Reviewed papers – Self and Relationships domains combined

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Bucher, 2019 [137]	Germany (1)	G 244 (75%)	27.4 (8.3)	Relationship status and duration, need satisfaction in rel., commitment	Life satisfaction , loneliness	SWLS	SEM controlled for sex, age, relationship duration and previous life satisfaction showed effects of increase in relational intimacy ($\beta = 0.30$, $p = 0.001$) on life satisfaction.	52 wk (2)
Ye, 2019 [138]	Hong Kong (1)	G 214 (73.8%)	20.6 (1.44)	Emotional intelligence, provided social support, received social support	Subjective happiness	Subjective Happiness Scale	T2 subjective happiness correlated with T1 emotional intelligence ($r = 0.32$, $p < 0.001$), T1 provided social support ($r = 0.16$, $p < 0.05$), and T1 subjective happiness ($r = 0.66$, $p < 0.001$). T1 trait EI associated with T2 subjective happiness ($B = 0.57$, $SE = 0.15$, $95\% CI = [.27, .86]$) with age, gender and T1 social support controlled. EI had an indirect effect on T2 subjective happiness through T1 provided social support and T2 received social support in sequence ($B = 0.05$, $SE = 0.02$; $95\% CI = [.02, .12]$).	6 mth (2)
Huang, 2020 [139]	US (1)	G 75 (83%)	22 (7)	Implicit theory of personality; Big Five personality. EMAs: others' friendliness, task demands, state extraversion and conscientiousness	Life satisfaction , college satisfaction	SWLS	T2 life satisfaction correlated with T1 extraversion ($r = 0.24$, $p < 0.05$) and T1 neuroticism ($r = -0.31$, $p < 0.01$). Other prospective results for life satisfaction n.s.	3 wk (2)

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Sheldon, 2020 [140]	US (1)	G 125 (60%)	Mode 20	Self-support, self-controllingness, need satisfaction (autonomy, competence, relatedness)	SWB	SWLS	T2 SWB correlated with T1 self-support for autonomy ($r = 0.42, p < 0.01$), T1 self-controllingness ($r = -0.20, p < 0.05$), T1 need satisfaction ($r = 0.51, p < 0.01$), and T1 SWB ($r = 0.59, p < 0.01$). In a hierarchical regression (first step T1 SWB), T2 SWB associated with need satisfaction at T1 ($\beta = 0.19, p = 0.032$) and T2 ($\beta = 0.43, p < 0.001$). $R^2 = 0.637$.	6 wk (2)
Hu, 2020 [126]	China (1)	S 749 (82.4%)	NA	Social support, resilience	Life satisfaction	SWLS	T3 life satisfaction correlated with T1 social support ($r = 0.18, p < 0.001$) and resilience ($r = 0.23, p < 0.001$). A repeated-measures MANOVA showed a main effect for time on life satisfaction over the study ($F = 9.92, p < 0.001, \eta^2 = 0.01$), with a u-shaped pattern.	3 yr (3)
Velten, 2018 [85]	Germany (1)	G 636 (58.9%)	21.69 (4.07)	BMI, frequency of physical and mental activity, alcohol and tobacco use, vegetarianism, social rhythm (regularity of social activities)	Positive mental health; depression, anxiety and stress	PMHS	Multi-group path analysis included all German participants ($n = 2800$) and a randomly selected sample of Chinese students ($n = 2745$), matched for age and gender. Regression paths set equal. Model fit was good (CFI = 0.955, RMSEA = 0.043, SRMR = 0.048). Baseline lifestyle factors explained 12.5% variance in wellbeing (German) and 11.2% (Chinese).	1 yr (2)
Velten, 2018 [85]	China (3)	8933 (61.9%)	20.59 (1.58)	As above	As above	PMHS	As above	1 yr (2)

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Rubin, 2016 [141]	Australia (1)	S 314 (64.3%)	22.98 (7.74)	Subjective social status (SSS); social contact with university friends	LS, depression, anxiety, stress	SWLS	T2 LS associated with T1 SSS ($\beta = 0.16, p = 0.002$) and T1 social contact ($\beta = 0.13, p = 0.025$) with T1 LS controlled. T1 SSS still significant when mediated by T1 social contact ($\beta = 0.15, p = 0.006$). A bootstrapped path analysis showed partial mediation.	Mean 20 wk (11 - 29) (2)
Margraf, 2020 [86]	Germany (1)	G 1608 (63.9%)	23.58 (4.73)	Social support, resilience, social rhythm, fertility wish, quality of health; family affluence, depression, anxiety, and stress	Positive mental health; depression	PMHS	A SEM across all three samples with regression coefficients constrained to be equal was a good fit ($\chi^2 = 3456, df = 162, p < 0.001, CFI = 0.911, RMSEA = 0.075, SRMR = 0.074; \Delta\chi^2 = 48, \Delta df = 210, p < 0.001, \Delta CFI = 0.005$).	17 mth (2)
Margraf, 2020 [86]	China (5)	G 12057 (61.3%)	19.63 (1.66)	As above	As above	PMHS	As above	17 mth (2)
Margraf, 2020 [86]	Russia (3)	G 677 (41.5%)	19.63 (2.16)	As above	As above	PMHS	As above	17 mth (2)

Table 6. Reviewed papers - Temporal structure

Author, Year	Country (no. sites)	Pop. n (% fem)	Age - mean (SD)	Independent variable(s)	Dependent variable(s)	Instrument	Findings	Duration (waves)
Anusic, 2012 [142]	US (1)	G 226 (85%)	18.8 (1.4)	Personality, LS, MH	LS, MH, personality	SWLS	LS was best described by a model which divided variance into autoregressive (86% of variance) and state (14%) components.	9 wk (8)
Bostic, 2001 [143]	US (1)	G 60 (76.7%)	19.16 (2.01)	Personality, SWB	SWB	SWLS	Mean SWB correlated with SD of SWB ($r = -0.52, p < 0.01$), extraversion ($r = 0.43, p < 0.01$) and external locus of control (subscales: 'chance' $r = -0.48, p < 0.01$; 'powerful others' $r = -0.27, p < 0.05$). Variability in SWB correlated with conscientiousness ($r = 0.33, p < 0.05$), 'chance' ($r = 0.33, p < 0.05$), and 'powerful others' ($r = 0.26, p < 0.05$). Mean week-to-week SWB autocorrelation was 0.43.	10 wk (11)
Li, 2014 [96]	China (1)	G 360 (51.4%)	19.69 (2.93)	LS, PA, NA	LS, PA, NA	SWLS	An indicator-specific trait model had good fit ($\chi^2/df = 1.98, CFI = 0.97, TLI = 0.94, RMSEA = 0.052, SRMR = R = 0.035$). Over three waves, SWLS consistency coeff. 0.46 – 0.61 and occasion-specificity coeff. 0.17 – 0.21, so reliability was 0.66 – 0.78.	8 mth (3)

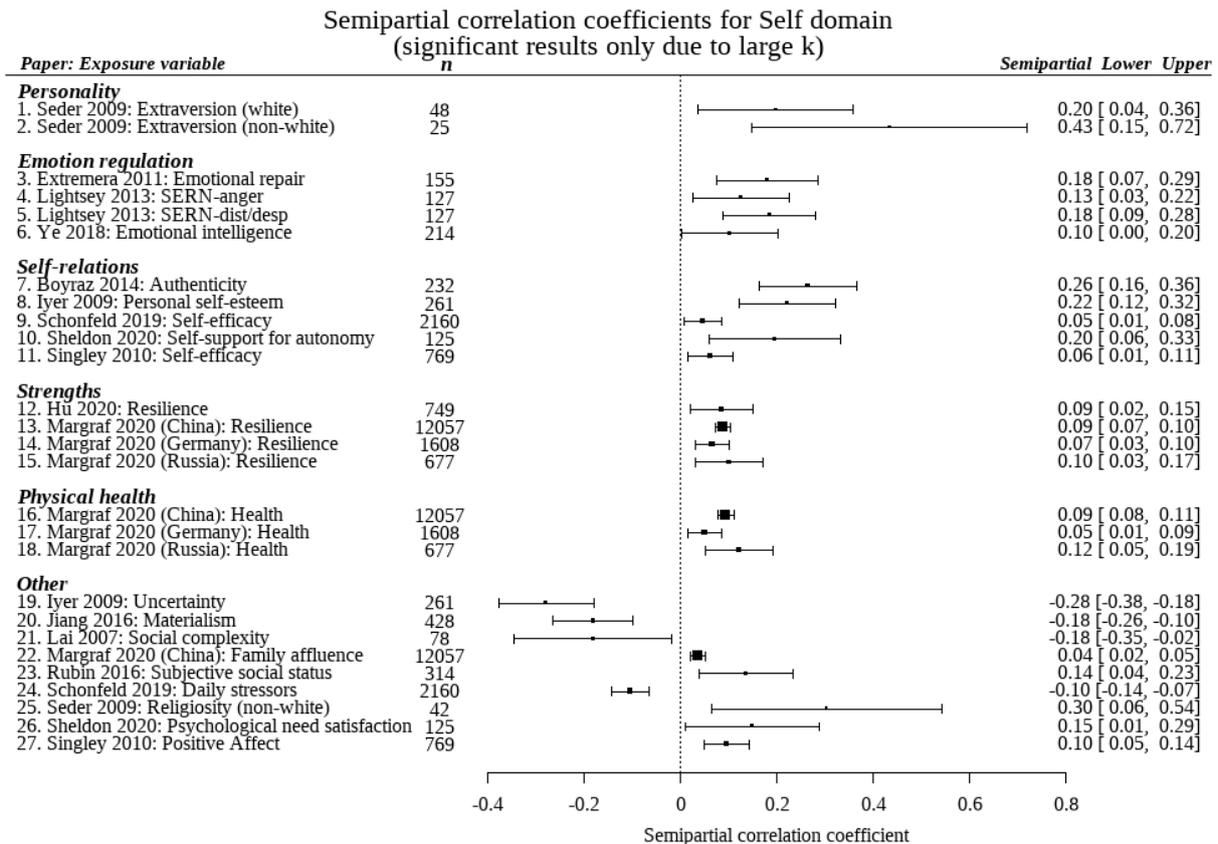
Note: Some of the data for studies using the Wabash National Study sample were taken from general information from the study website [144] and other papers using that sample.

3.2 Antecedents of wellbeing

3.2.1 Self domain (including mental illness)

Figure 2 and 3 plot the semipartial correlations of study variables from the Self domain which were significantly associated with T2 wellbeing after controlling for T1 wellbeing. The independent variables from this domain were the most numerous, comprising 46 of the 66 significant independent variables for which semipartial correlations could be calculated. Note that only significant results are plotted in this section, due to the large number of variables.

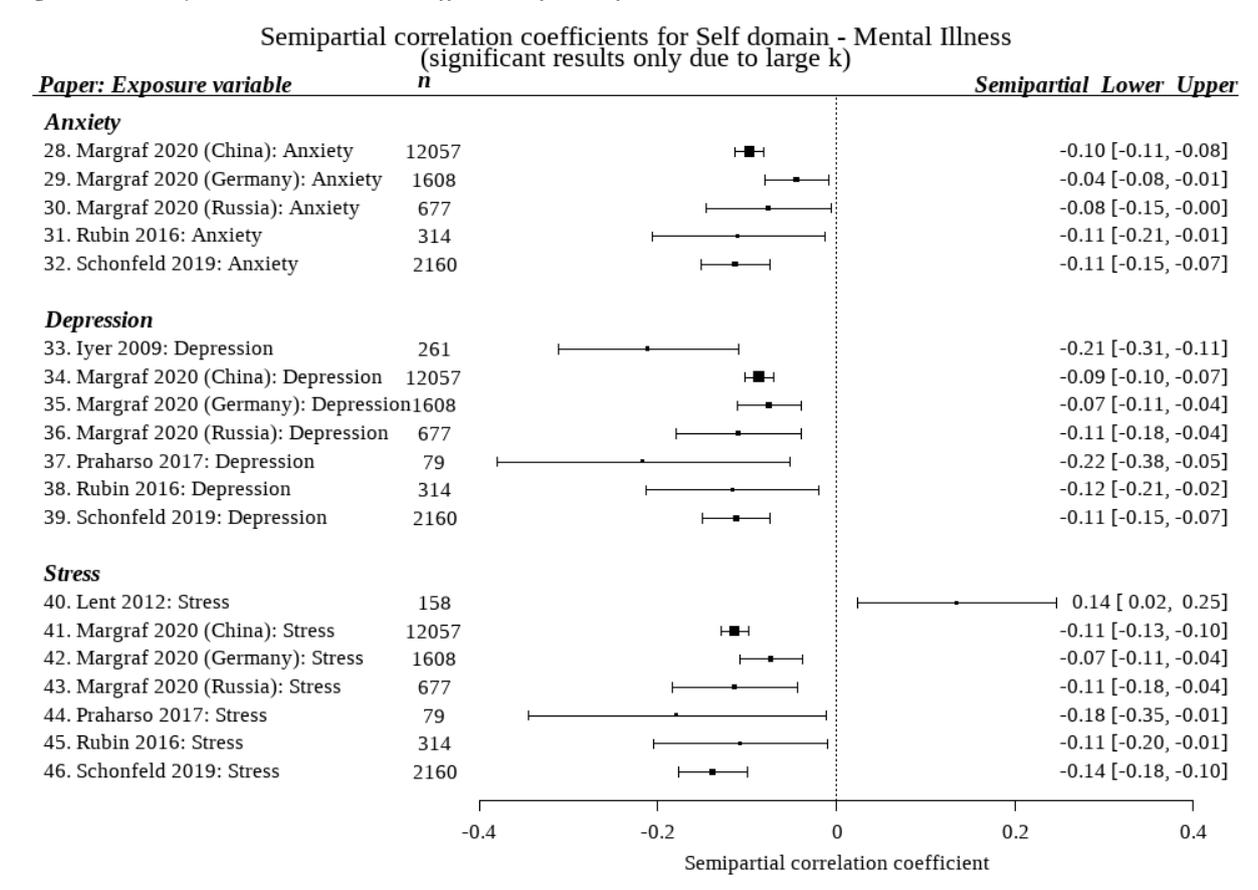
Figure 2. Semipartial correlation coefficients for Self domain variables



Seven semipartial correlations had absolute values of 0.20 or greater. Uncertainty regarding how university would affect one's life and how to be a good student had a semipartial correlation of -0.28 with prospective wellbeing [122]. Three of the others came from studies examining self-relations: authenticity had a semipartial correlation of 0.26 [96], self-esteem 0.22 [122], and self-support for autonomy 0.20 [140]. The remaining three came from one study with very small sample sizes [133], being extraversion for non-white students ($r_{sp} = 0.43$, $n = 25$) and white students ($r_{sp} = 0.20$, $n = 48$) and religiosity for non-white students ($r_{sp} = 0.30$, $n = 42$).

Emotion regulation variables ranged from 0.10 [138] to 0.18, notably emotional repair and self-rated ability to regulate distress and despondency (both $r_{sp} = 0.18$) [98,105]. Personal strengths was the next strongest category, with measures of resilience across four samples ranging from 0.07 to 0.10 [86,145]. Physical health was measured in three samples in different countries from the same study, with semipartial correlations ranging from 0.05 to 0.12 [86].

Figure 3. Semipartial correlation coefficients for Self domain variables (Mental illness)



Significant results for three mental illness constructs—depression, anxiety, and stress—were found in six studies (see Figure 3), with eight total samples (one being a multi-country study with three samples) and 19 variables. The semipartial correlations for depression ranged from -0.22 to -0.07; for anxiety, from -0.11 to -0.04, and for stress, from -0.18 to 0.14 (this last result perhaps representing ‘eustress’ [146]).

Overall, 23 study variables were positively correlated with prospective wellbeing and 23 negatively correlated. Semipartial correlations ranged from -0.28 to 0.43; the mean absolute value was 0.14 and the median was 0.11, so for ΔR^2 over baseline wellbeing the range was 0.0 to 0.19 with a mean of 0.04 and a median of 0.03.

There were seven studies for which semipartial correlations could not be calculated due to the required data not being reported, but which nevertheless presented results controlled for T1 wellbeing. These analyses all controlled for *more* variables than the semipartial correlation analysis presented above, which controlled only for T1 wellbeing, so while their results were not directly comparable, they were more robust. Three of these seven supported the results of the semipartial correlation analysis by finding significant results for similar study variables: positive effects for extraversion [95], positive affect [118], and negative effects for mental health problems [85]. Five studies included six variables with significant effects which did not appear in the semipartial correlation analysis (one study had variables in both categories): there were positive effects for physical activity [85], balance of positive recent life events [118], self-compassion [101], and valuing time over money [120]; and negative effects for negative affect [118], being a student of colour (in a US context) [89], and prioritising extrinsic over intrinsic aspirations [108].

A further 12 studies did not control for T1 wellbeing: nine of these produced significant results for prospective wellbeing. Some of these supported the results of the semipartial correlation

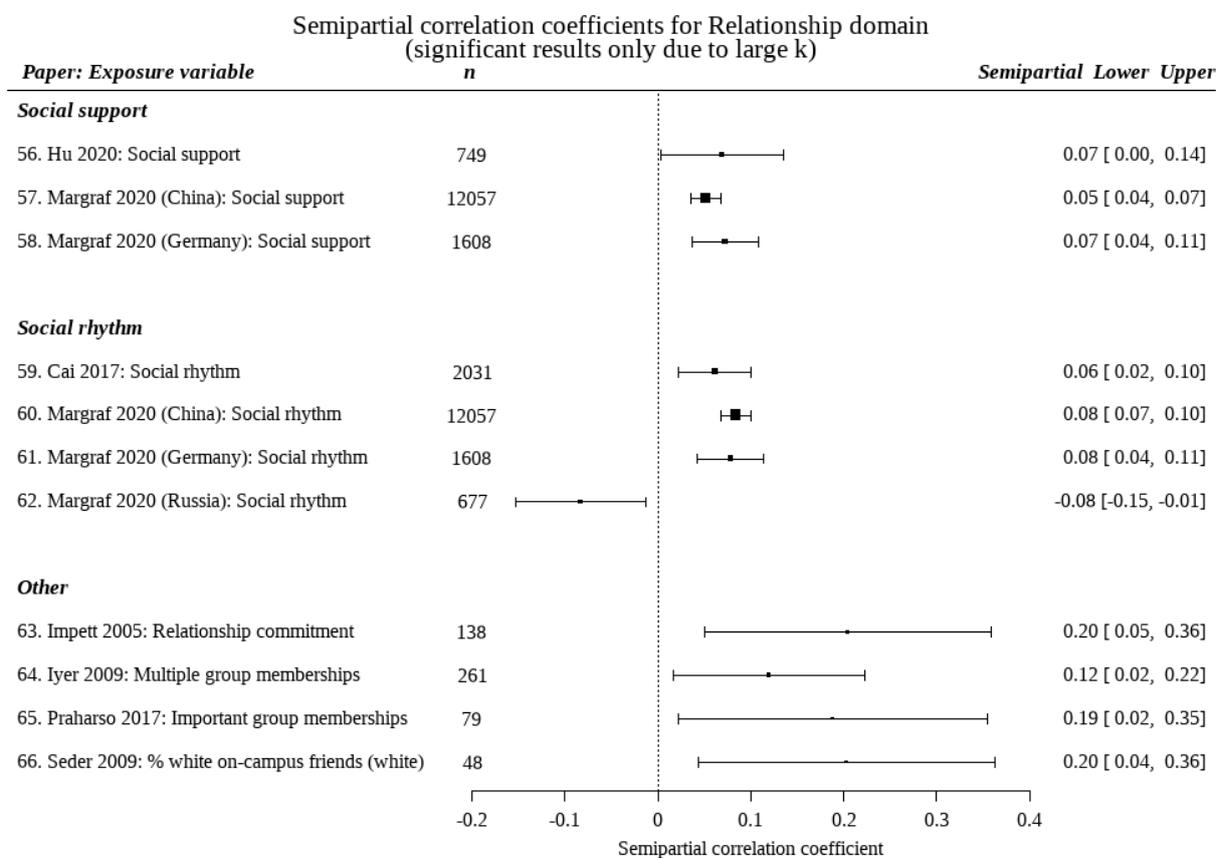
analysis with significant results for similar study variables: positive affect [69], mindfulness and self-control [107], and personality [100,139]. Eight found significant results for other variables: engagement [69,113] and achievement [69], prosociality [92], optimism [113], ‘should’ conflicts [107], marijuana use [110], and sleep [116,117].

Finally, four studies in the Self domain did not find any significant results for prospective wellbeing [106,111,112,115].

3.2.2 Relationships domain

Figure 4 shows the semipartial correlations of study variables from the Relationships domain which were significantly associated with T2 wellbeing after controlling for T1 wellbeing.

Figure 4. Semipartial correlation coefficients for Relationships domain variables



The three variables with the highest semipartial correlations were relationship commitment, with a semipartial correlation of 0.20, representing a ΔR^2 over baseline wellbeing of 0.04 [121]; percentage of White on-campus friends amongst a subsample of White students, $r_{sp} = 0.20$ (albeit with a small sample, $n = 48$) [133]; and number of important group memberships, $r_{sp} = 0.19$ [123].

All but one of the semipartial correlations were positive; their absolute values’ range was 0.05 to 0.20, with the absolute values having a mean of 0.14 and a median of 0.11, equating to ΔR^2 over baseline wellbeing in the range 0.00 to 0.04. The one negative semipartial correlation [86] appeared to be anomalous.

There were four studies for which semipartial correlations could not be calculated in the manner described above [85,95,108,124], but which nevertheless presented results controlled for T1 wellbeing. One supported the results of the semipartial correlation analysis by finding a negative effect for irregular social rhythm[85], where regular social rhythm had shown positive

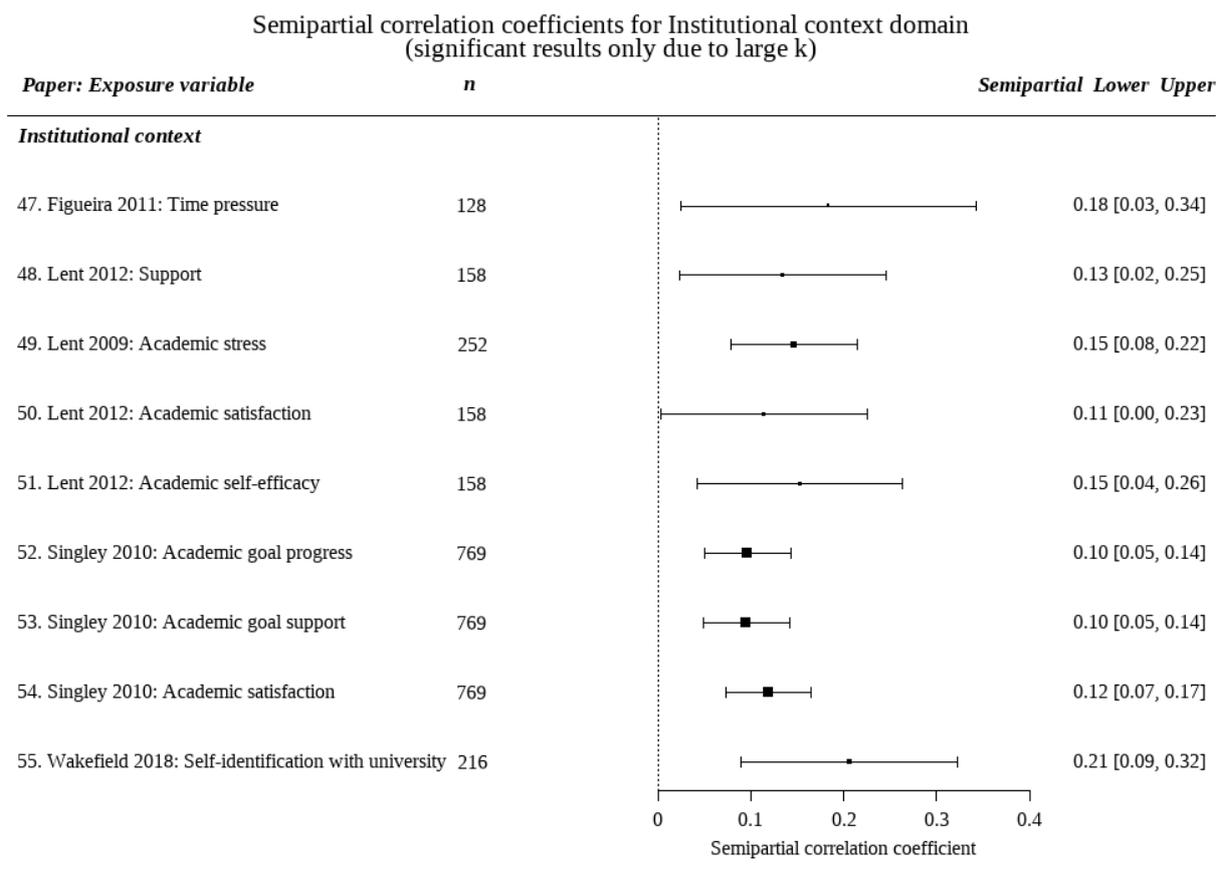
effects on wellbeing in other studies. The only other significant result was oral hookups for females [124], which had a positive effect on wellbeing.

Lastly, two studies did not control for T1 wellbeing [106,132]. Only one of their study variables had a significant relationship with prospective wellbeing: outgroup comfort [132].

3.2.3 Institutional context domain

Figure 5 shows the semipartial correlations of study variables from the Institutional Context domain which were significantly associated with T2 wellbeing after controlling for T1 wellbeing.

Figure 5. Semipartial correlations for Institutional Context domain variables



The two variables with the highest semipartial correlations were self-identification with the university, $r_{sp} = 0.21$ (ΔR^2 over baseline wellbeing of 0.04) [130] and time pressure, $r_{sp} = 0.18$ [97]. These were the largest effect sizes despite being measured across longer timescales: 30 and 34 weeks, respectively.

The seven remaining independent variables in this domain were drawn from a group of three studies based on the social cognitive model [134–136], which all measured the same or similar variables over periods of eight to fifteen weeks. Several aspects of academic adjustment measured in these studies (e.g., support, self-efficacy, progress, stress, satisfaction) made an incremental contribution to prospective wellbeing, with semipartial correlations ranging from 0.10 to 0.15 (ΔR^2 0.01 to 0.02).

There were six studies for which semipartial correlations could not be calculated, but still presented results controlled for T1 wellbeing; 13 of these variables were significant predictors of prospective wellbeing. None of these variables overlapped with those in the semipartial correlation analysis. The variables positively associated with prospective wellbeing included six

measures of engagement in university life and extracurricular activities [89,91], three related to academic experiences [88,128], and two variables relating to diversity [87]. There was one negatively associated variable, precollege academic motivation [89].

Lastly, one study which did not control for T1 wellbeing found that academic concerns were negatively associated with prospective wellbeing [132].

3.3 Consequences of wellbeing as independent variable

Only five papers focused on wellbeing as an independent variable. Most of these measured educational outcomes: life satisfaction had associations with later Grade Point Average (GPA) of $r = 0.18$ and $r = 0.42$ in two samples [125,131]; in Asian-American students it also moderated the negative effect of family conflict on GPA [125]. A composite wellbeing measure was associated with university dropout up to a year later [129], and another composite construct, PERMA, was associated with number of interviews for postgraduate opportunities two years later [69].

3.4 Temporal structure of wellbeing

Three studies focused on the temporal structure of wellbeing, two using models to decompose life satisfaction [142] and SWB [147] into components which varied in stability over time. They found that these constructs potentially could be broken down into stable traits, short-term states and medium-term autoregressive components, though the components which could be detected varied with the duration of the study.

3.5 Meta-analyses with time as a moderator

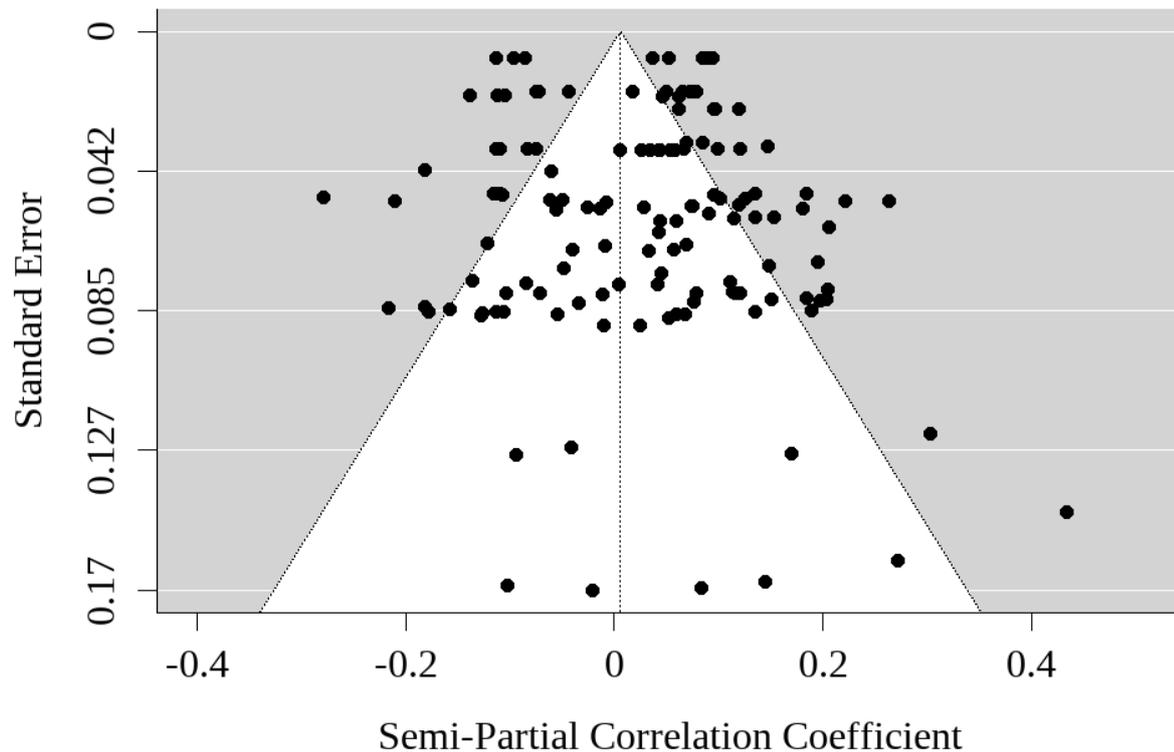
A meta-analysis was performed to investigate whether the effects of study variables were moderated by the duration between wellbeing measurements. Both the overall model (coefficient[SE] = 0.0977[0.0305], $p = 0.0013$) and the moderator (coefficient[SE] = -0.0239[0.0093], $p = 0.0101$) were significant, showing that in general the effect of study variables on wellbeing attenuated over time.

However, it was apparent that the measure used for most studies, the SWLS, tended to be used in shorter duration studies (i.e., mean 18 weeks) whereas studies using other measures tended to be used in longer duration studies (i.e., mean 68 weeks), so type of measure was a possible confounder of the moderating effect of duration. To discern if these effects might be due to the measure used for the dependent variable, rather than the duration of the measurement interval, a further meta-analysis was performed with study as a random effect moderated by both measurement interval and type of measure (defined as SWLS vs. all other measures). This showed that study (coefficient [SE] = 0.1219[0.0447], $p = 0.0064$) and study duration were significant (coefficient [SE] = -0.0344[0.0113], $p = 0.0024$), but type of measure was not significant (coefficient [SE] = -0.0139[0.0297], $p = 0.6402$), so the attenuation in effect was not due to the type of measure used.

3.6 Publication bias

Publication bias (i.e., published results not being representative of the available research) was examined with a funnel plot (see *Figure 6*, below) and tested with a rank correlation test for funnel plot asymmetry [148] yielding Kendall's $\tau = -0.0915$, $p = 0.1117$, suggesting that it was not present in the reviewed studies.

Figure 6. Funnel plot for all studies with semipartial correlations available



4. Discussion

4.1 Summary of results

This study was a systematic review and meta-analysis of the literature relating to antecedents and consequences of wellbeing among university students. The main analyses involved wellbeing and study variables measured at baseline and their prospective association with wellbeing measured at a later time. A meta-analysis showed that effects of significant study variables were moderated by measurement interval, generally decreasing over time. The semipartial correlations of study variables showed their incremental contribution to prospective wellbeing over and above the contribution of baseline wellbeing. A total of 90 significant effect sizes for study variables were found; these were categorised into three domains: Self, Relationships and Institutional Context.

A small number of studies provided different insights into the relation of wellbeing to other variables over time. A few studies showed wellbeing as an antecedent of other variables such as academic achievement and health; notably, these variables have also been shown to be antecedents of wellbeing in other studies [134–136,149,150]. Two studies examining the temporal structure of wellbeing showed that it may be decomposed into transitory, autoregressive and trait-like components [142,147].

4.2 Discussion of results

The meta-analysis of effect sizes moderated by measurement interval showed that the effects of study variables tended to diminish over time. This finding is complemented by the results of the studies by Anusic et al [142] and Li et al [147], which demonstrate that the temporal structure of wellbeing (life satisfaction and subjective wellbeing respectively) may be decomposed into elements of different durations: trait, autoregressive, and transitory, given sufficient study

duration [see also 151]. That is, each individual's wellbeing may be broken down into a trait element which changes very little, an autoregressive element which is influenced by, but not identical to, its values at the previous measurement, and a transitory/error element which combines short-term influences and measurement error.

This tripartite temporal structure raises questions about how its three elements relate to the antecedents of wellbeing. It may be that this structure is purely a mirror of its antecedent variables: that how antecedents of wellbeing break down into short-, medium- and long-term influences entirely determines the tripartite structure for an individual at a given point in time. Or it may be that wellbeing is to some extent self-causing, over and above being self-correlated (i.e. associated with earlier values of itself, or autocorrelated). Perhaps high wellbeing leads to behaviours likely to cause high wellbeing in future via mediated causal chains, somewhat similar to the broaden-and-build theory [152]. This is also suggested by empirical findings about the relationship of subjective wellbeing to physical health, social support, and work performance, which make "it [seem] likely that the causal arrow often travels in both directions" [153]. If this were the case, the autoregressive component of wellbeing would not be purely a correlation, but partly a relation of causation.

Delineating the nature of these relationships is a topic for further study. The temporal stability of variables affecting wellbeing should be measured and taken into account—as was done in some studies in this review [143,154,155]. This will help to determine to what extent the high autocorrelations of wellbeing between baseline and prospective measurements were due to the temporal consistency of the variables associated with wellbeing at baseline (in the studies reviewed, the largest effect size among antecedents of prospective wellbeing was generally baseline wellbeing).

The individual study variables shown to be significant antecedents of wellbeing were both numerous and diverse. There were 66 significant variables emerging from the analysis of semipartial correlations, and a further 24 from studies for which semipartial correlations could not be calculated but which nevertheless presented results controlled for T1 wellbeing, for a total of 90 variables (after eliminating variables which were measured in more than one study, there was a total of 49 distinct variables). These were categorised into three domains: the Self, Relationships, and Institutional Context; the diversity of antecedents therefore ranging from the physical body to abstract relationships with social and cultural signifiers. Many of these results were in accord with those in the existing literature on other populations. While there are no previous systematic reviews of longitudinal studies of wellbeing in tertiary students, a comprehensive review of studies of life satisfaction in youth aged 19 years and under [156] found associations between wellbeing and many of the variables in this review, such as personality, self-esteem, physical health, depression, and social support.

The set of variables with significant zero-order correlations with wellbeing is almost problematically large. Geerling and Diener noted recently that it appears almost endless—yet is also growing [150]. However, the analytic technique of controlling for baseline wellbeing allows this group to be narrowed down to a smaller subset (albeit still large in an absolute sense). It therefore allows the delineation of a group of variables to target with policy changes and interventions. The most strongly associated antecedents of wellbeing form the most obvious candidates for this group—though of course it may not be possible to target them directly, or at all. From the positively associated variables in the Self domain, authenticity, self-esteem, and self-support for autonomy had semipartial correlations of 0.20 or greater, and emotion regulation variables were also well supported. There is a substantial evidence base for the effectiveness of Acceptance and Commitment Therapy (ACT) and other mindfulness-based interventions

targeting these areas with regard to their effect on mental illness [10–14], though the evidence base for their effect on wellbeing is smaller [however, see 65]. The negatively associated variables in the Self domain were mainly related to mental illness, and universities often provide psychological services to students. But given the finite capacity of university counselling services, and the known rates of mental illness among people in this age group, scalable methods of treatment might be considered [157,158]. Further, despite recent advances, much mental illness still goes untreated, so awareness campaigns and screening programmes might help to bridge this gap. Physical health and resilience also offered positive semipartial correlations with prospective wellbeing, and there is emerging evidence supporting interventions for resilience [159–161].

The Relationships domain presented few potential targets for intervention. However, group memberships were well supported with $r_{sp} = 0.19$; they may be (and are) supported by universities with the provision of facilities and resources. Here the study results provide empirical support for existing practices.

In the Institutional Context domain, self-identification with the university had a semipartial correlation of 0.21 (though this was at one of the more prestigious universities in Spain, the University of Valencia). The three variables identified by Singley et al [136] may be more promising candidates for policy changes and interventions: academic goal progress (in relation to concrete academic goals), academic goal support (including access to role models and mentors, instrumental assistance, and financial resources), and academic satisfaction, with $r_{sp} = 0.10, 0.10$ and 0.12 respectively. These effect sizes were obtained despite a relatively large sample ($n = 769$)—effect sizes tended to be smaller with larger sample sizes—so these results stood out. Further, similar and significant results were found in the two studies by Lent et al. [134,135] which had designs very similar to the Singley et al 2010 study.

Many of the antecedents of wellbeing had complex relationships (e.g. mediated) with one another and with wellbeing. Almost half of the studies reviewed tested processes of moderation or mediation (28 out of 62). Further, there was evidence from multiple studies suggestive of circular causation for some variables such as academic achievement [125,131,134–136], and this reciprocal effect has been also found in younger populations [149]. More broadly, wellbeing is prospectively associated with a number of variables [162], and reciprocal causation is thought to occur in wider populations and in a wider range of variables [153].

One of the benefits available from longitudinal observation research may be the discovery of naturally occurring processes by which wellbeing increases or decreases over time (some of which might involve circular causation). Knowledge of these processes might allow the design of interventions which scaffold and enhance natural processes of growth in wellbeing or disrupt processes of decrease in wellbeing. While the research studies in this review cannot provide definitive answers, they do give some hints as to the possibilities. For example, Martin et al 2015 [128] found that membership of a “structured learning community”, i.e. coursework completed with a consistent group of students, was predictive of wellbeing over one- and four-year time scales. Further, as noted above, academic achievement may have a reciprocal causal relationship with wellbeing. So, while the nature of the causal mechanism still needs further investigation, this suggests a potential intervention to provide scaffolding for this naturally occurring process. The deliberate grouping of students into multi-year learning communities might provide opportunities for academic achievement and wellbeing to mutually support one another in a spiral of growth over time, in a way which is not possible in groups whose memberships change each semester. (It is also possible that the positive effect on wellbeing found in these learning

communities was due to social factors rather than academic achievement—hence the need for further research.)

This study also highlights a potential quandary for researchers and policymakers concerned with university student wellbeing: that there are variables which may not be studied by experiment in a straightforward way, but which have substantial effect sizes for student wellbeing. So while there exists an understandable and justifiable bias towards the use of interventions which enjoy the higher standard of evidence provided by experimental study, there is no *prima facie* reason why variables which are *not* amenable to experimental study will not have comparable effect sizes (such as, from this study, academic goal support). Further, a common reason why these variables are not amenable to experimental study is that they cannot be changed without affecting the entire student body; while this means that one cannot create control and experimental groups, it does mean that such policy changes will enjoy high levels of reach.

However, at least some of these variables are in a grey area—those for which the change in policy may not be studied experimentally, but for which it is possible to isolate a more general causal mechanism inherent in the specific change. This would be done with the aim of studying the mechanism experimentally, providing a stronger case for policy changes targeting that variable.

4.3 Limitations

There were a number of methodological limitations in this systematic review.

First, there are limitations associated with the systematic review and its search methods. Studies in languages other than English were not included. Neither was grey literature (i.e. non-peer-reviewed literature, such as government reports), and it is possible that there are relevant reports produced by universities on student wellbeing. However, given the breadth of the search criteria and the number of databases used, it was likely that the majority of eligible studies in the peer-reviewed literature have been included in this review. Further, it appears that publication bias was not present in the reviewed studies.

Second, there are limitations associated with the studies included in the review. In particular, most studies were based upon convenience samples. Psychology students were used in many of the samples, and the five large-sample studies using the Wabash National Study data focused on liberal arts colleges. Studies comprising Science, Technology, Engineering, and Mathematics students are likely to be underrepresented. Samples generally had a higher proportion of females, and it also appears likely that postgraduate students were underrepresented. Attrition bias is possible, given the focus on longitudinal study design. While attrition was analysed in some studies [e.g. 87,120,141], this was not the case for all. Further, the usual analysis of attrition by sex and age may not capture all relevant variables (e.g., personality) [163,164]. Studies were survey-based, so single method bias is a possibility, as is self-report bias. It is also possible that there is measurement bias in some studies, for example, it may have been the case that the psychology students who made up many of the samples answered questionnaires differently to non-psychology students due to their knowledge of questionnaire design.

However, the five studies based on the Wabash National Study data had well-controlled analyses and in some cases had more robust sample designs—and results from these studies were consistent with those from less well-designed studies. Studies tended to include some analysis to examine results by demographic categories as an attempt to examine sample bias.

The studies in the review also used different concepts and measures of wellbeing. While different concepts of wellbeing show strong statistical similarities [32], they are nevertheless

distinct, and may not be affected in the same way by changes to other variables. However, at a pragmatic level, while 67% of the study variables included in the analysis of semipartial correlations and meta-analyses used the SWLS as a dependent variable measure, a multilevel meta-analysis with type of measure (i.e., SWLS, non-SWLS) and study duration as moderators showed a significant effect for study duration, but not for type of measure. In future reviews it would be prudent to include similar tests of moderation by outcome measure.

Third, there are limitations associated with the analytic methods used. The analysis of semipartial correlations, which used a study variable measured at baseline and wellbeing measured at baseline and prospectively, controls only for baseline wellbeing and not for any other variables. It would be possible, and instructive, to control also for some of the more commonly measured variables such as measures of psychological distress. It also must be interpreted bearing in mind the presumed differences in temporal variability of the study variables. That is, some were unlikely to change over the measurement intervals involved (e.g., personality variables), while others were much more likely to change (e.g., daily events). The meta-analysis of time as a moderator, which found that the effects of baseline variables on prospective wellbeing attenuated with measurement interval, did not differentiate between the baseline variables. It is quite possible that the results of this analysis would be different with a different group of baseline variables. However, it seems likely that the moderating effect of time would be greater if the difference in study variables' propensity to change was taken into account.

5. Conclusions

This study used a broad search to systematically review 62 studies of wellbeing in university student populations. It extracted data from the studies to perform meta-analyses of the effect of study duration on effect size and to construct regression analyses of prospective wellbeing controlled for baseline wellbeing. The incremental contribution of baseline study variables to prospective wellbeing was thereby isolated.

The study added to the literature by providing a synoptic overview of these variables in the university student population, establishing a 'natural history' of wellbeing to form a background for policy and potential targets for interventions to improve wellbeing. It found 49 distinct variables which made an incremental contribution to wellbeing, spread across three domains: Self, Relationships, and Institutional Context. The variables making the strongest positive incremental contribution were a group clustered around self-relations and self-regulation, as well as relationship commitment, group memberships, and self-identification with the university. The variables making the strongest negative incremental contributions were depression, anxiety, stress, and uncertainty about university. The effects of study variables tended to diminish with time; further, it appears that wellbeing is composed of transitory, autoregressive and trait-like elements with different time horizons for change.

The presence of variables which make incremental contributions to prospective wellbeing over and above baseline wellbeing not only suggests that these may be targets for intervention and policy—it also suggests that there may be already-existing processes of change in wellbeing which might be enabled or enhanced by interventions and policy changes.

The breadth and diversity of antecedents of wellbeing creates an imperative for researchers to cast their net wide, both to detect confounding variables and to examine variables acting in combination. Further research into ways to influence the individual-level variables influencing wellbeing is warranted, and empirically supported interventions which support and increase the skills, cognitions, and behaviours underlying these variables should be deployed by universities.

Conflict of interest statement

The authors report no conflicts of interest.

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